AGRONOMIC INVESTIGATIONS FOR YIELD MAXIMIZATION IN CHILLI THROUGH MANAGEMENT OF LEAF CURL (*MURDA*) COMPLEX

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1. INTRODUCTION

Chilli (*Capsicum annuum* L.), a tropical and subtropical crop, is one of the major vegetable and spice crops grown in the country. It is an essential ingredient of Indian curry, which is characterized by tempting colour and titillating pungency. Both as green and dry, chilli is used as paste (both green and red), powder and as whole or in broken/split form. Chilli is a fascinating spice with two important commercial qualities. Some varieties are famous for red colour because of the pigment capsanthin, and others are known for biting pungency attributed by capsaicin. India is the only country wherein a large number of varieties of chilli are grown. Country earns tremendous foreign exchange from the export of spice chilli, oleoresin of low, medium or high pungency, and chilli powder.

India is the largest producer of chilli crop, grown on an area of 0.96 million ha with an annual production of 1.05 million tonnes with the productivity of 918 kg ha^{-1}. Karnataka ranks second in area (0.16 million ha) and production (0.11 million tonnes) of dry chilli after Andhra Pradesh (Anon., 2005).

The cultivation of Capsicum is of American origin, which is known from pre-historic remains of Peru and Bolivia. Though, introduced to India in late 17^{th} century, chilli has become an essential part of Indian cuisine and is valued for its characteristic pungency, colour and aroma. In Indian home, chilli is used by the poor and rich alike. As per provisional estimate made by Commodity Watch Group, India exported around 0.169 million tonnes of chilli during 2007-08 and the value of the export was Rs.9.064 billion. There is no doubt, greater international demand of chillies would continue in the years to come (Anon., 2008).

The current productivity levels are, however, far below the satisfactory level to meet even the domestic demand particularly due to poor nutrient management, viral diseases and the ravages caused by insect pests. The pest spectrum of chilli crop is complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage (Anon., 1987). Amongst these, aphids; *Myzus persicae* Sulzar and *Aphis gossypii* Glover., thrips-*Scirtothrips dorsalis* Hood., yellow mites- *Polyphagotarsonemus latus* Banks, and fruit borer - *Helicoverpa armigera* Hubner are the most vital production constraints. A total of 39 and 57 insect pests were recorded in Karnataka in chilli nursery and field crop, respectively (Reddy and Puttaswamy, 1983 and 1984). Interestingly, these insect pests respond differently to fertilization, particularly to nitrogen and potassium.

Thrips, mites and aphids desap chilli crop resulting into leaf curling, petiole elongation (*murda* symptom) with the presence of viral diseases. As early as in 50s; Puttarudraiah (1959) reported the involvement of thrips and mite for the viral spread and for the cause of *murda* disease. Now, due to this disease more than 90 per cent of chilli growers have switched over to some other profitable crops (Salane *et al.*, 2006).

The mites attack usually the terminal auxiliary tender shoots of the plants. The nymphs and adults actively feed on the under surface of the apical tender leaves. The affected leaves become deformed, brittle and crumpled. The symptoms of mite attack are downward curling, crinkling of leaves and elongation of leaf petiole followed by blister patches. If the plant is attacked in flowering stage, the flowers are transformed into leafy shoots and may whither and dry (Kurupachamy *et al.*, 1993). In case of thrips, both nymphs and adults suck the sap from tender crop canopy, resulting into shriveling of leaves and in extreme cases the shoots hardly develop and leaves fall off. In addition to eruption of internal areas, the puckering of leaves and upward curling of leaves are also observed (Reddy and Puttaswamy, 1983). The yield loss due to thrips and mite is estimated to be over 50 per cent (Ahmed *et al.*, 1987). Pesticides are therefore used to combat these insect pests.

During the last two decades insecticidal control of chilli pests especially in irrigated crop characterized by high pesticide usage has posed problem of residue in the fruits (Joia *et al.*, 2001). Infact, both significant domestic consumption and sizable export of chilli necessitate production of quality chillies devoid of contamination of pesticides, industrial chemicals and aflatoxins. But the presence of residues in spices in general and in chilli in particular has been a major non-tariff barrier against export of chillies to the developed countries. The reported presence of residues of many insecticides including ethion, chlorpyriphos, cypermethrin, endosulfan and quinalphos have seriously affected the export of chillies. Chilli consignments are detained at the ports of the importing countries very often due to high pesticide usage in India. Hence, it is imperative to produce pesticide free chilli by adopting eco-friendly management practices.

Several issues, therefore, need to be re-examined and put under evaluation so that sound management programme can be evolved with minimum or no pesticide spray. Since the pesticide consumption in the rainfed Cv.*Byadagi* chilli is increasing slowly and Byadagi chilli (dabbi) is being grown in large areas in the irrigated belts of Krishna river (N-W part of Karnataka) of the state, development of least chemical or no chemical package is the need of the hour for both rainfed and irrigated chilli ecosystems.

In the recent years there is lot of awareness and preference for organically produced food stuffs in the country. Both Government of India and Government of Karnataka have been earmarking significant amount of funds for popularizing organic farming techniques, specially in consumable crops. There is also tremendous demand for organic chilli especially cv. *Bydagi* in recent years.

Apart from that, soil health and ecological balance are of paramount importance in switching over to organic farming from chemical based conventional agriculture. In this context use of organics like poultry manure, vermicompost and neem cake, use of botanicals, biopesticides and polycropping need consideration.

Infact, indiscriminate use of insecticides has led to insecticide resistance, pest resurgence, environmental pollution and upsetting of natural ecosystem (Lakhan Singh and Sanjeevkumar, 1998). To overcome these problems, use of biopesticide spray, plant based substances and certain indigenous practices offer safe alternatives in pest management (Narayanaswamy, 1999). Further, variable levels of N and K and integrated nutrition to the chilli crop through organic and inorganic sources are also very important for the healthy growth of crop and for reducing the sucking pest complex. Vermicompost helps for better growth and development of the crop and imparts resistance to the crop against pest and diseases (Meerabai and Asha, 2001). While neem cake helps in reducing the sucking pests due to presence of bitter terpenoids mainly azadirachtin which is responsible for antifeedent, anti-ovipositional, growth disrupting, fecundity and fitness reducing properties of pests (Alam *et al*., 1979).

Mesta *et al.* (2004) reported that sunflower necrosis virus (SMV) could be managed effectively by growing sorghum as a barrier crop. Seed treatment coupled with sorghum as a barrier was the most effective. Similarly, Nelson and Natarajan (1994), Raghupathi and Veeraragavatham (1996) and Anandam and Doraiswamy (2007) observed the beneficial effects of barrier cropping in pest management. Studies on barrier cropping in chilli are, however, scarce.

In view of the above, investigations were carried out during 2005-2006, 2006-2007 at Agriculture Research Station, Devihosur, Haveri, Karnataka to evaluate the efficiency of barrier cropping, intercropping, integrated nitrogen nutrition, varied levels of nitrogen and potassium, and botanicals in quality chilli production and management of leaf curl on ecological principles with following objectives.

1. To identify the suitability of barrier cropping and optimization of barrier cropping in quality chilli production.
2. To evaluate the efficiency of intercropping in relation to higher productivity and management of leaf curl disease.
3. To find out crop response to nitrogen supplementation through organics and varied levels of nitrogen and potassium fertilization in quality chilli production, and
4. To evaluate the efficiency of biorationals and their interaction with nitrogen nutrition in the management of sucking pest menace in chilli.

2. REVIEW OF LITERATURE

The literature pertaining to the role of barrier cropping, levels of N and K, bio-pesticides and botanicals in crop production with special emphasis on the management of pest and diseases including leaf curl (murda) complex in chilli and other related crops is reviewed and presented here under.

2.1 ROLE OF COMPONENT CROPS IN THE PEST MANAGEMENT

2.1.1 Border/barrier crops

The border crops are planted around the main crop in 2-3 rows in close spacing. Usually, the border crops are taller than main crop. These crops act as trap crop, banker and ecofeast crop.

Ragupathy *et al.* (1997) from Coimbatore, Tamil Nadu reported that maize (*Zea mays*) and castor (*Ricinus communis* L.) as border crop in cotton prevented the entry of wind carried insects into the main crop. Similar findings were also made in other crop situations (Table 2.1, Lingappa *et al*., 2003)

At Madrid, Spain the infection and spread of potato virus Y and cucumber mosaic virus in pepper was significantly reduced due to barrier cropping with increase in yield in two out of four years of trials (Fereres, 2000).

Smith and McSorley (2000) observed that whitefly (*Bemisia argentifolii*) menace on common beans in north Florida was marginally reduced when corn (*Zea mays* L.) was used as a barrier crop and egg plant (*Solanum melongena* L.) was used as a trap crop. Therefore, they opined that barrier crops and certain trap crops might have limited value in the whitefly management.

Mesta *et al.* (2004) from Raichur, Karnataka reported that management of sunflower necrosis virus (SNV) could be achieved through both chemical and non-chemical means. Use of sorghum (*Sorghum bicolor* L) as a border crop reduced the incidence of virus from 18 to 7 per cent. The benefit to cost ratio revealed that seed treatment alone with border crop was better in the management of SNV.

Salas (2004) at Venezuela in tomato crop found that *Bemisia tabaci*, was controlled when maize was used as a trap crop and rice husk as a soil cover. All these treatments resulted in higher yield without significant differences among themselves.

Katti (2007) at Raichur, Karnataka, found that the IPM module of four rows of sorghum along the border before 15 days of main crop sowing, followed by seed treatment of imidachlorprid 70WS @ 5 g kg^{-1} of seed and application of vermicompost @ 2.5 t ha^{-1} + 50 % RDF with two neem formulation sprays were effective in reducing the sucking pests and the necrosis disease in sunflower.

Drees (2008) from Texas University of the U.S.A. proposed and controlled the pests by list of tantalizing approaches including use of barrier and trap crops, use of companion planting and homemade plant sprays for repelling insects like aphids, bagworms, borers,

Table 2.1 Important pests controlled by border/barrier cropping systems

Sl. No.	Main crop	Border crop	Pests	Reference
1.	Redgram	Sorghum	*Helicoverpa armigera* (Hub.)	Ragupathy *et al.* (1997)
2.	Cotton	Castor	*Spodoptera litura* (F.) and *Liriomyza trifolii* (Burgess)	Ragupathy *et al.* (1997)
3.	Tobacco	Castor	*S. litura*	Ragupathy *et al.* (1997)
4.	Groundnut	Castor	*S. litura*	Muralibaskaran *et al.* (1999)
5.	Cotton	Maize	Sucking pests	Jayraj e*t al.* (Unpublished)
6.	Tomato	Maize	Thrips	Guimaraes *et al.* (1997)

mites, cutworms, leaf hoppers, leaf folders, beetles, mealy bugs, plant bugs, sawflies, scale spittle bugs and whiteflies.

The differences in the effectiveness of the barrier crop strategy and efficacy mainly depended upon kind of virus/pest and its spreading pattern (monocyclic or polycyclic), the barrier crop height, time of maximum risk of infection and extent of competition between barrier and protected crop. Before use it should be confirmed that the barrier crop is not the host for any potential insect pests or pathogen capable of damaging the protected crop. Then only, barrier crop can be an effective crop management strategy to protect the crop against virus/pests infection, only under specific circumstances.

2.1.2 Trap crops

Trap cropping system consists of species of plants, which are planted to attract and retain pest species, or provide a favourable habitat to increase the natural enemies in the main crop (Lingappa *et al*., 2003)

The major benefit of trap cropping is that, it reduces the quantum of pesticide usage on main crop besides enhancing the natural control of pests (Table 2.2). Usually, the trap crop will be used after every 5-10 rows interval depending upon nature of crop and economics.

At Dharwad, Karnataka Shivaramu (1999) found that chilli interspersed with marigold (trap crop) at the row ratio of 20:1, 18:1 or 16:1 resulted in significantly higher chilli yield compared to other ratio combinations. Marigold also helped in trapping the eggs and larvae of *H. armigera.* Further, he concluded 18:1 as the best row proportion combination of chilli and marigold for reducing the incidence of chilli fruit borer.

Sreenivas and Patil (2000) from Raichur reported that among different trap crops tried in cotton for trapping eggs and larvae of *H. armigera*, redgram (ICPL-87) proved superior with less bollworm incidence (6.75 %), besides receiving maximum good opened bolls (22.57 $plant^{-1}$), minimum bad opened bolls (7.97 $plant^{-1}$) and highest seed cotton yield (8.74 q ha^{-1}). Subsequent studies at Raichur, Karnataka,revealed that sowing of castor between two cotton plants and sowing 50 per cent of castor randomly in cotton resulted in significantly less incidence of serpentine leaf miner (Sushila and Patil, 2002).

Boucher *et al.* (2003) from University of Connecticut, the U.S.A. introduced a new term of perimeter trap cropping, They studied the oviposition scars (stings) of pepper maggot in main crop and sub plots and found that no spray with no trap crop resulted in significantly higher stings and maggots compared to spray with no trap crop or no spray with trap crops. Among all, the sprays in addition to trap crop resulted in significantly lower stings and maggots (10.80 and 12.19, respectively). Similar results were obtained with perimeter sub plot areas also. They also compared conventional/IPM commercial farms with perimeter trap cropping farm and found that perimeter trap cropping had significantly lower mean ranks of stings and maggots per fruit compared to conventional/IPM technologies. Further, Grubinger (2008) again from University of Connecticut of U.S.A. found that perimeter trap cropping of two rows of collards helped cabbage by reducing diamond back moth population below threshold level. Similarly, he observed that bell pepper plant could be protected with cherry plant as a perimeter trap crop. By this 98 per cent pest free fruits and 99.99 per cent clean bell pepper fruits could be obtained.

At Bhavanisagar Tamil Nadu, the use of redgram as a trap crop along with NSKE (Neem seed kernel extract) spray to cotton resulted in higher occurrence of natural enemies in the field (Duraimurugan and Ragupathy, 2005).

Thus, trap cropping proved advantageous in the management of certain pests in crop ecosystem.

Table 2.2 The important trap crops used and the pests controlled

Main crop	Trap crop	Pest controlled
Cotton	Alfalfa	*Lygus hesperus* L.
	Bhendi	Shoot weevil, *Alcidodes affabar*
	Marigold	*H. armigera* *Erias vitella* (F.)
Tobacco	Clusterbean	*Heliothis virescens* (F.)
	Castor	*Spodoptera litura* (F.)
Sugarcane	Maize	*Eldona saccharina* Walker

Table 2.3 Important natural enemies conserved by banker cropping

Main crop	Banker crop	Natural enemies	Pest	Reference
Cotton	Groundnut and mungbean	*Trichogramma* sp. *Campoletes* sp.	*H. armigera*	Venugopal Rao *et al.* (1995)
Redgram	Sorghum	Coccinellids and *Chrysopids*	*H. armigera*	Duffield and Reddy (1997)
Cotton	Sunflower and castor	*Bracon breviocarnis* Salvin *Trichogramma* sp.	*H. armigera, S. litura*	Swaminathan and Jayraj (Unpublished)
Cotton	Sorghum, sunflower and castor	*Chrysoperla carnea* (Stephens)	*H. armigera, Aphis gossypii* Glover*, Bemecia tabaci* (Gennadius)	Swaminathan and Jayraj (Unpublished)
Groundnut	Castor	*C. carnea Braccon* sp.	*Aphis cracivora* Koch *Aproaerema modicella* (Devant) *B. tabaci, S. litura*	Swaminathan and Jayraj (Unpublished)

2.1.3 Banker crops

Banker crops are grown to provide the food like pollen and nectar to non-carnivorous stages of the adult predator besides providing shelter and required microclimate. Many natural enemies feed directly on plant products such as pollen and floral nectar. Banker crops provide balanced diet for natural enemies. Insects like coccinellids require pollen for completion of their life cycle. Research findings confirmed the usefulness of banker cropping in many crop situations (Table 2.3, Lingappa *et al.*2003).

Maize in cotton enhanced *Chrysoperla* population by providing pollen as food to adult lacewings (Jha *et al*., 2001). Thus, banker crops are important to increase activity of natural enemies. They help in early arrival of natural enemies and thereby postpone/delay build up of pest populations.

At Madurai, Tamil Nadu, sunflower and cowpea in a paired row system with cotton was favoruable for the conservation of *C. carnea* (Swaminathan *et al.,* 1999). Sole cotton was less favourable to the multiplication of *C. carnea* and hence, recorded higher population of insect pests.

Thus, at various locations in the country banker crop appeared promising and hence need further evaluation.

2.1.4 Ecofeast cropping

Ecofeast cropping (or sacrificing crop) is to enhance and conserve natural enemies through providing alternate hosts, which are not pest on main crops and are sacrificed completely without getting any yield (Table 2.4, Lingappa *et al*., 2003).

Plant injury by the herbivores increases production of attractant volatile materials, which invites natural enemies. Hence, sacrificing crops provide more favorable hosts as ecofeast and will enhance and conserve the natural enemies.

Jha *et al*., (2001) from Anand, Gujarat observed large population of *Geocoris ochropterus* (Fiber) when cotton was interspersed with maize harvested after 70 days than without maize. Maize helped in shifting of *G. ochropterus* from itself to cotton and thus helped in continuation as well as conservation of predator.

2.1.4 Barrier crops in the management of chilli murda and mosaic diseases

Deol and Ratawal (1978) at Ludhiana, reported pearlmillet (*Pennisetum typhoides* stapf & hubb.), sorghum (*Sorghum bicolor* L.), sesame (*Sesamum indicum* L.) and sunflower (*Helianths annuus* L.) as the promising barrier crops (1133, 763 and 688 kg ha^{-1}dry fruit yield, respectively) for *kharif* chilli against cucumber mosaic virus compared to chilli without barrier crop (475 kg ha^{-1}).

Table 2.4 Important natural enemies conserved by ecofeast cropping system

Main crop	Eco-feast crop	Pest	Natural enemies	Reference
Cotton	Cowpea	*E. vitella*	Coccinellids	Sundaramurthy and Chitra (1997)
Cotton	Cowpea, blackgram and maize	*Amrasca devastans* (Dist.), *Thrips tabaci, Bemisia tabaci*	Coccinellids and chrysopids	Balasubramanian *et al.* (1998)
Cotton	Alfalfa	*H. armigera*	All natural enemies	Van Emden *et al.* (1967)
Groundnut	Pearlmillet	*A. modiella*	*Chelonus* sp.	Kennedy *et al.* (1990)
Chickpea	Coriander	*H. armigera*	*Campoletis chloridae* (Uchida)	Cowgill (1995)
Cotton	Cowpea and sunflower	*A. gossypii, A. devastans*	*C. carnea*	Swaminathan *et al.* (1999)
Cotton	Sorghum and greengram	*B. tabaci, A. gossypii*	*Monochilus sexmaculatus*	Swaminathan and Jayraj (Unpublished)

At Paramakudi, Tamil Nadu Nelson and Natarajan (1994) observed agathi to be the best barrier crop for both thrips and mites control in chilli. The thrips population was 4.33 leaf^{-1} and 3.90 leaf^{-1}, respectively in agathi bordered crop and chilli protected with insecticides compared to no barrier crops (11.60 leaf^{-1}). Further, they also reported maize (1.83), agathi (2.19) and sunflower (2.09) as the best barrier crops against mites.

At Solan, maize and *chari* (*Sorghum bicolor* L.) were superior barrier crops for the management of mosaic disease of chilli crop and these two crops reduced the disease incidence by 25.00 and 26.78 per cent, respectively (Handa *et al.,* 1995).

Ragupathi and Veeraragavatham (1996) from Coimbatore, Tamil Nadu considered sorghum as the best barrier crop for mosaic in chilli. It reduced the mosaic incidence to 10.46 per cent compared to control with no barrier crop (31.85%).

Anandam and Doraiswamy (2007) from Tirupathi, Andhra Pradesh observed that chilli mosaic disease caused by virus, and aphids as carriers could be effectively controlled by barrier crops viz., maize, sorghum and sunflower. Whether chilli sprayed with insecticides or not, barrier crops significantly reduced the disease spread and increased the yield over control. Among all the treatments tried, maize as a barrier crop with insecticidal sprays to chilli performed better and was most effective in reducing the disease spread and increasing yield.

2.2 EFFECT OF INTERCROPPING IN PEST MANAGEMENT

Intercropping system is planting of crop in mixed system, as a risk insurance measure against biotic and abiotic stresses. It is a traditional practice that has persisted over years among the farming community of the developing world.

Mixed cropping and intercropping are known to reduce insect pest infestations. Natural enemies of the insect pests may be enhanced by mixed cropping through improved shelter, humid conditions and possible availability of food sources (honey or nectar).

Letourneau (1990) at California, the U.S.A. studied different components of mixed crop patches of species richness, plant density, colour contrast, structural competing characters and volatile plant components. *Orisus tristicolor* colonies were more abundant on squash intercropped with corn and cowpea or in squash monoculture than in any other mimic.

2.2.1 Intercropping in chilli

Basavarajappa and Rajshekhar (2001) from Dharwad, Karnataka observed maximum reduction in per cent chilli mosaic (70.27) and aphid population (61.81), when chilli was intercropped with onion (*Allium cepa* L.) (1:2 ratio). The next best intercrop was brinjal (*Solanum melongina* L.). However, the control (no intercrop) treatment had maximum mosaic incidence and aphid population.

Manjunath *et al.* (2001) at Arabhavi, Karnataka reported chilli + tomato (1.88 and 2.25 $leaf^{-1}$), chilli + garlic (2.93 and 2.41 $leaf^{-1}$) and chilli + coriander (3.19 and 3.70 $leaf^{-1}$) as the best intercropping systems for reducing the thrips and mites population of chilli. But, best chilli yields were obtained with chilli + tomato (9.69 q ha^{-1}) and chilli + greengram (7.99 q ha^{-1}) intercropping systems.

2.2.2 Intercropping studies in cotton

The habitat manipulation in sole cotton ecosystem through intercropping is beneficial in maintaining the eco-balance and also it reduced the incidence of bollworm damage. Further, higher yield of intercrops also emphasize the usefulness of such an intercropping in sustaining cotton cultivation.

At Guntur, Andhra Pradesh, Venugopal Rao *et al.* (1995) reported that groundnut and setaria combination with cotton reduced the incidence of *H. armigera* larvae and bollworm damage. But, the damage of *H. armigera* in pigeonpea intercropped cotton plots were almost on par with sole cotton. This revealed the less suitability of pigeonpea combination. Even though, setaria affected the main crop yields to certain extent, the yields of intercrop were high (20 q ha^{-1}) indicating the benefits of such an intercrop in sustaining the cotton cultivation. In this experiment, the egg parasitization due to *Trichogramma* sp. was very high, as high as 51 per cent in groundnut plots followed by 31 per cent in mungbean plots.

Mahabaleshwara (1997) at MARS, Dharwad, Karnataka observed that chrysopid and coccinellid populations were higher when cotton was intercropped with lucerne or groundnut and the beneficial effect was also reflected in reduced per cent of bollworm damage (9.84) and significantly higher cotton yield (7.5 q ha^{-1}).

At Madurai, Tamil Nadu, among the different intercrops tried with cotton, clusterbean was more beneficial in reducing the incidence of leaf hopper, thrips, and whitefly and in increasing population of beneficial insect like spider (Balasubramanian *et al.*, 1998). The reduced incidence of the harmful insects may be due to allelochemicals produced by clusterbean which might have deterred the pests.

Natarajan and Sheshadri (1998) at Coimbatore, Tamil Nadu, observed significantly higher population of beneficial coccinellids (6.4/10 leaves) in cotton intercropped with cowpea compared to crop intercropped with soybean and onion. Interestingly, cotton alone recorded lower population of these beneficial insect. The parasites on spotted bollworm were higher when intercrops such as cowpea and soybean were grown with cotton (35.2 and 32.9% respectively) in comparison to sole cotton (18.2%).

Jeykumar and Uthamasamy (2000) from Sirsa, Tamil Nadu, reported that cowpea and blackgram were better intercrops. Advance sowing of intercrops (20 days advance to base crop) or synchronized sowing of both the crops recorded reduced incidence of leaf miner.

Mote *et al.* (2001) at Rahuri, Maharashtra found that among different intercrops tried with cotton, cowpea and greengram were beneficial in reducing the per cent boll damage, per cent locule damage besides reducing the incidence of jassids, aphids and thrips. Both the intercrops recorded maximum predator population also.

From Parabhani, Maharashtra, similar results of beneficial effects of intercrops of sorghum and maize with cotton in reducing the per cent infested fruiting bodies were reported by Rajput and Daware (2002).

Hegde (2001) at Dharwad, Karnataka, found that incidence of bollworm damage, leaf eating caterpillars and green semilooper were lower when cotton was intercropped with groundnut and Lucerne, and the effects were on par with treating cotton plants with *Nomuraea rileyi* (Samson), a bioagent. He also observed decrease in fruiting body damage, bad opened bolls (BOBs) and increase in good opened bolls (GOBs) and total yield of cotton (15.04 q ha^{-1}) with these two intercrops. The highest benefit cost ratio of 7.67 was obtained under cotton + lucerne intercrop.

The report from Hissar, Haryana, indicated increased parasitization of *Trichogramma* on *H. armigera* and hawk moth (*Acherantia styx*) when cotton was intercropped with sesame compared to pure sesame crop or pure cotton crop (Palaram *et al.*, 2002). Intercropping sesame in cotton preferably helped in managing *H. armigera* because of sesame's attraction to *Heliothis* and its ability to harbour higher number of beneficial insects.

At Hissar, Haryana, maize, sorghum and cowpea were observed to be helpful for buildup of predator population and these crops recorded more of coccinellids, spiders, green lace wing bug and rove beetle populations compared to sole cotton (Kavitha *et al.*, 2003).

Zhudong *et al.* (2004) in Beijing, China, found that cotton was most preferred host by *H. armigera* with the survival rate of generation of 33.2 per cent followed by corn (11.7 host plant^{-1}) with the highest net reproductive rate (117.6 host plant^{-1}) followed by corn (44.5 host plant^{-1}) and the least net reproductive rate was found with hot pepper (5.1 host plant^{-1}) and tomato (9.5 host plant^{-1}). Tomato and pepper were the least preferred crops by *H. armigera*. They also found that longevity of female and male adults of *H. armigera* was significantly lower with cotton and corn as intercrops and was the least with hot pepper. Same trend was found with number of eggs per female. The body weight of immature stages of *H. armigera* such as 4th instar larvae and pupae (both male and female) was the highest with corn and cotton and was the least with hot pepper and tobacco.

Chikte *et al.* (2006) from Akola, Maharashtra, reported that the predator spider population was the highest (2.63 plant^{-1}) when cotton was intercropped with marigold followed by cotton + cowpea (2.09 plant^{-1}) and cotton + greengram (1.69 plant^{-1}). But least population of the spider was recorded with cotton + soybean (0.89 plant^{-1}) and cotton + sorghum (0.99 plant^{-1}). Hence, intercropping systems of marigold and cowpea with cotton were found effective in the conservation of predatory spiders in cotton.

2.2.3 Intercropping in sugarcane

At Agricultural Research Station, Sankeshwar, Karnataka sugarcane intercropping with onion, garlic and coriander significantly reduced per cent dead heart, and consequently resulted in higher cane yield (98.46, 89.48 and 89.82 metric t ha^{-1}, respectively) compared to sole sugarcane (81.15 mt ha^{-1}) (Tippannavar *et al.*, 1999).

Sardana (2001) at Karnal, Haryana, observed that sugarcane intercropped with coriander had significantly increased per cent parasitization by *Trichogramma* on early shoot borer (30.48%). Consequently, there was significantly lower percentage of early shoot borer incidence. He also evaluated different intercrops in sugarcane on the incidence of root borer. Pulses such as greengram, cowpea, and blackgram had reduced incidence of root borer in the early stage of sugarcane (July month). However, at harvest stage the incidence was relatively higher compared to July month due to the organic matter added by these intercrops, which acted as a food for the borer.

At University of Agricultural Sciences, Dharwad, Karnataka significant reduction in early shoot borer, and higher percentage parasitization by *T. chilonis*, cane equivalent yield and net returns were obtained when sugarcane was intercropped with coriander (Rachappa and Krishna Naik, 2004). In another study Basavaraj (2006) reported that IPM module consisting of paired row planting of sugarcane resulted in reduced incidence of sugarcane woolly aphid (SWA) and higher cane yield besides incremental benefit cost ratio of 8.81: 1.

2.2.4 Intercropping in other crops

Singh *et al.* (1991) at IARI, New Delhi, opined that intercropping as a tool of pest management strategy would play a role in pest population build up in groundnut of both hemipteran and homopteran insects. Intercropping of redgram, greengram, soybean and sesamum accelerated the incidence of *Creontiadies pallidafer, Cletus signates* (Walker), *Sogotella frucifera* (Horvath), *Orius olbicinetus* (Distant), *Spilostethus pondarus* (Scop) and *Bemisia tabaci* (Genn) whereas sorghum intercrop helped in reducing the incidence of *B. tabaci.*

At Regional Agricultural Research Station, Bijapur, Karnataka, Karibasavaraja *et al.* (2005) reported that intercropping of sorghum + garlic and sorghum + onion reduced the incidence of shootfly in sorghum and these intercrops could be used as a management strategy for shootfly with paired row planting of sorghum without any reduction in plant population of main crop.

Rabindraprasad *et al.* (2007) at Ranchi, Jharkhand, reported intercropping of marigold with brinjal in the row proportion of 1:1 helped in reducing incidence of root knot nematode up to 15 per cent as compared to sole crop of brinjal, and intercropping also helped in reducing shoot borer damage. Brinjal + marigold grown on the soil treated with carbofuran recorded substantially higher brinjal equivalent yield of 31.90 t ha^{-1} with highest net profit of Rs. 71,720/- ha^{-1} and benefit cost ratio of 13.7: 1.

Sinha *et al.* (2007) from IARI, New Delhi, observed that when okra was intercropped with baby corn, it resulted in significant reduction in the pre-spray population of leaf hoppers and shoot and fruit borers population.

2.3 ROLE OF FERTILIZERS IN PEST MANAGEMENT

2.3.1 Effect of N and K in the management murda complex

Jeyraman and Balasubramanian (1988) from Madurai, Tamil Nadu reported least incidence of pests and diseases with application of K_2O @ 105 kg ha^{-1}. However, yield levels of chilli were on par with 70 kg ha^{-1} K_2O. They attributed the effectiveness of potassium in the control of the disease to the amino nitrogen content of the plants, which decreased from 8.5 (0 kg ha^{-1} K_2O) to 4.25 mg g^{-1} dry weight on potassium (105 kg ha^{-1} K_2O) application. Further, they also cautioned that K_2O application alone without plant protection may not be sufficient to sustain the yield of chilli and the prophylactic spray plays an important role in the control of pests and diseases.

On the other hand, at Akola, Maharashtra Ukey *et al.* (1998) reported reduced thrips and mites population (28.56 to 21.52 insects 15 $leaves^{-1}$) with decrease in nitrogen levels from 100 to 50 kg ha^{-1} while, increase in the potassium application from 50 to 75 kg ha^{-1} reduced the thrips and mites population from 23.45 to 21.67 insects 15 $leaves^{-1}$.

Mallapur *et al.* (2003) from A.R.S. Annigeri, Karnataka, observed reduced leaf curl index, thrips (0.8 LCI $plant^{-1}$) and mites (0.4 LCI $plant^{-1}$) with CAN application compared to urea application (1.3 and 0.7 LCI $plant^{-1}$ for thrips and mites, respectively). Further, they also found that increase in potash level from 50 to 75 kg ha^{-1} reduced the sucking pests incidence particularly of thrips and mites.

2.3.2 Effect of fertilizers in the management of insect and pests in other crop ecosystems

Rippa and George (1965) reported increased whitefly breeding with increase in nitrogen content of the leaves.

Moutia (1958) from Mauritius reported that *Tetranychus* spp. on tomato (*Lycopersican esculantum* Mill.) was increased once in 6 to 8 years due to increased application of nitrogen and phosphate fertilizers.

Lall and Datta (1959) recorded highest infestation of *Tetranychus teluria* in bhendi (*Abelmoschus esculantus* L.) fields whose soil samples had higher level of nitrogen with slight acidic pH reaction.

Puttaswamy and Channabasavanna (1981) from Bangalore, Karnataka reported higher population of mites in brinjal when high N was applied. They ascribed this to improved physiological status of the host plants, which favoured feeding, and oviposition of mites. Further, Manjunath, (1982) also reported that increased nitrogen level in the soil resulted in increased mites population in brinjal crop.

Reddy and Rao (1982) reported that the use of fertilizer greatly influenced the whitefly population and the plants, which received more nitrogenous fertilizers, became more vulnerable to whitefly attack.

The red spider mite (*Tetranychus urticae* Koch) increased its reproduction on bean leaves supplied with 2.0 per cent solution of calcium nitrate. The increase in reproduction of red spider mite occurred with a combination of all three major nutrients (Saini, 1986).

In linseed, Singh *et al.* (1991) reported increased bud fly infestation with increased doses of nitrogen and the infestation decreased with phosphorus dose, whereas yield was significantly increased with each increased dose of nitrogen (from 0 to 45 kg ha^{-1}) and phosphorus (from 0 to 25 kg ha^{-1}).

Balaji and Veeravel (1995) from Annamalainagar, Tamil Nadu reported the lowest incidence of 0.17 and 1.73 adults and nymphs of whitefly 3 $leaves^{-1}$ $plant^{-1}$, respectively on brinjal with 0:60:60 kg ha^{-1} NPK and the highest 0f 1.04 and 3.56 adults and nymphs 3 $leaves^{-1}$ $plant^{-1}$, respectively with 20:60:60 kg ha^{-1} NPK.

At Bapatla, Andhra Pradesh Sudhakar *et al*. (1998a) observed significantly reduced population of *Tetranychus neocalidonicus* Andre with application of higher doses of potash (100 kg ha^{-1}) due to change in the nutrient composition of host plant. The increased potassium fertilizer generally appeared to have a negative influence on pest population. This may be due to higher protogenesis in plants, a physiological phenomena correlated with elimination of amino acids and reducing sugars in the sap, which otherwise favours the development of sap feeders. Application of higher doses of potash also significantly reduced the population of aphids, whitefly and mites (Sudhakar *et.al.,* 1998b).

Pathak and Shriram (1999) from Manipur reported minimum stem borer and leaf hopper population and leaf hopper incidence in the plots supplied with no fertilizer (control). Enhanced doses of nitrogen resulted in significantly higher per cent of stem borer incidence. While, increasing concentration of potassium indicated a declining trend in the incidence of stem borers. The treatment combination of $N_0P_{100}K_{60}$ kg ha^{-1} had minimum insect population.

At Vengurla, Andhra Pradesh, Godase and Patel (2001) recorded significantly higher jassid population (24.71 jassids 9 $leaves^{-1}$) in brinjal when double dose of nitrogen was applied. Whereas, significantly lower jassid population (9.14 jassids 9 $leaves^{-1}$) was recorded with the treatment consisting of double dose of potassium. Hence, they opined that jassid preferred the plants, which received higher level of nitrogen. Further, Godse and Patel (2002) also reported that the intensity of whitefly adults in brinjal was significantly higher with higher level of nitrogen (i.e., double dose of N and normal dose of P and K). Whereas, significantly less whiteflies were found in control treatment with no fertilizer.

Myers *et al.* (2004) from University of Wisconsin, the U.S.A. reported that the aphid population and its intrinsic rate of growth, rate of increase and net reproductive rate were significantly higher in the K-deficit soybean leaves compared to non-deficit soybean leaves in laboratory studies. In field also the aphids performed better on K-deficient plants, but aphid abundance in the field depended on the additional factor such as dispersal, that may affect final densities within the plots.

Sabbour and Abbass (2006) at Cairo, Egypt observed that population of onion thrips (*Thrips tabaci*), which recorded 297.3 ± 5.8 individuals after fertilization with ammonium nitrate, was reduced when different bioagents were added to the fertilizers. The reduction ranged between 67 to 41 per cent for *T. tabaci*.

Balakrishnan *et al.* (2007) from Madurai, Tamil Nadu recorded higher population of sucking pests in cotton (var. SPVR 2) under recommended fertilizer without organics (48.6 jassids, 35.2 whiteflies, 74.1 aphids and 52.2 thrips 10 $plant^{-1}$) while, untreated check plots had less sucking pests (45.5 jassids, 33.4 whiteflies, 20.8 aphids and 50.5 thrips 10 $plants^{-1}$). They opined that the increased incidence of these sucking pests might be due to increased auxin content of the plants under heavy nitrogenous manuring. The inorganic fertilizers increased the plant growth and provided nutrients to the plants in larger amounts in shorter period, leading to heavy insect population. Vermicompost at 2 t ha^{-1} in combination with half dose of NPK (20:80:0 kg ha^{-1}) recorded highest seed cotton yield (845 kg ha^{-1}) followed by FYM at 12.5 t ha^{-1} + 20:10:0 NPK kg ha^{-1} which was due to less incidence of sucking pests because of induced/ecological resistance developed by the plants.

2.4 EFFECT OF ORGANIC AMENDMENTS AND BIORATIONALS ON THE SUCKING PEST ACTIVITY IN CHILLI

2.4.1 Organic soil amendments

At Bapatla, Andhra Pradesh neem cake application @ 500 kg ha^{-1}, seedling dip with 1 per cent neem oil, followed by neem oil, spray at weekly intervals reduced the thrips population to lower levels (Mallikarjuna Rao and Ahmed, 1986).

Patriquin *et al.* (1995) in London, U.K., opined that organic fertilizers or organic system of fertilization could be less conducive to pests than conventional fertilizers. Further, they also felt that pests and diseases of plants were indicative of soil fertility problems.

Jasvirsingh *et al.* (1997) at Sakleshpur, Karnataka, recorded greater number of healthy fruits per plant of chilli with the application of vermicompost @ 10 t per ha, compared to other treatments.

In a study conducted at Akola, Maharashtra to find the effect of soil application of vermicompost in combination with farm yard manure, it was found that full dose of NPK (150:50:50 kg ha^{-1}, respectively) + FYM (5 t ha^{-1}) + vermicompost (5 t $ha^{-1)}$ recorded minimum population of aphids (2.92 $leaf^{-1}$) and mites (3.81 $leaf^{-1}$), and highest yield of chilli (Varma and Supare, 1997).

Shashidhar (2000) at Agriculture Research Station, Hanumanamatti, Karnataka, recorded lower per cent murda incidence (1.88%) and Leaf Curl Index (LCI) 0.4 with combined application of organics and in-organics *viz.,* incorporation of redgram stalk + 100% recommended dose of fertilizer followed by biogas spent slurry + 100% recommended dose of fertilizer (2.66% and 0.52) and farm yard manure + 100% recommended dose of fertilizer (3.33%, 1.5) compared to recommended dose of fertilizer alone (100:50:50 kg ha^{-1} NPK) Thus, he observed the negative influence of organics on leaf curl causing pests.

Similarly in another study to find out the effect of neem products against chilli thrips, Mallikarjuna Rao *et al.* (1999) at Bapatla, Andhra Pradesh found that the combination of neem cake application @ 500 kg ha^{-1} followed by seedling root dip with 1 per cent neem oil followed by neem oil spray at weekly intervals reduced the thrips population to lower level. Further, Mallikarjuna Rao *et al.* (1999a) observed the effectiveness of the treatment intervals against chilli aphids also and the effects were as good as chemical check.

At Dharwad, recommended dose of fertilizers (100:50:50 NPK kg ha^{-1}) in combination with vermicompost besides producing superior growth parameters of chilli resulted in lower pest incidence in the nursery (Sunitha, 2000).

Ukey and Sarode (2001) at Akola, Maharashtra observed the lowest mites population with low level of N (50 kg ha^{-1}). The mite population increased with the higher level of N (100 kg ha^{-1}). However, P had no effect on the mites population.

Giraddi *et al.* (2003) at Dharwad, Karnataka reported that, among the organic amendments used, neem cake (500 kg ha^{-1}) with 50% RDN (50:50:50 NPK kg ha^{-1}) resulted in significantly lower thrips and mite induced leaf curl (0.62%) and high fruit yield (320 kg ha^{-1}). The treatment was as effective as recommended plant protection schedule (RPP). Further, Giraddi and Smitha (2004) also reported significantly lower mites population and LCI with neem cake @ 200 kg ha^{-1} + 50 per cent RDF and *in situ* green manuring with sunnhemp @ 5 t ha^{-1} + 50 per cent RDF, compared to RDF alone. With regard to the LCI, both the treatments were comparable with the standard check, dicofol + 100 per cent RDF.

Yadav and Vijayakumari (2003) at Coimbatore, Tamil Nadu observed improvement in biometric parameters and yield parameters of chilli with vermicompost application alone and with vermicompost admixed with various organic and inorganic manures.

Varghese (2003) at Dharwad, reported that combination of neem cake @ 500 and 1000 kg ha^{-1} with vermicompost @ 2500 kg ha^{-1} along with 50 per cent RDN (50:50:50 NPK kg ha^{-1}) proved to be most effective in reducing thrips, mite and LCI. Further, Varghese and Giraddi (2005) found that application of neemcake @ 500 kg ha^{-1} + 50 per cent RDF in combination with four or three sprays of RPP were superior in reducing the population of thrips, mites and LCI to the lowest level. The treatment produced higher dry chilli yield. This was followed by neem cake application with two sprays. Thus, the study emphasized the possibility of reduced usage of toxic synthetic chemicals in high value export oriented crop of chilli.

In another study at Dharwad, application of vermicompost @ 2.5 t ha^{-1} followed by four sprays with neem seed kernel extract (NSKE) 5% and Neemazal at 2, 5, 7 and 11 weeks after transplanting alternatively and neemcake @ 0.5 t ha^{-1} followed by NSKE 5% and Neemzal sprays, recorded significantly less population of thrips, mites and LCI and improved growth parameters and chilli yield (249 kg ha^{-1} and 239 kg ha^{-1}, respectively) (Saumya, 2006). These treatments were comparable to standard check; FYM + 100% RDF+ RPP(366 kg ha^{-1}).

2.4.2 Effect of organic soil amendments on sucking pests of other crops

Neem cake contains 2 per cent bitter terpenoids mainly azadirachtin which is responsible for anti-feedant, anti-ovipositional, growth disrupting, fecundity and fitness reducing properties on pests.

Alam *et al.* (1979) at Aligarh, Uttar Pradesh attributed pests suppressing activity of neemcake primarily to certain phenolic compounds released during decomposition apart from stimulatory effect on root growth. Mehrotra (1980) reported that neem cake helped to produce profuse growth of roots to absorb nutrients easily.

Tandon and Lal (1980) reported that application of neem cake reduced the incidence of sucking pests of mango.

At Nairobi, Kenya, Saxena *et al.* (1984) studied the effect of neem cake and urea against BPH in rice. The results indicated that the application of neem cake and urea at the ratio of 3:10 significantly reduced population of BPH comprising of both nymphs and adults at 30 days after treatment compared to application of urea alone.

At Bangalore secretion of earthworms found to have beneficial effect on growth and yield of crops and it also helped in building resistance in crops to withstand pests and diseases (Kale, 1988).

Thulaseedharan (1988), at Coimbatore, Tamil Nadu reported that neem cake when supplemented with nitrogenous fertilizers reduced the incidence of leaf hoppers, aphids, whiteflies and mites on cotton. Abdulkareem *et al.* (1989) reported that survival of *Nephotettix virescens* (Distant) was significantly lower on potted rice plants treated with carbofuran (1 kg a.i. ha^{-1}) mixed with neem seed kernel or cake powder (1:1 w/w) than on untreated plants. Plants treated with neem kernel powder + S - carbofuran mixture had the lowest rate of rice tungro virus infection (2%) while it was 100 per cent in untreated plants.

Rajendran (1993), also at Coimbatore, Tamil Nadu, reported that neem cake at 250 kg ha^{-1} with 20 kg ha^{-1} N reduced the population of carmine spider mite, leaf hoppers, aphids and whitefly on okra.

Sundararaj (1999) from Coimbatore, Tamil Nadu reported that egg and nymphal population of babul whitefly *Acudaleyrodes hipora* on Acacia seedlings were the lowest in the treatment consisted of neem cake powder alone or in combination with other nutrients and the same trend was observed till three months after application. The organic amendments along with 75 per cent dose of recommended nitrogen found better in reducing the population of sucking pests of cotton than application of full dose of nitrogen only.

At Madurai, Tamil Nadu neem cake @ 250 kg ha^{-1} along with 40 kg ha^{-1} N recorded lower population of leaf hoppers (3.33 $plant^{-1}$), aphids (4.85 $plant^{-1}$), thrips (1.22 $plant^{-1}$) and whitefly (0.68 $plant^{-1}$) (Balasubramanian and Muralibaskaran, 2000).

At Dharwad, Ramesh (2000) revealed that leaf hopper damage and thrips intensity in groundnut crop was significantly lower in the plots receiving vermicompost @ 2 t ha^{-1} in comparison to fertilizer applied and control plots.

Surekha and Arjuna Rao (2000) from Bapatla, Andhra Pradesh suggested that vermicompost was more effective in bringing down the population of aphids followed by FYM than NPK as straight fertilizers in bhendi (*Abelmoschus esculantus* (L.) Molench.) ecosystem. Significantly lower (11.29 g $leaves^{-1}$) population of brinjal aphid was noticed when neem cake was applied @ 1.7 t ha^{-1} whereas, maximum number of aphids (40.29 9 $leaves^{-1}$) were recorded in the crop applied with higher level (200 kg N ha^{-1}) of nitrogen (Godase and Patel, 2001).

Krishnamurthy *et al.* (2001) at I.I.H.R., Bangalore reported that neem and pongamia @ 250 kg ha^{-1} while planting and repeated 2-3 times at 30 days interval and vermicompost application significantly reduced thrips incidence in brinjal.

Vermicompost contains major and minor plant nutrients in available forms besides enzymes, antibiotics, vitamins and plant growth hormones and have definite advantage over other organic manures in respect of quality and shelf life of the produce. This would probably make plant system defensive against pest infestation and plants might exhibit tolerance mechanism (Meerabai and Asha, 2001).

Rajashekara Rao *et al.* (2001) at Bapatla, obtained the lowest leaf miner population (10.6 larvae 10 $plants^{-1}$) in groundnut plots applied with FYM @ 8 t ha^{-1}. It was on par with neem cake @ 770 kg ha^{-1} recording 11 larvae 10 $plants^{-1}$ followed by vermicompost @ 3.75 t ha^{-1} (12.4 larvae 10 $plants^{-1}$). Whereas, control plot recorded maximum number of leaf miner larvae (22 larvae 10 $plants^{-1}$) which received only NPK fertilizers.

Manu (2005) from Dharwad, also reported neem cake @ 500 kg ha^{-1} as the best organic treatment which recorded lowest population of leaf hoppers, thrips, aphids and whiteflies and higher number of bolls (39.10 $plant^{-1}$) and kapas yield of cotton (7.5 q ha^{-1}).

Balakrishnan *et al.* (2007) from Madurai, Tamil Nadu reported that mean population of sucking pests, jassids, whiteflies, aphids and thrips was lower when vermicmpost @ 2 t ha^{-1} + with half dose of RDF (20:10:0 NPK kg ha^{-1}) followed by FYM @ 12.5 t ha^{-1} + half dose of RDF. The vermicompost @ 2 t ha^{-1} in combination with half dose of NPK (20:10:0 kg ha^{-1}) also recorded the highest seed cotton yield (845 kg ha^{-1}) followed by FYM @ 12.5 t ha^{-1} + 20:10:0 NPK kg ha^{-1} which was due to less incidence of sucking pests because of induced resistance developed by the plants.

2.4.3 Effect of soil amendments on the incidence of natural enemies in chilli

Smitha (2002) at Dharwad, Karnataka reported that neem cake 2 @ q ha^{-1} was safer to coccinellid beetles and predatory mites in chilli ecosystem. Application of neem cake @

250 to 1000 kg ha^{-1}, sunnhemp @ 250 to 1000 kg ha^{-1} and vermicompost @ 750 to 2500 kg ha^{-1} in chilli were found quite safe to natural enemies like predatory mite, *Amblyseius* sp. and coccinellid beetle (Varghese, 2003).

From another study at Dharwad, Karnataka, Ravikumar (2004) reported that organic amendments like vermicompost (1-2 t ha^{-1}), neem cake (0.5 to 1.0 t ha^{-1}), biogas spent slurry (1 t ha^{-1}) and FYM (12.5 to 25.0 t ha^{-1}) were found safe to coccinellids as well as *Chrysoperla* in chilli ecosystem.

In another study at Dharwad, Karnataka, Abhilash (2005) observed the effect of organic amendments and biorationals on predators in soybean ecosystem and reported that the activity of natural enemies was noticed in all the plots applied with organic amendments and bio-rationals. Among biorationals, vermiwash recorded higher number of predators. Manu (2005), also confirmed the safetyness of soil organic amendments to natural enemies like cocinellids and *Chrysoperla* in cotton ecosystem.

2.5 EFFECT OF BOTANICALS AND INDIGENOUS MATERIALS IN THE MANAGEMENT OF CHILLI *MURDA* COMPLEX CAUSED BY SUCKING PESTS

Rajasri *et al.* (1991) at Bapatla, Andhra Pradesh studied the effect of insecticides including neem products against sucking pests of chilli *viz*., thrips and mites. Among the commercial formulations of neem, Repelin (1%) was found to be effective in recording highest mean per cent reduction of thrips and mites.

In Tamil Nadu, Mariappan and Samuel (1993) found that neem seed oil had proven effect on the survival of *A*. *craccivora* and *M*. *persicae* that transmits chilli mosaic virus. Neem oil at both 3 per cent and 5 per cent concentrations reduced the virus transmission by aphids and recorded highest mortality of aphids. Similarly, neem derivatives viz, neem oil, Comnhox Comnol Nekhex, Repelin and Morgocide proved their superiority by recording least per cent virus transmission and highest per cent aphid mortality.

At Imphal, Manipur James and Varatharajan (1995) reported that alternate sprays of Achook (1%) and monocrotophos (0.05%) significantly reduced (64.6%) chilli thrips and recorded higher yield of chilli in comparison to Achook and neem coated urea, alone which resulted in lower yield compared to monocrotophos alone or alternate sprays of Achook (1%) and monocrotophos (0.05%).

Sobithadevi and Reddy (1995) reported that among the neem formulations, Indiara and Neemark reduced the pepper vein banding virus and cucumber mosaic virus on chilli transmitted by aphids.

Bagle (1998) at Godhra, Gujarat, while evaluating the efficacy of varying dosages of different insecticides and botanicals against leaf curl incidences in chilli observed the superiority of insecticides over botanicals. Among different botanicals tested, neem seed kernel extract showed lowest rating of leaf curl in Pusa jwala and G-4 varieties of chilli.

Chandrasekharan and Veeravel (1998) from Annamalainagar University, Tamil Nadu, reported that Achook 1.5 per cent recorded 72.9 per cent reduction in thrips population followed by Achook 1 per cent (65.5%) and neemoil 5 per cent (60.1%). The plant products however, found inferior to the chemical check, monocrotophos 0.05 per cent which recorded 82.9 per cent reduction of mites.

At Bapatla, Andhra Pradesh, combination of seedling dip with 1 per cent neem oil emulsion followed by neem cake soil application @ 500 kg ha^{-1} and neem oil emulsion spray at weekly interval were effective against chilli aphids and the effects were on par with chemical control (Mallikarjuna Rao *et al*., 1999).

Chakraborthi (2000) from Mohanpur, West Bengal reported that integrated use of neem based products and spray of phosphomidon at vegetative stage (45 DAT) was effective than sole spray of agro-chemicals for the control of vectors, which caused apical leaf curling in chilli.

Ahmed *et al.* (2001) reported that neem oil application @ 5 ml $litre^{-1}$ recorded 34.28 per cent reduction of chilli mite over control.

Ramaraju (2001a) from Coimbature, Tamilnadu reported moderate efficacy of neem oil 3 per cent and NSKE 5 per cent in reducing the red spider mite on bhendi and brinjal. The per cent reduction of chilli mite was highest in *Azadirachta indica* Ajuss treated plants (aqueous leaf extract 5%) followed by *Sanseiveria* sp. (76.20%) and *Aloe* sp. (75.80%) 24 hr after spray. *Lippia nodifolia* and *Aloe* sp. recorded higher reduction of chilli mites with the reduction of 76.70 and 64.60 per cent at 3 and 7 days after spray, respectively (Ramaraju, 2001b).

Smitha (2002) reported that botanicals viz., Neem gold (3 ml l^{-1}), vitex 5 per cent and clerodendron 5 per cent were moderate in their efficacy against yellow mite in chilli but were inferior to chemicals when applied only once. However, after second spray they were on par with fenpyroximate (1 ml l^{-1}), a chemical acaricide. However at Dharwad, Karnataka application of only *Vitex nigundo* L. 5 per cent (leaf extract) and NSKE 5% recorded the lowest leaf curl index due to reduction in thrips and mites. These treatments were superior to other plant products tested and were on par with recommended package of practices (RPP) (Lingappa *et al.*, 2002).

Sanjay Reddy (2003) again from Dharwad, Karnataka reported that the indigenous products viz., NSKE (2.5%) + GCK (0.5%), NSKE (5%) + cow urine (16.66%), and GCK (1%) + cow urine (16.66%) recorded minimum leaf curl index by inflicting higher mortality of yellow mites. Verghese (2003) reported that application of Nimbicidine was as effective as RPP against thrips and mites and recorded least LCI and high dry chilli yield. In another study, Mallapur *et al.* (2004) reported that application of GCK 0.5 per cent + Nimbicidine reduced incidence of thrips and mites. Next best treatment was turmeric + cow urine (25%) and GCK. Tatagar (2004) from Haveri, Karnataka reported that application of Vertimac (1.9 EC) @ 0.56 ml l^{-1} was found effective against chilli thrips and mites by recording least leaf curl index and higher chilli yield.

2.5.1 Effect of botanicals on the sucking pests of other crop ecosystem

Gopal *et al.* (1992) from Pudukkottai, Tamil Nadu found that need based application of endosulfan and NSKE 5 per cent was effective in controlling leaf miner (*Aproareme modicella*) in soybean.

At Pusa, Bihar more than 74 per cent mortality of active stage of *T. ludeni* on okra (*Abelmoschus esculantus* (L.) Molench.) was reported by dicofol (0.02% and 0.04%), Sulphur WP (0.35 and 0.125%), ethion (0.1%), tetradifen (0.05%) and NSKE (0.05%) (Kumar and Sharma, 1993).

Peter (1994) from Padappai, Tamil Nadu reported that neemazol F, a commercial neem formulation, @ 50 ppm was found compatible with monocrotophos, endosulfan and fenvalerate for control of sucking pest complex on cotton. Besides, it recorded significantly higher yield than untreated control.

Mohapatra (1996) in West Bengal tested field efficacy of dicofol (0.05%), ethion (0.05%) and NSKE 2 per cent on *P. latus* infesting jute. Dicofol proved superior inflicting 83.33 per cent mortality while NSKE recorded 37.49 per cent, compared to control (6.32%) at 15 days after spray.

Saikia *et al.* (1996) at Coimbatore, Tamil Nadu found that commercial neem formulation neemzal F at 25 ppm and 50 ppm azadirachtin spray levels were effective against BPH as ovipositional deterrent with least number of eggs laid (18.5/ five females of BPH) and recorded significant reduction in egg hatchability and feeding potential of BPH. Neemazol-T/S was also very effective at 25 ppm and 50 ppm azadirachtin level.

At Kanpur, the toxicant extracted from kernel part of neem using ether solvent recorded maximum mortality of nymphs of red cotton bug compared to toxicant extracted from fruits, pericarp and leaves (Singh *et al.*, 1997).

Das (1998) observed the lowest damage by *Melangromyza obtuse* and *H. armigera* and highest grain yield in pigeonpea, in plots treated with dimethoate 0.15 per cent + NSKE 5 per cent.

Deole *et al.* (2003) at Nagpur, Maharashtra concluded that NSKE 5 per cent was most ideal, for pest control in chickpea crop for small and marginal farmers. It recorded good profits, besides of high benefit cost ratio.

The population of leaf hoppers was the lowest (2.66 nymphs plant^{-1}) with the application of neem products (No. 60 EC) @ 3.0 ml l^{-1}, which was on par with nimbicidine 1.0 ml l^{-1} (2.77) and Neemzal F. 1.0 ml l^{-1} (2.89). All the neem product treatments were superior to control (Srinivasan and Sundarbabu, 2000). Similarly supremacy of nimbecidine @ 5 ml l^{-1} was reported by Manu (2005) against cotton sucking pests from Dharwad, Karnataka.

2.5.2 Effect of botanicals on lepidopteron pests in other crop ecosystems

Application of NSKE and garlic alone and their combinations were significantly superior to Endosulfan spray in reducing the bollworm infestation in cotton ecosystem (Anon, 1989). Highest yield of 19.2 q ha^{-1} was obtained in the treatment sprayed with NSKE + garlic.

Sarode *et al.* (1995) from Akola, Maharashtra reported maximum larval reduction (63.3%) and minimum pod damage in NSKE 5 per cent sprayed plots followed by NSKE 6 per cent as compared to control in redgram ecosystem.

Vijayalakshmi *et al.* (1996) from Chennai, Tamil Nadu reported the effectiveness of garlic extract in combination with other extracts like neem, chilli, ginger, tobacco and cow urine (with soap solution) against *H. armigera* and *S. litura* up to 13 days of spray.

Dandale *et al.* (2000) at Akola, Maharashtra studied the efficacy of spinosed against cotton bollworm in comparison with synthetic pyrethroids. The treatment spinosed 48 SC @ 50 and 75 g ha^{-1} a.i. was equally effective as that of synthetic pyrethroids (Decis tablet and Bullock) in controlling the boll worms. The chemical retained its effectiveness against *H. armigera* even after 14 days of spraying.

Among the different plant products tested by Rosaih (2001), at Hyderabad, Andhra Pradesh Neemazal at 0.5 per cent showed least fruit infestation (14.8%), followed by pongamia seed extract (18.3%) and NSKE 10 per cent (38.2%) in okra (*Abelmoschus esculantus* (L.) Molench.) due to *H. armigera*.

Siddegowda *et al.* (2003) at Gulbarga, Karnataka noticed that spinosed 45 SC at higher dosages (90 g a.i. ha^{-1}) recorded significantly lower pod damage and grain yield. However, the lower dosage of spinosad @ 50 g a.i. ha^{-1} recorded pod damage and grain yield on par with endosulfan @ 700 g ha^{-1} a.i. in pigeonpea.

Emamectin benzoate 5 SG (Proclaim) was evaluated against cotton bollworms by Giraddi *et al.* (2004) at Dharwad, Karnataka. They observed that 11.0 g ha^{-1} a.i. dosage resulted in significant control of bollworms with lower density of *Helicoverpa* larvae (0.6 $plant^{-1}$), damage to fruiting bodies (11.7%), and higher number of good opened bolls (15.6 $plant^{-1}$), lower number of bad opened bolls (4.8 $plant^{-1}$) and kapas yield (9.2 q ha^{-1}). The bioefficacy obtained in the crop sprayed with the test product was comparable to profenophos 50 EC.

Ladaji (2004) at Dharwad, Karnataka, reported that the new molecule, spinosed 48SC @ 0.2 ml l^{-1} proved significantly superior over rest of the molecules by reducing the pod borer incidence in chickpea to the extent of 84.4 and 82.0 per cent after first and second sprays and the treatment recorded highest pod yield of 14.5 q ha^{-1}. The other treatments to follow included spinosed (0.1 ml l^{-1}), indoxacarb (0.5 ml l^{-1}) and emamectin benzoate (0.4 g l^{-1}). However, the highest IBC ratio (11.2) was obtained with Lambda-cyhalothrin. Udikeri *et al.* (2004) at A.R.S.Dharwad, Karnataka observed that the damage due to boll worm was least in emamectin benzoate (4.2%) which produced significantly more number of good opened bolls as well as higher seed cotton yield (15.9 q ha^{-1}) as compared to untreated check (9.7 q ha^{-1}).

Bheemanna *et al.* (2005) at Raichur, Karnataka evaluated emamectin benzoate (Proclaim) 5 per cent SG against okra fruit borers. Emamectin benzoate @ 8.5 g ha^{-1} a.i. recorded lower fruit borer damage (4.4%) and higher fruit yield (41.9 q ha^{-1}) compared to untreated check.

Prasadkumar and Devappa (2006) at Arabhavi, Karnataka evaluated emamectin benzoate against cabbage diamond moth. Emamectin benzoate @ 150 g and 200 g ha^{-1} was effective in suppressing the larval population of the pest compared to other insecticides and it also recorded higher yield.

2.5.3 Effect of biorationals on natural enemies

Tandon and Nillana (1987) reported that *Bacillus thuringienisis* was safe to natural enemies viz., *Chrysoperla. carnea, Coccinella. septempunctata* and predaceous mite *Amblyseius perisimitis* (Muma).

The neem extracts with or without neem oil were safe and harmless to the eggs, larvae and adults of *Chrysoperla carnea* (Stephens) and *Coccinella septempunctata* L. with no effects on mortality or fecundity of the insect (Karthner, 1991).

Mattur *et al.* (1993) reported that neem oil had no effect on survival or behaviour of larvae of *Coccinella undecimpunctata*. L. except for a prolongation of the fourth instar larvae. Consumption of the aphids by these predators was unaffected.

Two commercial products of neem seed extract (Neem-azal-S and Morgosa-O) were proved to be safe against the predatory mites, *Amblyseius barkeri* (Hughes) and *Typhlodormus richteri* (Karg) (Dimetry *et al.*, 1994).

Mansour *et al.* (1997) studied the effect of Neem-guard on predaceous mite *Phytoseilus persimillis* (Athias-Henriot) and predatory spiders. It was observed that Neem guard was highly toxic to phytophagous red spider mite but had no effect on *Phytoseilus persimilis* and predatory spiders.

On the other hand, Neem Azal-F decreased the food consumption rate at the two concentrations used (0.2% and 0.05%) for the predatory mites belonging to *Amblyseius* spp. (Momen *et al*., 1997).

Dunbar *et al.* (1998) from California, the USA reported emamectin benzoate as a safe chemical against coccinellids. This might be due to its rapid degradation on the surface of foliage, and limited contact with phytophagous insects, its mode of action being mainly by ingestion. It would be ecologically selective to wide range of beneficial species due to rapid breakdown of the active ingredient by phyto oxidation to non-toxic level on the leaf surface, limiting contact activity to a very short period.

Mishra and Mishra (1998) reported that the populations of predatory coccinellids were least affected by neem formulations, Neemax and Multineem, which gave similar net returns as that of malathion treatment. At Kanpur, neem products, Achook (WSP), RD-9 Repelin, Neemazal T/S, Neem gold, Neemta 2100, and Nimbecidine 0.05 per cent proved safe to coccinellids (Singh and Singh, 1998). The order of safety was maximum in Achook followed by RD-9 Repelin.

Chinniah and Mohanasundaram (1999) from Coimbatore, Tamil Nadu suggested that the neem products viz., neem cake extract 10 per cent, NSKE 5 per cent and neem oil 3 per cent were much safer to the predatory mite, *Amblyseius* spp. in cotton ecosystem and were eco-friendly in nature, whereas, neem based integrated treatments were found safer to coccinellid and syrphid predators of sucking pests of chilli (Chakraborti, 2000).

Mann and Dhaliwal (2001) from Ludhiana, Punjab reported that maximum reduction of *Chrysoperla carnea* population was observed in Rakshak Gold and Neem Azal at 800 ppm with 1.4 and 1.46 numbers 15 plants^{-1}, respectively. Triazophos proved highly toxic to *C. carnea* with 0.66 chrysopids 15 plants^{-1}. Neem Azal and Rakshak gold at 800 ppm suppressed chrysopids, which was found better next to triazophos.

Smitha (2002) from Dharwad, Karnataka reported that the neem products found safe to predatory mites and coccinellids in chilli ecosystem. Various neem derivatives such as neem oil, NSKE, Nimbicidine, bioneem, spic Neem gold and Neemarin were found safe to predatory mite, *Amblyseius* sp. and coccinellid beetles in chilli ecosystem (Varghese, 2003). In chilli, different indigenous materials viz., cow urine, garlic extract, NSKE, green chilli extract and vermiwash were also found safe to *Chrysoperla* as well as coccinellid beetles (Ravikumar, 2004).

Emamectin benzoate 5 SG (Proclaim) at 8 to 11.0 g ha^{-1} a.i. dosage was found safe to coccinellid predators in cotton ecosystem (Giraddi *et al*., 2004).

Manu (2005) from Dharwad, Karnataka reported safetyness of neem derivatives such as Nimbicidine and NSKE on coccinellids and *Chrysoperla* in cotton ecosystem.

Foregoing presentation, thus, emphasizes the utility of ecofriendly practices such as component cropping namely barrier cropping, intercropping, nutrition with organic nitrogen, higher level of potassium, use of organic amendments namely vermicompost, neem cake, and biorational/botanicals in effective pest management. Such of the practices are of greater relevance in high value and pest ridden crops such as chilli, which is an export potential crop and the export demand greatly depends on the quality and pesticide free produce.

3. MATERIAL AND METHODS

Field experiments were conducted for the management of leaf curl complex (*murda*) in chilli, involving barrier crops, intercrops, various organic nitrogenous sources, bio-rationals and inorganic fertilizers, at Agricultural Research Station, Devihosur, Haveri, UAS, Dharwad during 2005-06 and 2006-07 at fixed site. Plant growth, yield and quality of chilli and pest and disease including *murda*, and predator population were studied. The materials used and the experimental techniques adopted during the course of investigation are described in this chapter.

3.1 LOCATION OF EXPERIMENTAL SITE

Agricultural Research Station, Devihosur is situated at 14.47°N latitude, 75.21°E longitude and at an altitude of 563.0 m above mean sea level (MSL). The experimental sites were located in Plot No. 4 of the farm. The Agricultural Research Station, Devihosur comes under Agro-Climatic Zone-8 (Northern Transition Zone) of Karnataka.

3.2 SOILS OF THE EXPERIMENTAL SITE

The soil was medium deep black soil. Composite soil samples from the experimental site were collected to a depth of 0 to 22.5 cm before transplanting of crop for analysis of various physical and chemical properties of the soil (Table 1). The soil had 53.4 per cent clay, 24.8 per cent silt, 13.4 per cent fine sand and 8.4 per cent coarse sand and electrical conductivity of 0.41 ds m^{-1}. The soil was neutral (7.2 pH) in reaction. The available nitrogen; phosphorus and potassium were 272.0, 36.6 and 336.0 kg ha^{-1}, respectively. The organic carbon content of the soil was 0.56 per cent. In general, the experiment site was medium in fertility status.

3.3 CLIMATE

The data with regard to rainfall and ambient temperature (maximum and minimum), relative humidity that prevailed during crop growth period at Agricultural Research Station, Devihosur are presented in the Table 2 and the rainfall data is illustrated in Fig.1.

3.3.1 Climatic condition

The mean annual rainfall of the station was 699.93 mm, which was well distributed. The highest rainfall was observed in the month of July (136.73 mm) followed by August and June.

The total rainfall received during the cropping season was 862.3 mm in 2005 and 684.4 mm during 2006. The rainfall received during 2005 was higher by 173.9 mm. The average rainfall during growing period (June to February) was 726.2 mm during 2005 and 578.1 mm during 2006, respectively. The average maximum and minimum temperatures during growing period was 30.0°C and 18.9°C during 2005 and 30.4°C and 20.5°C during 2006, respectively. The averages of two years maximum and minimum temperature during growing period were 30.2°C and 19.5°C, respectively. The mean relative humidity of the two seasons was 76.4 and 54.4 percent during morning and evening, respectively. During 2005 July, August and October months received 98.9, 33.4 and 598 per cent higher rainfall compared to 2006. But the variation in the maximum and minimum temperature and relative humidity during 2005 and 2006 were marginal. While, rainfall during June and September months of 2006 was above the normal rainfall and the rainfall was higher was by 26.5 and 15.6 per cent compared to 2005. In general variations in temperature (both maximum and minimum) and relative humidity (both morning and evening) during growing seasons were marginal.

3.4 EXPERIMENTAL DETAILS

Experiments were conducted for two consecutive years during growing seasons of 2005-6 and 2006-7 on fixed sites. *Rabi* sorghum was the previous crop in the experimental site before starting of the experiment.

3.4.1 Experiment I: Effect of barrier cropping on the performance of chilli and incidence of leaf curl

3.4.1.1 Treatment details

T_1: 3 rows barrier crop of grain sorghum
T_2: 6 rows barrier crop of grain sorghum
T_3: 9 rows barrier crop of grain sorghum
T_4: 3 rows barrier crop of grain maize
T_5: 6 rows barrier crop of grain maize

Table 1. Physico-chemical properties of the soils of the experimental site

Sl. No.	Physical characteristics	Depth of the soil (0-22.5 cm)	Method of estimation
I Physical characteristics			
	Particle size analysis		
a	Coarse sand (%)	8.4	International pipette method (Piper, 1966)
b	Fine sand (%)	13.4	
c	Silt (%)	24.8	
d	Clay (%)	53.4	
II Chemical properties			
a	Soil reaction (1:2.5 soil water suspension) (pH)	7.1	Potentiometric method (Jackson, 1967)
b	Electrical conductivity (ds m^{-1})	0.41	Conductometric method (Jackson, 1967)
c	Organic carbon (%)	0.56 (Medium)	Walkley and Black's wet oxidation method (Jackson, 1967)
d	Available nitrogen (kg ha^{-1})	272 (Low)	Alkaline permanganate method (Subhaiah and Asija, 1986)
e	Available phosphorus (kg ha^{-1})	33.6 (Medium)	Olsen's Method (Jackson, 1967)
f	Available potassium (kg ha^{-1})	336 (High)	Flame Photometric Method (Jackson, 1967)

T_6: 9 rows barrier crop of grain maize
T_7: 3 rows barrier crop of fodder sorghum
T_8: 6 rows barrier crop of fodder sorghum
T_9: 9 rows barrier crop of fodder sorghum
T_{10}: 3 rows barrier crop of fodder maize
T_{11}: 6 rows barrier crop of fodder maize
T_{12}: 9 rows barrier crop of fodder maize
T_{13}: No barrier crop

3.4.1.2 Design: Randomised Complete Block Design with factorial concept.

3.4.1.3: Replications: Three

3.4.1.4: Plot size: 12 m x 6 m = 72 m^2 = windward
: 12 m x 6 m = 72 m^2 = leeward

3.4.1.5 Chilli variety: *Byadgi* dabbi

3.4.1.6 Barrier crop cultivars

Fodder maize	: Cv. SA-Tall
Grain maize	: Hybrid DMH-2
Fodder sorghum	: Cv. SSV-74
Grain sorghum	: Cv. DSV-6

Table 2. Monthly meteorological data for the experiment years (2005 and 2006), normal (29 years) rainfall (1976-2005), Mean temperatures and relative humidity (2005 and 2006) as recorded at the meteorological observatory, Agricultural Research Station , Devihosur, (District Haveri), UAS, Dharwad (Karnataka)

Months	Rainfall (mm)			Temperature (^oC)						Relative humidity (%)					
	2005	2006	Normal (1976-2006)	2005		2006		Average of two years		2005		2006		Average of two years	
				Max.	Min.	Max.	Min.	Max.	Min.	Morn.	Even.	Morn.	Even.	Morn.	Even.
January	3.8	0.0	1.73	31.9	15.8	31.5	17.5	31.7	16.7	67.1	40.3	61.8	33.4	64.5	36.5
February	0.0	0.0	2.33	32.9	17.4	33.8	15.3	33.4	16.4	61.6	34.9	52.8	18.5	57.2	26.7
March	0.0	2.6	7.43	36.6	19.6	35.0	19.4	35.8	19.5	68.2	29.3	71.6	31.1	69.9	30.2
April	72.0	2.1	35.32	36.5	20.7	36.3	21.3	36.4	21.0	71.8	38.0	74.7	39.4	73.4	38.7
May	60.3	101.6	60.73	36.8	21.4	35.4	22.7	35.5	21.3	72.4	47.3	76.5	61.8	74.5	54.5
June	112.7	142.6	108.25	31.5	22.1	30.1	21.6	30.8	21.9	80.7	71.7	85.7	70.6	83.3	71.2
July	296.5	149.1	136.73	27.9	21.7	26.2	21.4	27.1	21.7	88.6	81.8	87.5	81.8	89.1	81.8
August	159.4	119.5	114.58	27.2	21.5	27.3	21.2	27.3	21.4	90.3	80.2	86.4	80.4	88.4	80.3
September	82.0	94.8	77.98	28.3	21.1	30.3	21.9	29.3	21.5	89.7	80.8	87.3	71.8	88.5	76.3
October	75.4	10.8	95.12	30.1	20.8	31.5	20.7	30.8	20.8	85.5	68.3	74.6	53.8	80.1	61.1
November	0.2	61.3	51.29	29.9	16.2	30.9	24.9	30.4	20.6	72.0	52.5	78.1	57.3	75.1	54.8
December	0.0	0.0	8.44	30.2	14.7	31.4	14.9	30.8	14.8	73.1	42.8	71.6	39.4	72.4	41.1
Total	862.3	684.4	699.93												

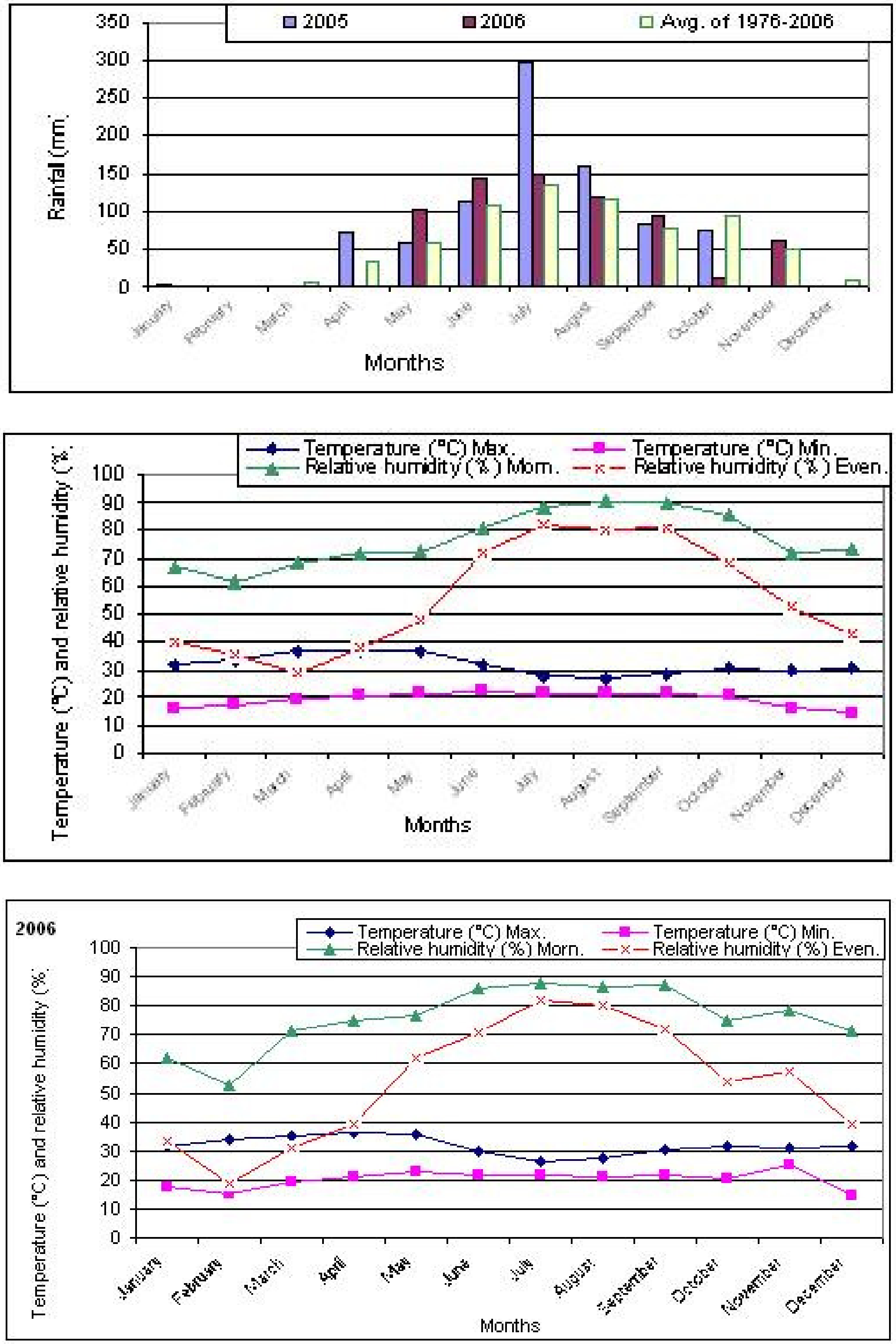


Fig. 1. Monthly meteorological data for the experiment years (2005and 2006), normal (29 years) rainfall (1976-2005), Mean temperatures and relative humidity (2005and 2006) as recorded at the meteorological observatory, ARS, Devihosur, (District Haveri)

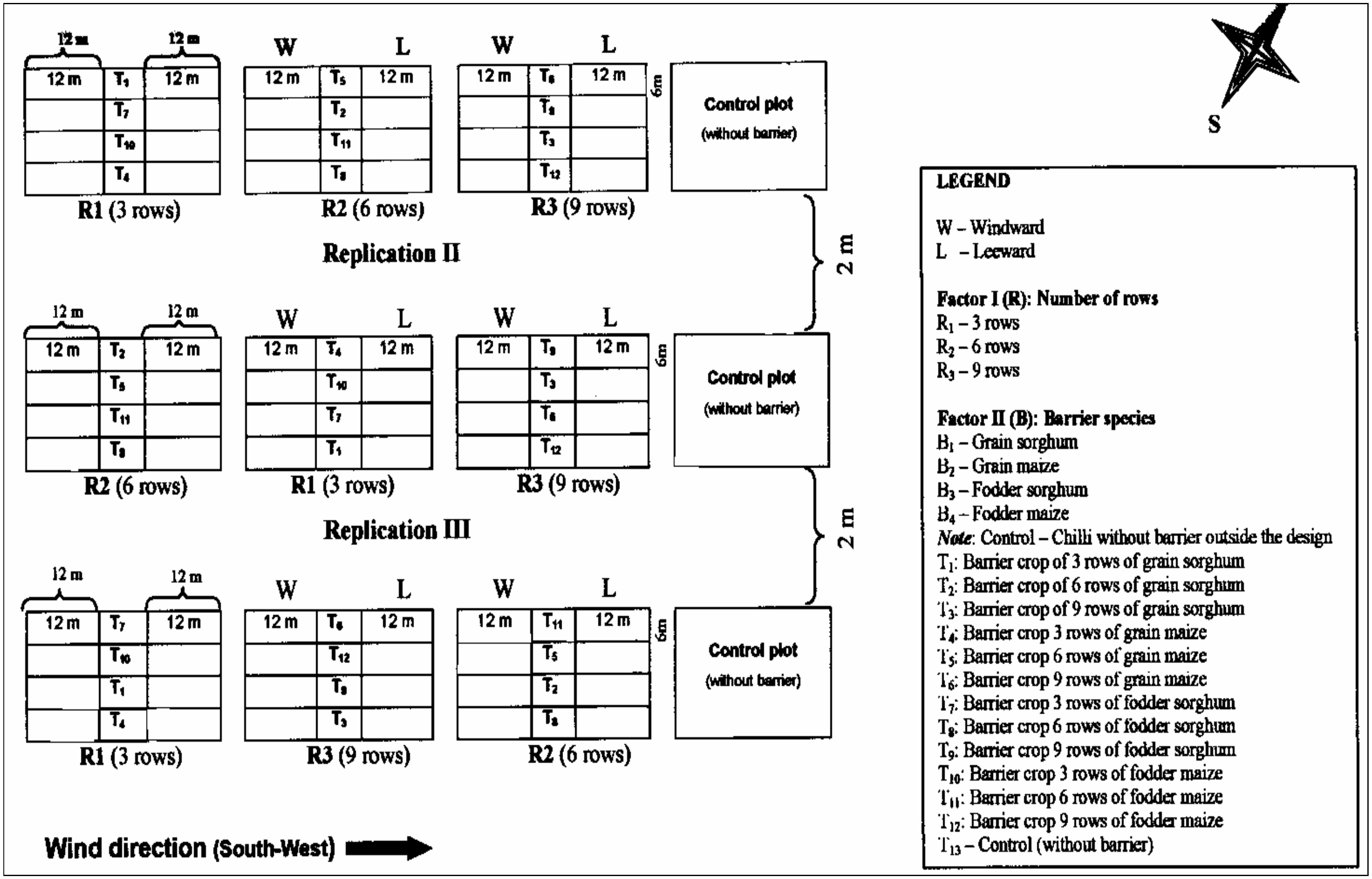
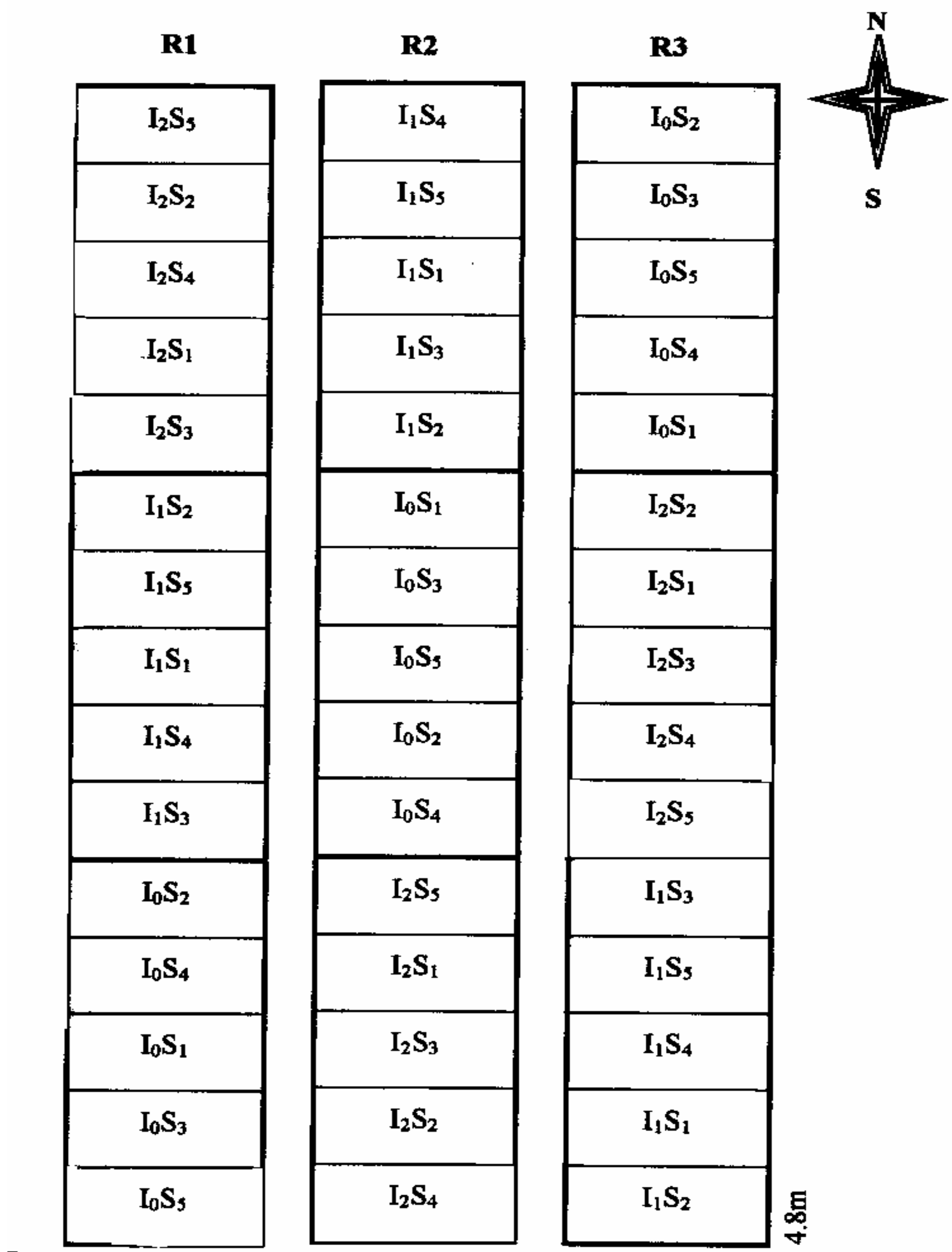


Fig.2: Plan and layout of Experiment I



Legend

Main plots
I_0: Sole chilli
I_1: Chilli + garlic (1: 2)
I_2: Chilli + coriander (1: 2)

Sub plots
S_1: $N_0P_{50}K_{100}$ (Entire N through organics)
S_2: $N_{25}P_{50}K_{75}$ (75% N substitution through organics)
S_3: $N_{50}P_{50}K_{50}$ (50% N substitution through organics)
S_4: $N_{75}P_{50}K_{25}$ (25% N substitution through organics)
S_5: $N_{100}P_{50}K_0$ (No substitution of organic N)

Fig.3: Plan and layout of Experiment II

3.4.1.7 Methodology adopted for sowing of barrier crops

The barrier crop strips were sown using seed drill having three coulters as per treatment 15 days in advance of transplanting of chilli in 20 rows (12 m) on either side of the barrier. The direction of sowing of barrier crop was across S-W/N-S wind (both, monsoon winds and post-monsoon winds). Barrier was raised using 25 per cent extra seedlings so as to form relatively a thick barrier. All the recommended practices were followed for both maize and sorghum barriers for better growth and establishment of the crop.

3.4.2 Experiment II: Effect of intercropping, N substitution and graded levels of K on the performance of chilli and behaviour of *Murda* complex

Treatment Details

Main plots I_0: Sole chilli
I_1: Chilli + garlic (1:2)
I_2: Chilli + coriander (1:2)

Sub plots S_1: $N_0P_{50}K_{100}$ (Entire N through organics)
S_2: $N_{25}P_{50}K_{75}$ (75% N substitution through organics)
S_3: $N_{50}P_{50}K_{50}$ (50% N substitution through organics)
S_4: $N_{75}P_{50}K_{25}$ (25% N substitution through organics)
S_5: $N_{100}P_{50}K_0$ (No substitution of organic N)

Note: All the treatments received 100 kg ha^{-1} N through organic and or inorganics as per treatment.

3.4.2.1 Design: Split plot
3.4.2.3 Replications: Three
3.4.2.4 Plot size:
Gross plot size: 7.2 m x 4.8 m
Net plot size: 6.0 m x 3.6 m
Spacing: 60 cm x 60 cm
3.4.2.5 Variety
Chilli: *Byadgi* dabbi
Garlic and coriander: Local varieties

3.4.3 Experiment III: Effect of N substitution and biorationals on the performance of chilli and behaviour of leaf curl complex

Treatment Details

Main plots (Nitrogen sources)

T_1: 100: 50: 50 kg ha^{-1} NPK (RDF, Entire N through fertilizers)

T_2: 50: 50: 50 kg ha^{-1} NPK (remaining 50% N substitution through 2.5 t ha^{-1} vermicompost and 500 kg ha^{-1} neem cake)

Sub plots (biorationals)

S_1: Alternate spray of Nimbecidene (5 ml l^{-1}) and GCK (Garlic-chilli kerosene) extract (1.0%) (3, 5, 7, 9 and 11 Weeks After Transplanting (WAT))

S_2: Alternate spray of Nimbecidene (5 ml l^{-1}) and leaf extract (10%) (3, 5, 7, 9 and 11 WAT)

S_3: Alternate spray of Nimbecidene (5 ml l^{-1}) and Panchagavya (3%) (3, 5, 7, 9 and 11 WAT)

S_4: Alternate spray of Nimbecidene (5 ml l^{-1}) and leaf extract and panchagavya mixture (3,5,7,9 and 11 WAT)

S_5: Alternate spray of Nimbicidene and silica (3,5,7,9 and 11 WAT)

S_6: Alternate spray of Nimbicidine and K.K. Firm herbal product (Action 100) (3,5,7,9 and 11 WAT)

S_7: Alternate spray of Abamectin (1.9 EC) and Perfect (3,5,7,9 and 11 WAT)

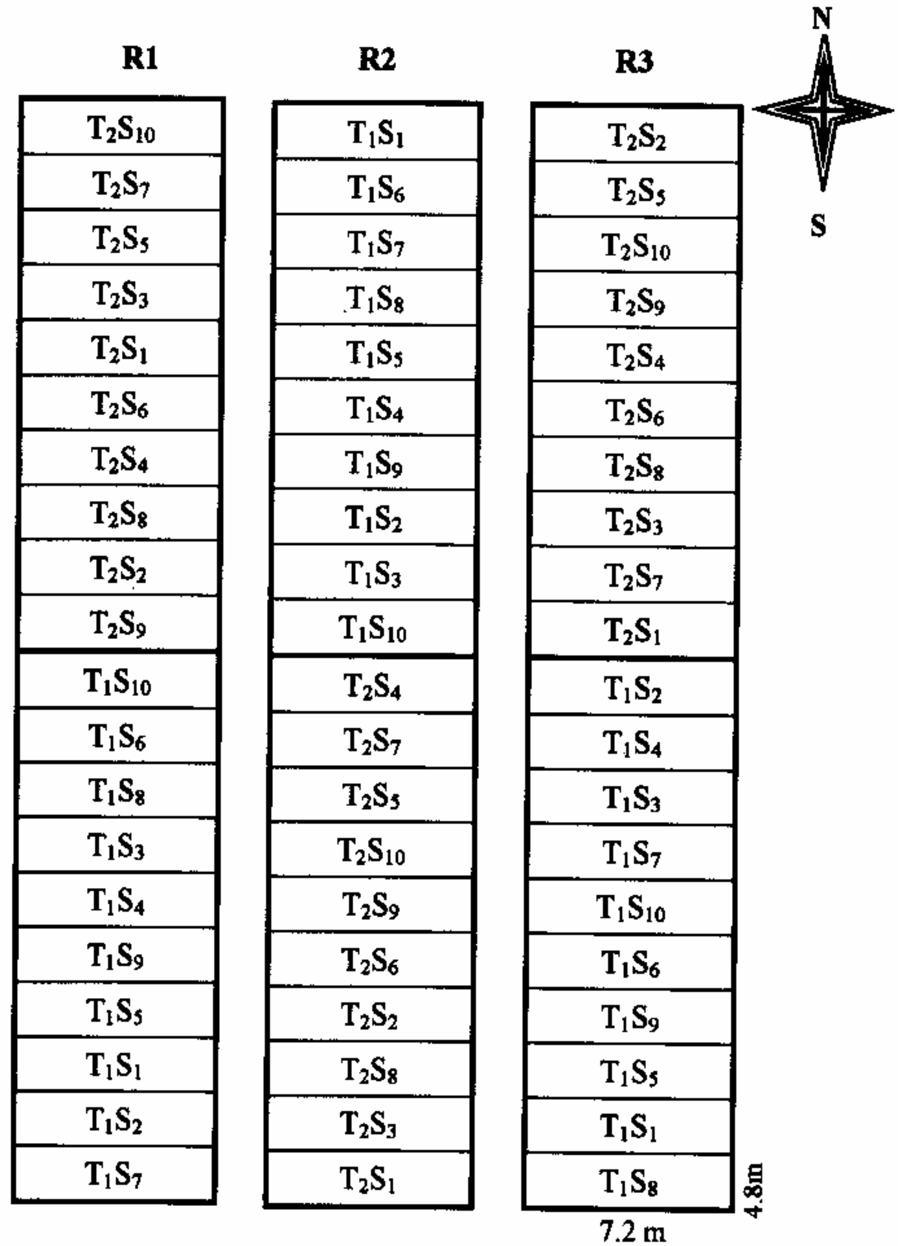
S_8: Silica -dusting and soil application of silica (3, 5, 7, 9 and 11 WAT)

S_9: Recommended plant protection (two sprays of dimethoate (1.7 ml l^{-1}) at 2,5 WAT dicofol (2.5 ml l^{-1}+ carabaryl (4 g l^{-1}) at 7 and 11 WAT)

S_{10} : Control (No Spray)

Note: Microbial consortium common to all, source of 50% inorganic N is through CAN.

3.4.3.2 Design: Split plot
3.3.3.3 Replications: Three
3.4.3.4 Plot size: Gross: 7.2 m x 4.8 m
Net: 6.0 m x 3.6 m
3.4.3.5 Variety: *Byadgi* dabbi
3.4.3.6 Preparation of microbial consortium



LEGEND

Main plots:

T_1: 100: 50: 50 kg NPK / ha (RDF, entire N through fertilizer)

T_2: 50: 50: 50 kg NPK /ha (remaining 50% N substitution through 2.5 T vermicompost and 500 kg neem cake)

Sub plots (Biorationals):

S_1: Alternative sprays of Nimbecidene (5 ml/lit) and GCK extract) (1.0%) (3, 5, 7, 9 and 11 WAT)

S_2: Alternative sprays of Nimbecidene (5 ml/lit) and leaf extract spray (10%) (3, 5, 7, 9 and 11 WAT)

S_3: Alternative sprays of Nimbecidene (5 ml / lit) and Panchagavya (3%) (3, 5, 7, 9 and 11 WAT)

S_4: Alternative sprays of Nimbecidene (5 ml / lit) and spray of leaf extract and panchagavya mixture) (3,5,7,9 and 11 WAT)

S_5: Alternative spray of Nimbicidene and silica spray (3,5,7,9 and 11 WAT)

S_6: Alternative spray of nimbicidine and K.K. herbal product (Action 100) (3,5,7,9 and 11 WAT)

S_7: Alternative spray of Abamectin (1.9 EC) and perfect (3,5,7,9 and 11 WAT)

S_8: Only silica spray / dusting and soil application of silica (3, 5, 7, 9 and 11 WAT)

S_9: RRP (Two sprays of dimethoate (1.7 ml/lit) at 2,5 WAT dicofol (2.5 ml/lit + carabaryl (4g/lit) at 7 and 11 WAT)

S_{10}: Control (No Spray)

Fig.4: Plan and layout of Experiment III

Contents of microbial consortium are *Pseudomonas fluorescens* (strain- WGUK-327(2)), *Azotobacter* (strian-UASD-AZO1), *Azospirillum* (strain:ACD-15+ ACD-20)) and PSB (P-solubilizing bacteria-strain: *Serratia marcescens* (ER-2))

All these cultures were obtained form the Department of Agricultural Microbiology, University of Agricultural Sciences, Dharwad. All the cultures each of half kilogram were mixed with 10 liters of water and twice solution was made and seedlings were dipped in these solutions for one hour before transplanting.

3.4.3.7 Preparation of biorationals spray solutions

3.4.3.7.1 Preparation of panchagavya: The materials required for panchagavya preparations are.

Fresh cow dung	: 7 kg
Cow urine	: 3 liters
Cow milk	: 2 litres
Cow curd	: 2 litres
Cow ghee	: 1 kg
Sugarcane juice	: 3 liters
Coconut water	: 3 liters
Ripped banana	: 12
Yeast	: 100 g

Procedure

Cow dung (7 kg) + cow ghee (1 kg) → incubated 2 days → added 3 liters of cow urine + 10 liters water → stirred 2 times per day for 1 week → added sugarcane juice (3 liters) → added cow milk (2 liters) → added cow curd (2 liters) → added coconut water (3 liters) → added yeast (100 g) + 12 ripped banana → incubated for 2 weeks. After these incubation periods panchagavya was used for spray.

3.4.5.7.2 The materials required for plant mixture spray preparation are as follows

Preparation of plant mixture spray

Nigundo (*Vitex nigundo*)	– 1 kg
Neem (*Azadirachta indica*)	- 1 kg
NSKE (Neem seed kernel extract)	- 1 kg
Adothoda vesica	– 1 kg
Pongamia (*Pongamia pinnata*)	- 1 kg
Argemone (*Argemone mexicana*)	- 1 kg

Each of these plants (herbs) were chopped → added 100 ml cow urine + 10 liters of water → incubated for 4 weeks, filtered with muslin cloth and solution was used for spray.

3.4.3.7.3 Preparation of garlic chilli kerosene extract (GCK)

Garlic bulbs (10 g) and green chilli pods (10 g) were thoroughly ground separately in a pestle and mortar; later grund materials were soaked overnight in 10 ml kerosene each separately. Next day, the extracts of garlic and chilli were mixed and filtered through muslin cloth. Later, the volume was made upto 1 liter to obtain 1 per cent GCK extract.

Table 3. Nutrient content of organics used in the experiment

Orgnics	N (%)	P (%)	K (%)
FYM	0.58	0.30	0.72
Vermicompost	1.10	0.78	0.90
Neem cake	4.40	1.40	1.60
Poultry manure	2.70	2.50	2.35

3.5 VARIETAL DESCRIPTION OF BYADGI DABBI

Chilli (*Capsicum annuum* L.) is the important commercial crop and both Kaddi and Dabbi type of varieties of chilli are grown in the country. Dabbi plant grows to a height of 60-70 cm with a spread of 40-50 cm. Leaves are light green in colour, erect type, shiny, larger in size with lanceolate in shape. Canopy open type with profuse branching. Mature fruits are deep red in colour with 10-12 cm length with broad base and conical shaped. The mature fruits develop wrinkled surface. Fruits are mild in pungency and with very good aroma. It is extensively cultivated in Dharwad, Haveri, Shimoga, Bellary and Gulbarga districts of Karnataka.

3.6 CULTURAL OPERATIONS

The details regarding various cultural operations carried out during the course of investigations are furnished below.

3.6.1 Nursery

The raised seed beds of 3 m x 1 m x 10 cm (L x B x H) were prepared with 0.6 m gap between rows of beds, 30-40 g of chilli seeds were used for each bed and the seeds were sown in the lines marked in the seed bed with 10 cm spacing between each line. FYM and fertilizers were applied to all the beds the as per recommended practices of 10 kg FYM and 30:15:15 grams of N, P_2O_5 and K_2O and all the plant protection measures were undertaken as per package of practices.

3.6.2 Land preparation

The land was ploughed once with tractor drawn mould board plough followed by harrowing twice with tractor and once with bullocks to bring the soil to fine tilth. The marking for chilli transplanting was done with the wooden marker at the spacing of 60 cm x 60 cm The organic sources FYM, vermicompost, neemcake and poultry manures were incorporated as per treatment specifications and in the spots where chilli seedlings would be transplanted.. Chilli seedlings were transplanted at the spacing of 60 cm x 60 cm. In the Experiment III the seedlings were dipped in the microbial consortium for 1 hour before transplanting.

3.6.3 Cultivation details

A detail of the cultural practices experiment-wise is presented in Table 4 to 6.

3.7 COLLECTION OF EXPERIMENTAL DATA

For analyzing the growth pattern of the crop, five plants were selected randomly from the net plot area in each treatment and were tagged to record various observations at 30 days interval upto harvest/last picking from the day of transplanting. The parameters and procedures followed are given in Table 7.

3.8 CHEMICAL ANALYSIS

3.8.1 Plant analysis

Plant samples collected at harvest were used for estimation of nitrogen and potassium uptake by the plant. The dried samples were ground in a Willey mill and passed through 40 mesh sieve. The ground material was collected in butter paper bag and was used for chemical analysis. Nitrogen was estimated by Micro-kjeldahl method and Flame Photometer was used for potassium estimation (Jackson, 1967).

3.8.2 Nutrient uptake

Based on the nutrient content in plant at harvest and dry matter accumulation at harvest, the uptake values (kg ha^{-1}) of nitrogen and potassium were worked out.

Table 8. Method employed for soil (N and K) analysis

Sl. No.	Estimation	Author	Method
1.	Available N	Subbaiah and Asija (1986)	Alkaline permanganate method
2.	Available K	Jackson (1967)	Extraction with NH_4OAc and estimation using flame photometer

3.8.3 Soil analysis

The experiment was conducted on a fixed site during 2005-06 and 2006-07. Soil samples were collected from each treatment after final picking of fruits of chilli crop during both the years to assess the changes/variations in the available N and K contents of the soil. The soil samples collected from a 22.5 cm depth were dried under shade and were powdered with wooden pestle and mortar and passed through 2 mm sieve and these samples were used for analysis as under (Table 8).

3.9 QUALITY PARAMETERS

Samples of red ripe fruits from all pickings were collected treatment-wise for determining quality traits. They were sun dried for 10-15 days till they were brittle and then distilled carefully. The sun dried fruits were used for the analysis of capsaicin and oleoresin.

3.9.1 Ascorbic acid

Freshly harvested green chilli was used for ascorbic acid estimation. It was determined volumetrically by reducing 2, 6-dichlorophenol-indophenol dye to get a pink end point (Sadasivam and Manikam, 1992).

3.9.2 Capsaicin content and Scoville Heat Unit (SHU)

The capsaicin content was estimated by the procedure proposed by Palacio (1977). In this estimation procedure, 2 grams of ground-dried chilli was passed through No.40 sieve (0.42 mm) and was placed in the 100 ml volumetric flask. The material was diluted with ethyl acetate upto 100 ml and allowed it to stand for 24 hours to extract. One ml of the extract was taken and diluted with 5 ml of ethyl acetate just before reading, and then 0.5 ml of vanadium oxytrichloride ($VoCl_3$) solution (0.5% $VoCl_3$ in ethyl acetate) was added and the volumetric flask (100 ml) was shaken thoroughly and reading was taken at 720 nm. Then reading was subtracted from the value obtained with 0.5 ml $VoCl_3$ added to 5 ml ethyl acetate (blank) and the reading was compared with the standard curve prepared for capsaicin. The amount of capsaicin in the samples was expressed in percentage. The capsaicin content in fruits is expressed in terms of scoville heat units (Scoville, 1912). Suzuki *et al.* (1957) have established the relationship that one per cent of pure capsaicin has a scoville heat value of 150000 units

$$\% \text{ capsaicin} = \frac{\text{mg capsaicin}}{1000 \times 1000} \times \frac{100}{1} \times \frac{100}{2}$$

3.9.3 Oleoresin content

Ten grams of chilli powder sample was taken in a chromatographic column, plugged with stop cock. Fifty ml of acetone was added and allowed over night. The slurry was collected in a pre-weighed beaker and solvent was evaporated over a water bath. The collected slurry was cooled and weighed. Difference in weight over sample weight was expressed as per cent oleoresin (AOAC, 1997) or (ASTA method 2.3). Oleoresin yield per ha was worked out by using the formula.

$$\text{Oleoresin yield (kg ha}^{-1}) = \underset{(\text{kgha}^{-1})}{\text{Fruit yield}} - \underset{\text{weight (kg ha}^{-1})}{\text{discolored fruit}} \times \frac{\text{Oleoresin per cent in fruits}}{100}$$

3.10 STATISTICAL ANALYSIS

The data collected form the experiments were analyzed statistically following the procedure as described by Gomez and Gomez (1984). The level of significance used in 'F' and 't' tests was P = 0.05. The mean value of main plot, sub-plot and interaction effects were separately subjected to Duncan's Multiple Range Test (DMRT) using the corresponding error mean sum of squares and degrees of freedom values under M-STAT-C programme.

Table 4. Details of the cultural practices carried out in Experiment I

Sl. No.	Cultural operations	Year 2005-06	Year 2006-07	Methodology
1.	Nursery bed preparation and sowing	12.6.2005	19.6.2006	In raised beds
2.	Sowing of barrier crops	9.7.2005	6.7.2006	Bullock drawn seed drill
3.	Transplanting of chilli seedlings	20.7.2005	19.7.2006	Two healthy seedlings per hill at 60 cm x 60 cm spacing
4.	Gap filling of barrier crops	22.7.2005	22.7.2006	Seeds were sown in the gaps
5.	Gap filling in chilli seedlings	12.8.2005	7.8.2006	Seedlings are transplanted in the gaps
6.	Basal dose of fertilizer application	22.8.2005	21.8.2006	Fertilizer level of 50:50:50 kg ha^{-1} N, P_2O_5 and K_2O in the form of urea, SSP and muriate of potash were applied as basal dose
7.	Intercultivation I II III	27.8.2005 17.9.2005 5.10.2005	29.8.2006 23.9.2006 6.10.2006	With bullock drawn blade hoe
8.	Weeding I II	30.8.2005 24.9.2005	1.9.2006 26.9.2006	Hand weeding
9.	Top dressing of nitrogen fertilizer I II	8.10.2005 18.9.2005	10.10.2006 20.9.2006	Remaining 50 per cent (50 kg) of nitrogen was equally applied as top dressing at 30 and 40 DAT
10.	Top dressing of nitrogenous fertilizer to barrier crops	13.9.2005	13.9.2006	In the form of Urea.
11.	Harvest of barrier crops Maize Sorghum	15.11.2005 12.12.2005	19.11.2006 10.12.2006	Harvested when maize grains dried and sorghum was matured
12.	Harvest of chilli crop I picking II picking III picking	23.1.2006 30.1.2006 14.2.2006	26.12.2006 3.1.2007 24.1.2007	Hand picking, the fruits were dried in partial shade for 4-5 days and weighed and stored
13.	Observations on growth and entomological parameters I observation 30 DAT II observation 60 DAT III observation 90 DAT IV observation at last picking	28.8.2005 30.9.2005 1.11.2005 20.1.2006	21.8.2006 23.9.2006 28.10.2006 24.12.2006	Detailed procedure adopted furnished in Table 7

Table 5. Details of the cultural practices carried out in Experiment II

Sl. No.	Cultural operations	Year 2005-06	2006-07	Methodology
1.	Nursery bed preparation	12.6.2005	19.6.2006	In raised beds
2.	Date of transplanting	21.7.2005	20.7.2006	Two healthy seedlings per hill at 60 cm x 60 cm spacing
3.	Sowing of intercrops (coriander and garlic)	24.7.2005	21.7.2006 (garlic) 27.7.2006 (coriander)	Seeds were sown by making lines between the two chilli rows for coriander, and for garlic the bulbs were planted between the two chilli rows.
4.	Gap filling in intercrops	4.8.2005	6.8.2006	Seeds were sown in the gaps for coriander and garlic bulbs were planted between the two chilli rows.
5.	Thinning of coriander	15.8.2005	30.8.2006	
6.	Intercultivation I	31.8.2005	26.8.2006	With bullock drawn blade hoe
7.	Weeding in the experimental block			
	I	4.9.2005	11.8.2006	Hand weeding
	II	30.9.2005	3.9.2006	
	III	10.10.2005	6.10.2006	
8.	Date of basal fertilizer application	5.8.2005	3.8.2006	Fertilizers were applied as per treatments.
9.	Top dressing of nitrogenous fertilizer	16.9.2005	3.9.2006	As per the treatment.
10.	Harvesting of intercrops			
	Coriander	12.11.2005	11.10.2006	At crop maturity
	Garlic	15.11.2005	10.10.2006	
11.	Harvest of chilli crop			Hand picking, the fruits were dried in partial shade for 4-5 days and weighed and stored.
	I picking	26.1.2006	6.1.2007	
	II picking	3.2.2006	16.1.2007	
	III picking	13.2.2006	24.1.2007	
12.	Observation on growth and entomological parameters			
	I observation (30 DAT)	30.8.2005	24.8.2006	Detailed procedure adopted furnished in Table 7
	II observation (60 DAT)	01.10.2005	24.9.2006	
	III observation (90 DAT)	30.11.2005	21.10.2006	
	IV observation at last picking	24.1.2006	5.1.2007	

Table 6. Details of the cultural practices carried out in Experiment III

Sl. No.	Cultural operations	Year		Methodology
		2005-06	2006-07	
1.	Date of nursery bed preparation	13.6.2005	19.6.2006	In raised beds
2.	Date of transplanting	22.7.2005	20.7.2006	Two healthy seedlings per hill at 60 cm x 60 cm spacing
3.	Date of gap filling	30.7.2005	10.8.2006	Seedlings are transplanted in the gaps
4.	Intercultivation I II III	27.8.2005 17.9.2005 8.10.2005	17.8.2006 25.8.2006 3.9.2006	With bullock drawn blade hoe
5.	Weeding I II	31.8.2005 13.8.2005	26.8.2006 30.7.2006	Hand weeding
6.	Fertilizer application	13.8.2005	30.7.2006	Fertilizers were applied as per treatments.
7.	Vermicompost and neem cake application	12.8.2005	31.7.2006	As per the treatment and applied as basal at the time of transplanting
8.	Harvesting I picking II picking III picking	8.2.2006 16.2.2006 20.2.2006	28.12.2006 15.1.2007 26.1.2007	Hand picking, the fruits are dried in partial shade for 4-5 days and weighed and stored
9.	Observation on growth parameters First observation (30 DAT) Second observation (60 DAT) Third observation (90 DAT) Fourth observation (last picking)	 3.9.2005 4.10.2005 6.11.2005 6.2.2006	 22.8.2006 23.9.2006 22.10.2006 24.12.2006	Detailed procedure adopted furnished in Table 7
10.	Entomological observations I observation Before spray After 1 week of first spray	 12.8.2005 18.8.2005	 13.8.2006 22.8.2006	Detailed procedure adopted furnished in Table 7
	II observation Before spray After 1 week of second spray	 26.8.2005 8.9.2005	 28.8.2006 7.9.2006	Detailed procedure adopted furnished in Table 7
	III observation Before spray After 1 week after third spray	 16.9.2005 23.9.2005	 25.9.2006 22.9.2006	Detailed procedure adopted furnished in Table 7
	IV observation Before spray After one week after fourth spray	 1.10.2005 8.9.2005	 7.9.2006 15.10.2006	Detailed procedure adopted furnished in Table 7
	V observation Before spray After 1 week of fifth spray	 17.10.2005 26.10.2005	 15.10.2006 24.10.2006	Detailed procedure adopted furnished in Table 7

Table 7. Procedure followed for recording biometric observations

Sl. No.	Parameters	Procedure followed
Growth parameters of chilli		
1.	Plant height (cm)	The plant height of randomly selected five plants were recorded from the base of the plant to the tip of the growing point at 30, 60 and 90 DAT and at final picking
2.	Secondary branches	Total number of secondary branches per hill were counted in randomly selected five plants at 30, 60, 90 DAT and last picking.
3.	Leaf area (cm^2 $hill^{-1}$)	Leaf area was measured at 30, 60 and 90 DAT and at harvest by disc method and was expressed in (cm^2 $hill^{-1}$). Fifty discs of known size were taken through cork borer from randomly selected leaves of two hills, which were uprooted to record dry matter accumulation. Both discs and remaining leaf blade was oven dried at 65℃ and leaf area was calculated by using the formula: $$LA = \frac{W_a \times A}{W_d}$$ Where, LA= Leaf area per hill (cm^2) W_a= Oven dry weight of all leaves (inclusive of 50 discs) in grams A= area of 50 discs in cm^2 W_d =Oven dry weight of 50 discs in grams.
4.	Dry matter production (g $hill^{-1}$)	The oven dry weight (drying at 65^0C to constant weight) of different plant parts were recorded by partitioning of whole plant in to stem, leaf and fruits at different crop growth stages (30, 60, 90 DAT and at final picking). The sum of mean dry weight of all the plant parts represents the total dry matter per hill and was expressed in grams.
Yield attributes and yield of chilli		
5.	Number of fruits per hill	The fruits obtained from the selected five plants at 60 and 90 DAT and at last picking were counted and averaged.

6.	Fruit length (cm)	Length of the fruit from base to the tip was measured.
7.	100-fruit weight (g) (Sun dried)	Weight of 100 fruits randomly selected from net plot was taken, and expressed in grams.
8.	1000-seed weight (g)	Weight of 1000 seeds selected from fruits of the net plot was taken
9.	Seed : pod ratio	The seeds, pericarp and placenta separated from randomly selected fruits were weighed separately and ratio was calculated.
10.	Fruit yield (kg ha^{-1})	The fruits harvested from net plot were dried in partial shade before recording fruit weight, fruit yield per hectare was computed.
11	Chilli equivalent yield (kg ha^{-1})	It was calculated as the product of crop yield and price of standard crop. Chilli was taken as a standard crop for calculating chilli equivalent yield. $\text{Chilli equivalent yield} = \frac{\text{Crop yield per ha X Price of crop}}{\text{Price of standard crop (Chilli)}}$
Entomological observations		
11.	Population of mites and thrips in chilli (no. $leaf^{-1}$)	The population of mites and thrips on chilli were recorded on the top 3 leaves of the 5 tagged (selected) plants and the average was used to indicate the population of thrips and mites $leaf^{-1}$ and the numbers of leaves were calculated for each plant to obtain the population per plant.
12.	Population density of predators in chilli and intercrops (no. $plant^{-1}$)	The predators' population on 5 randomly selected plants in the chilli and intercrops were recorded and average number of predators per plant was calculated.
13.	Population density of predators in barrier crops (no. $plant^{-1}$)	The predators' populations on 5 randomly selected plants in the barrier crops were recorded and average number of predators per plant was calculated.
14.	Leaf curl index (LCI) (0-4 scale)	The leaf curl index was recorded by visual ratings on five randomly selected plants in each plot. The ratings were recorded on terminal leaves (no curling=0, low curling=1(1 to 25% curling), moderate curling=2 (26 to 50% curling), heavy curling=3 (51 to 75% curling), and very high curling=4(>75% curling)). The ratings were pooled and an overall rating was worked out.

3.10.1 Correlation studies

Correlation studies were made between yield and yield attributing characters, growth parameters, quality parameters and entomological parameters as per procedure outlined by Gomez and Gomez (1984).

3.10.2 Economic analysis

Based on the current price of inputs used and the produce obtained during both the years, the net profit per ha and benefit: cost (B: C) ratio were worked out using the following formula.

$$\text{Net profit (Rs. ha}^{-1}) = \text{Gross income (Rs. ha}^{-1}) - \text{Cost of cultivation (Rs. ha}^{-1})$$

$$\text{Benefit: cost ratio} = \frac{\text{Gross return (Rs. ha}^{-1})}{\text{Cost of cultivation (Rs. ha}^{-1})}$$

4. EXPERIMENTAL RESULTS

The experiments conducted at Agricultural Research Station, Devihosur, Haveri, University of Agricultural Sciences, Dharwad during growing seasons of 2005-06 and 2006-07 are presented in this chapter. The pooled results were highlighted, as the trend remained more or less uniform.

4.1 EXPERIMENT I: EFFECT OF BARRIER CROPPING ON THE PERFORMANCE OF CHILLI AND INCIDENCE OF LEAF CURL

4.1.1 Growth parameters

4.1.1.1 Plant height (cm)

Plant height in chilli varied significantly due to number of rows of barrier crops, barrier species and their interaction (Table 9 and 10). In general, plants under leeward side of the barriers were taller than plants on the windward side.

As the number of rows of barrier crops increased beyond three rows, plant height increased significantly. At all stages, plant height with nine rows of barrier was the highest particularly on the leeward side compared to crop on the windward side (35.6 cm, 61.3 cm, 79.8 cm and 82.9 cm in the leeward side and 34.3 cm, 59.1 cm, 77.2 cm and 80.7 cm in the windward side at 30, 60, 90 DAT and at final picking, respectively). However, differences in plant height between six and nine rows were non-significant.

Among barrier species also plant height on the leeward side always remained higher. Chilli with fodder sorghum as a barrier crop recorded significantly taller plants (35.8 cm, 60.2 cm, 79.2 cm, 84.1 cm in the leeward side and 35.5 cm and 58.3 cm, 78.5 cm and 81.4 cm in the windward side and at 30, 60, 90 DAT and at final picking, respectively) followed by grain sorghum barrier species. While, chilli with fodder maize as a barrier crop recorded lower plant height (31.1 cm, 56.2 cm, 72.1 cm and 76.3 cm in the leeward side and 29.4 cm, 53.0 cm, 72.1 cm and 74.8 cm in the windward side at 30, 60, 90 DAT and at final picking, respectively). The trend remained same throughout the growth and the differences widened as the plant growth progressed.

Among treatment combinations chilli plant with fodder sorghum in nine rows (R_3B_3) recorded significantly taller plants at all stages of crop growth (37.9 cm, 64.0 cm, 83.8 cm and 87.9 cm in the leeward side and 37.9 cm, 61.7 cm, 82.8 cm and 85.0 cm in the windward side at 30, 60 and 90 DAT and at final picking, respectively), while plant height with three rows of fodder maize (R_1B_4) was lower than the values with other treatment combinations (28.9 cm, 51.4 cm, 67.2 cm and 71.0 cm at 30, 60 and 90 DAT and at final picking, respectively).

However, the differences among treatment combinations were marginal and often there were no clear cut and significant indications. Nevertheless, plant height of chilli under barriers was significantly higher compared to chilli without barrier crops (22.4 cm, 30.3 cm, 37.9 cm and 45.5 cm at 30, 60 and 90 DAT and at final picking on the leeward side, respectively).

4.1.1.2 Number of secondary branches plant^{-1}

The variations in number of secondary branches as influenced by barrier intensity (number of rows), barrier species and their interactions were significant (Table 11 and 12). The leeward side plants produced more number of secondary branches compared to the windward side.

Under intense rows of barriers (nine rows) the numbers of branches per plant in chilli were maximum (3.9, 7.3, 9.5 and 12.0 in the leeward side, 3.6, 6.9, 9.1 and 11.5 in windward side at 30, 60 and 90 DAT and at final picking, respectively). As the number of rows decreased the secondary branches per plant decreased recording the lowest value with minimum (three) number of rows (2.9, 6.3, 7.9 and 9.8 in the leeward side, and 2.7, 5.8, 7.5 and 9.1 in the windward side at 30, 60 and 90 DAT and at final picking, respectively). However, the differences in number of secondary branches per plant between six and nine rows except in leeward side at 30 DAT were non-significant.

Table 9. Plant height (cm) at 30 and 60 Days after transplanting (DAT) as influenced by number of rows of barrier and barrier species

Treatments	30 DAT						60 DAT					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	29.7^{b}	30.3^{b}	30.0^{b}	31.4^{b}	31.2^{b}	31.3^{b}	57.4^{b}	44.4^{b}	50.9^{b}	59.5^{b}	45.2^{b}	52.3^{b}
R_2:6 rows	33.7^{ab}	32.5^{ab}	33.1^{a}	34.9^{a}	33.1^{ab}	34.0^{a}	65.3^{a}	47.6^{ab}	56.5^{a}	67.8^{a}	49.4^{a}	58.6^{a}
R_3:9 rows	34.5^{a}	34.2^{a}	34.3^{a}	35.8^{a}	35.4^{a}	35.6^{a}	67.3^{a}	50.8^{a}	59.1^{a}	70.8^{a}	51.7^{a}	61.3^{a}
SEm+/-	1.37	0.91	0.82	1.18	1.15	0.82	1.70	1.12	1.02	1.67	1.21	1.02
C.D.at 5%	4.01	2.68	2.35	3.45	3.39	2.35	4.99	3.29	2.90	4.89	3.54	2.93
Barrier species												
B_1: GS	33.2^{ab}	32.9^{ab}	33.0^{ab}	36.3^{a}	32.8^{ab}	34.6^{ab}	66.4^{a}	48.9^{ab}	57.7^{a}	67.0^{ab}	48.7^{ab}	57.8^{ab}
B_2: GM	32.1^{ab}	31.8^{bc}	32.0^{bc}	32.6^{ab}	33.3^{ab}	32.9^{bc}	60.7^{ab}	45.1^{b}	52.9^{b}	62.9^{b}	46.9^{b}	54.9^{b}
B_3: FS	35.5^{a}	35.4^{a}	35.5^{a}	35.7^{a}	36.0^{a}	35.8^{a}	66.4^{a}	50.1^{a}	58.3^{a}	69.0^{a}	51.4^{a}	60.2^{a}
B_4: FM	29.6^{b}	29.2^{c}	29.4^{c}	31.4^{b}	30.8^{b}	31.1^{c}	59.8^{b}	46.2^{ab}	53.0^{b}	64.3^{ab}	48.1^{ab}	56.2^{b}
S.Em±	1.58	1.05	0.95	1.36	1.33	0.95	1.97	1.29	1.18	1.93	1.39	1.19
C.D.at 5%	4.64	3.09	2.71	3.98	3.91	2.71	5.77	3.80	3.35	5.65	4.09	3.39
Interaction												
R_1B_1	30.2^{ab}	31.1^{bcd}	30.6^{cd}	34.4^{abc}	31.6^{ab}	33.0^{a-d}	59.4^{bc}	45.8^{bcd}	52.6^{bc}	60.6^{bcd}	45.7^{bc}	53.1^{cde}
R_1B_2	28.9^{ab}	30.9^{bcd}	29.9^{cd}	29.4^{bc}	31.0^{ab}	30.2^{cd}	55.0^{c}	42.2^{d}	48.6^{c}	55.3^{d}	43.7^{c}	49.5^{e}
R_1B_3	32.4^{ab}	32.1^{bcd}	32.3^{bcd}	32.8^{abc}	33.3^{ab}	33.1^{a-d}	61.3^{abc}	46.3^{a-d}	53.8^{bc}	64.7^{a-d}	46.5^{bc}	55.6^{b-e}
R_1B_4	27.4^{b}	26.8^{d}	27.1^{d}	28.8^{c}	29.0^{b}	28.9^{d}	54.0^{c}	43.1^{cd}	48.6^{c}	58.0^{cd}	44.8^{bc}	51.4^{de}
R_2B_1	34.6^{ab}	33.0^{abc}	33.8^{abc}	36.8^{ab}	31.6^{ab}	34.2^{abc}	68.0^{ab}	48.9^{a-d}	58.5^{ab}	69.0^{abc}	49.1^{abc}	59.1^{abc}
R_2B_2	33.1^{ab}	32.0^{bcd}	32.6^{bc}	34.1^{abc}	33.3^{ab}	33.7^{a-d}	63.0^{abc}	45.7^{bcd}	54.4^{bc}	64.0^{a-d}	47.4^{abc}	55.7^{b-e}
R_2B_3	36.8^{a}	35.6^{ab}	36.2^{ab}	36.4^{abc}	36.7^{ab}	36.6^{ab}	68.0^{ab}	50.5^{abc}	59.3^{ab}	71.0^{ab}	52.6^{ab}	61.8^{ab}
R_2B_4	30.1^{ab}	29.3^{cd}	29.7^{cd}	32.1^{abc}	30.9^{ab}	31.5^{bcd}	62.0^{abc}	45.2^{bcd}	53.6^{bc}	67.0^{abc}	48.6^{abc}	57.8^{a-d}
R_3B_1	34.8^{ab}	34.5^{abc}	34.7^{abc}	37.8^{a}	35.2^{ab}	36.5^{ab}	71.8^{a}	52.1^{ab}	62.0^{a}	72.0^{a}	51.3^{abc}	61.6^{ab}
R_3B_2	34.4^{ab}	32.5^{bcd}	33.4^{abc}	34.2^{abc}	35.7^{ab}	34.9^{abc}	64.0^{abc}	47.4^{a-d}	55.7^{ab}	69.3^{ab}	49.7^{abc}	59.5^{abc}
R_3B_3	37.4^{a}	38.5^{a}	37.9^{a}	37.8^{a}	38.0^{a}	37.9^{a}	70.0^{ab}	53.4^{a}	61.7^{a}	73.0^{a}	55.0^{a}	64.0^{a}
R_3B_4	31.4^{ab}	31.3^{bcd}	31.4^{bcd}	33.4^{abc}	32.7^{ab}	33.1^{a-d}	63.3^{abc}	50.4^{abc}	56.9^{ab}	68.0^{abc}	51.0^{abc}	59.5^{abc}
S.Em±	2.74	1.83	1.65	0.35	2.31	1.65	3.40	2.24	2.04	3.34	2.42	2.06
C.D. at 5%	8.03	5.35	4.69	6.89	6.77	4.70	9.99	6.58	5.81	9.78	7.08	5.87
Control	24.8	20.1	22.4	24.8	20.1	22.4	28.6	32.0	30.3	28.6	32.0	30.3
S.Em±	2.27	1.78	1.62	2.34	2.25	1.62	3.28	2.39	2.02	3.2	2.50	2.03
C.D. at 5%	7.92	5.19	4.61	6.82	6.57	4.61	9.57	6.96	5.76	9.33	7.28	5.77

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 10. Plant height (cm) at 90 DAT and at final picking as influenced by number of rows of barrier and barrier species

Treatments	90 DAT						At final picking					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	72.2^{b}	68.4^{b}	70.2^{b}	74.5^{b}	67.8^{b}	69.9^{b}	75.0^{b}	72.2^{b}	73.6^{b}	74.5^{b}	74.8^{b}	74.7^{b}
R_2:6 rows	79.6^{a}	71.6^{ab}	74.7^{a}	82.8^{a}	72.0^{a}	77.4^{a}	78.2^{ab}	79.6^{a}	78.9^{a}	82.8^{a}	79.4^{ab}	81.2^{a}
R_3:9 rows	80.7^{a}	74.6^{a}	77.2^{a}	84.5^{a}	75.0^{a}	79.8^{a}	80.6^{a}	80.7^{a}	80.7^{a}	84.5^{a}	81.4^{a}	82.9^{a}
SEm+/-	1.92	1.72	1.32	1.44	1.30	0.98	1.53	1.92	1.23	1.44	1.83	1.16
C.D.at 5%	5.62	5.03	3.76	4.22	3.82	2.79	4.49	5.62	3.50	4.22	5.36	3.31
Barrier species												
B_1: GS	78.7^{ab}	70.8^{ab}	74.9^{ab}	80.5^{b}	73.0^{ab}	75.7^{b}	80.5^{a}	78.7^{ab}	79.6^{a}	80.5^{b}	80.2^{ab}	80.4^{ab}
B_2: GM	74.1^{b}	70.5^{ab}	72.2^{b}	78.4^{b}	70.5^{ab}	73.5^{bc}	75.9^{ab}	74.1^{b}	75.0^{b}	78.4^{b}	76.8^{ab}	77.6^{bc}
B_3: FS	81.8^{a}	75.7^{a}	78.5^{a}	85.9^{a}	74.0^{a}	79.2^{a}	81.0^{a}	81.8^{a}	81.4^{a}	85.9^{a}	81.3^{a}	84.1^{a}
B_4: FM	75.3^{ab}	69.2^{b}	72.1^{b}	77.6^{b}	68.9^{b}	72.1^{c}	74.4^{b}	75.3^{ab}	74.8^{b}	77.6^{b}	74.9^{b}	76.3^{c}
S.Em±	2.21	1.98	1.52	1.66	1.50	1.13	1.77	2.21	1.42	1.66	2.11	1.34
C.D.at 5%	6.49	5.81	4.34	4.87	4.41	3.23	5.19	6.49	4.04	4.87	6.19	3.83
Interaction												
R_1B_1	73.8^{abc}	66.3^{b}	70.1^{cd}	76.4^{cde}	70.9^{abc}	73.5^{cd}	77.0^{abc}	73.8^{abc}	75.4^{bc}	76.4^{cde}	76.0^{ab}	76.2^{cde}
R_1B_2	70.0^{bc}	68.6^{b}	69.3^{cd}	72.8^{de}	66.6^{bc}	69.5^{de}	74.0^{bc}	70.0^{bc}	72.0^{c}	72.8^{de}	73.5^{ab}	73.2^{de}
R_1B_3	76.0^{abc}	71.9^{ab}	73.9^{bcd}	78.6^{cde}	69.3^{bc}	73.6^{cd}	76.7^{abc}	76.0^{abc}	76.4^{bc}	78.6^{cde}	77.9^{ab}	78.3^{cde}
R_1B_4	69.0^{c}	66.8^{b}	67.9^{d}	70.1^{e}	64.3^{c}	67.2^{e}	72.2^{c}	69.0^{c}	70.6^{c}	70.1^{e}	71.9^{b}	71.0^{e}
R_2B_1	80.0^{abc}	71.2^{ab}	75.8^{abc}	82.1^{a-d}	72.8^{abc}	77.4^{bc}	80.3^{abc}	80.0^{abc}	80.2^{ab}	82.1^{a-d}	81.2^{b}	81.2^{abc}
R_2B_2	76.0^{abc}	70.5^{ab}	73.3^{bcd}	80.3^{bcd}	70.7^{abc}	75.4^{cd}	76.7^{abc}	76.0^{abc}	76.4^{bc}	80.3^{bcd}	77.8^{ab}	79.0^{bcd}
R_2B_3	84.5^{a}	74.7^{ab}	79.2^{ab}	88.9^{ab}	74.2^{ab}	81.1^{ab}	81.4^{abc}	84.5^{a}	83.0^{ab}	88.9^{ab}	83.4^{ab}	86.2^{ab}
R_2B_4	78.0^{abc}	70.1^{ab}	74.1^{bcd}	80.2^{bcd}	70.4^{abc}	74.4^{cd}	74.5^{abc}	78.0^{abc}	76.2^{bc}	80.2^{bcd}	75.4^{ab}	77.8^{cde}
R_3B_1	82.4^{ab}	74.9^{ab}	78.6^{ab}	83.0^{abc}	75.3^{ab}	79.1^{abc}	84.2^{ab}	82.4^{ab}	83.3^{ab}	83.0^{abc}	83.4^{ab}	83.2^{abc}
R_3B_2	76.4^{abc}	72.5^{ab}	74.4^{bcd}	82.1^{a-d}	74.3^{ab}	78.2^{bc}	77.0^{abc}	76.4^{abc}	76.7^{bc}	82.1^{a-d}	79.1^{ab}	80.6^{a-d}
R_3B_3	85.0^{a}	80.5^{a}	82.8^{a}	90.1^{a}	78.5^{a}	83.8^{a}	84.9^{a}	85.0^{a}	85.0^{a}	90.1^{a}	85.6^{a}	87.9^{a}
R_3B_4	79.0^{abc}	70.6^{ab}	74.8^{abc}	82.6^{abc}	72.0^{abc}	76.6^{bc}	76.4^{abc}	79.0^{abc}	77.7^{abc}	82.6^{abc}	77.3^{ab}	80.0^{bcd}
S.Em±	3.83	1.98	2.64	2.88	2.60	1.96	3.06	3.83	2.45	2.88	3.65	2.33
C.D. at 5%	11.24	5.81	7.52	8.43	7.63	5.58	8.99	11.24	6.99	8.43	10.70	6.63
Control	37.8	38.0	37.9	37.8	38.0	37.9	46.9	44.0	45.5	46.9	44.0	45.5
S.Em±	3.88	3.55	2.63	2.89	2.72	1.99	3.80	2.96	2.41	2.89	3.51	2.27
C.D. at 5%	11.39	10.4	7.47	8.44	7.94	5.64	11.1	8.64	6.85	8.42	10.23	6.45

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 11. Number of secondary branches at 30 and 60 DAT as influenced by number of rows of barrier and barrier species

Treatments	30 DAT						60 DAT					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	2.6^{b}	2.8^{b}	2.7^{b}	2.8^{b}	3.0^{b}	2.9^{b}	5.5^{b}	6.1^{b}	5.8^{b}	6.1^{b}	6.4^{b}	6.3^{b}
R_2:6 rows	3.5^{a}	3.3^{a}	3.4^{a}	3.7^{a}	3.5^{a}	3.6^{b}	6.7^{a}	6.6^{ab}	6.6^{a}	7.0^{a}	7.1^{a}	7.1^{a}
R_3:9 rows	3.7^{a}	3.5^{a}	3.6^{a}	3.9^{a}	3.8^{a}	3.9^{a}	6.9^{a}	6.9^{a}	6.9^{a}	7.2^{a}	7.4^{a}	7.3^{a}
SEm+/- C.D.at 5%	0.11 0.32	0.16 0.46	0.10 0.27	0.13 0.39	0.11 0.36	0.09 0.25	0.17 0.51	0.21 0.61	0.13 0.38	0.19 0.55	0.16 0.47	0.12 0.35
Barrier species												
B_1: GS	3.2^{bc}	3.3^{ab}	3.2^{ab}	3.5^{ab}	3.5^{b}	3.5^{b}	6.3^{ab}	6.8^{a}	6.6^{ab}	6.6^{b}	7.1^{a}	6.9^{b}
B_2: GM	2.9^{c}	3.0^{b}	3.0^{b}	3.3^{b}	3.3^{bc}	3.3^{b}	6.2^{b}	6.3^{ab}	6.3^{bc}	6.4^{b}	6.7^{ab}	6.5^{b}
B_3: FS	3.4^{ab}	3.7^{a}	3.5^{a}	3.8^{a}	3.9^{a}	3.8^{a}	6.8^{a}	6.9^{a}	6.9^{a}	7.6^{a}	7.6^{bc}	7.6^{a}
B_4: FM	3.6^{a}	2.8^{b}	3.2^{ab}	3.4^{ab}	3.0^{c}	3.2^{b}	6.0^{b}	6.0^{b}	6.0^{c}	6.5^{b}	6.5^{c}	6.5^{b}
S.Em± C.D.at 5%	0.13 0.37	0.18 0.53	0.11 0.31	0.15 0.45	0.13 0.39	0.10 0.29	0.20 0.58	0.24 0.70	0.13 0.38	0.22 0.63	0.18 0.54	0.14 0.40
Interaction												
R_1B_1	2.4^{d}	2.8^{bc}	2.6^{d}	2.8^{cd}	3.1^{cd}	2.9^{de}	5.6^{cde}	6.3^{ab}	6.0^{def}	6.0^{c}	6.4^{cd}	6.2^{cde}
R_1B_2	2.3^{d}	2.6^{c}	2.5^{d}	2.5^{d}	3.0^{cd}	2.8^{e}	5.3^{de}	6.0^{ab}	5.7^{ef}	5.8^{c}	6.2^{cd}	6.0^{de}
R_1B_3	2.7^{cd}	3.3^{abc}	3.0^{cd}	3.1^{bcd}	3.6^{abc}	3.4^{cd}	6.0^{b-e}	6.4^{ab}	6.2^{c-f}	6.8^{abc}	7.0^{abc}	6.9^{bc}
R_1B_4	2.8^{cd}	2.4^{c}	2.6^{d}	2.8^{cd}	2.5^{d}	2.6^{e}	5.2^{e}	5.8^{b}	5.5^{f}	5.8^{c}	5.9^{d}	5.9^{e}
R_2B_1	3.5^{ab}	3.4^{abc}	3.5^{abc}	3.8^{ab}	3.6^{abc}	3.7^{abc}	6.6^{abc}	6.9^{ab}	6.8^{a-d}	6.8^{a-c}	7.2^{abc}	7.0^{bc}
R_2B_2	3.2^{bc}	3.1^{abc}	3.2^{bc}	3.6^{abc}	3.2^{bcd}	3.4^{cd}	6.5^{abc}	6.4^{ab}	6.5^{b-e}	6.6^{c}	6.8^{bcd}	6.7^{bcd}
R_2B_3	3.6^{ab}	3.8^{ab}	3.7^{ab}	4.0^{a}	3.9^{ab}	4.0^{ab}	7.1^{ab}	7.0^{ab}	7.1^{ab}	7.9^{ab}	7.8^{ab}	7.9^{a}
R_2B_4	3.8^{ab}	3.0^{abc}	3.4^{abc}	3.6^{abc}	3.2^{bcd}	3.4^{cd}	6.4^{a-d}	6.1^{ab}	6.3^{b-f}	6.8^{a-c}	6.6^{cd}	6.7^{bcd}
R_3B_1	3.6^{ab}	3.7^{ab}	3.7^{ab}	4.0^{a}	3.9^{ab}	4.0^{ab}	6.8^{ab}	7.3^{a}	7.0^{abc}	6.9^{a-c}	7.8^{ab}	7.4^{ab}
R_3B_2	3.3^{bc}	3.2^{abc}	3.3^{abc}	3.7^{ab}	3.6^{abc}	3.7^{abc}	6.8^{ab}	6.5^{ab}	6.7^{a-d}	6.7^{bc}	7.0^{abc}	6.9^{bc}
R_3B_3	3.8^{ab}	4.0^{a}	3.9^{a}	4.2^{a}	4.3^{a}	4.2^{a}	7.4^{a}	7.4^{a}	7.4^{a}	8.0^{a}	8.0^{a}	8.0^{a}
R_3B_4	4.2^{a}	3.1^{abc}	3.7^{ab}	3.8^{ab}	3.3^{bc}	3.6^{bc}	6.4^{a-d}	6.2^{ab}	6.3^{b-f}	7.0^{abc}	6.9^{bcd}	7.0^{bc}
S.Em± C.D. at 5%	0.22 0.64	0.31 0.91	0.19 0.54	0.27 0.78	0.23 0.67	0.18 0.50	0.35 1.01	0.41 1.21	0.27 0.77	0.37 1.10	0.32 0.94	0.24 0.70
Control	2.1	2.4	2.3	2.1	2.4	2.3	3.6	3.3	3.5	3.6	3.3	3.5
S.Em± C.D. at 5%	0.24 0.79	0.30 0.87	0.19 0.54	0.30 0.88	0.22 0.65	0.18 0.50	0.41 1.2	0.41 1.20	0.28 0.78	0.39 1.13	0.31 0.92	0.25 0.71

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 12. Number of secondary branches at 90 DAT and at final picking as influenced by barrier species and number of rows of barrier

Treatments	90 DAT						At final picking					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	7.1^{b}	8.0^{b}	7.5^{b}	7.7^{b}	8.2^{b}	7.9^{b}	8.4^{b}	9.7^{b}	9.1^{b}	8.9^{b}	10.7^{b}	9.8^{b}
R_2:6 rows	8.7^{a}	9.0^{a}	8.8^{a}	9.1^{a}	9.2^{a}	9.1^{a}	10.5^{a}	11.5^{a}	11.0^{a}	11.2^{a}	11.8^{a}	11.5^{a}
R_3:9 rows	8.8^{a}	9.4^{a}	9.1^{a}	9.2^{a}	9.8^{a}	9.5^{a}	10.8^{b}	12.2^{a}	11.5^{a}	11.4^{a}	12.6	12.0^{a}
SEm+/-	0.23	0.20	0.16	0.25	0.23	0.17	0.27	0.38	0.23	0.27	0.29	0.20
C.D.at 5%	0.66	0.65	0.45	0.74	0.67	0.48	0.80	1.10	0.66	0.80	0.85	0.57
Barrier species												
B_1: GS	8.2^{a}	8.9^{ab}	8.5^{ab}	9.0^{ab}	9.2^{ab}	9.1^{ab}	10.1^{ab}	11.2^{ab}	10.6^{ab}	10.7^{ab}	12.1^{ab}	11.4^{ab}
B_2: GM	8.0^{a}	8.8^{ab}	8.4^{bc}	8.1^{bc}	9.0^{b}	8.6^{bc}	9.5^{b}	10.5^{ab}	10.0^{b}	10.3^{ab}	11.3^{ab}	10.8^{bc}
B_3: FS	8.6^{a}	9.2^{a}	8.9^{a}	9.4^{a}	9.7^{a}	9.5^{a}	10.6^{a}	12.0^{a}	11.3^{a}	11.1^{a}	12.3^{a}	11.7^{a}
B_4: FM	8.0^{a}	8.3^{b}	8.1^{c}	8.0^{c}	8.4^{b}	8.2^{c}	9.3^{b}	10.8^{b}	10.0^{b}	9.90^{b}	11.1^{b}	10.5^{c}
S.Em±	0.26	0.26	0.18	0.29	0.26	0.20	0.31	0.43	0.27	0.32	0.33	0.30
C.D.at 5%	NS	0.75	0.52	0.85	0.77	0.56	0.92	1.27	0.76	0.93	0.98	1.14
Interaction												
R_1B_1	7.0^{c}	7.8^{c}	7.4^{c}	7.9^{bc}	7.9^{de}	7.9^{ef}	8.4^{cde}	9.4^{cd}	8.9^{d}	9.0^{cd}	11.4^{bcd}	10.2^{de}
R_1B_2	6.9^{c}	8.0^{bc}	7.5^{c}	7.1^{c}	8.4^{c-e}	7.8^{ef}	8.2^{de}	9.2^{d}	8.7^{d}	8.6^{d}	10.6^{cd}	9.6^{e}
R_1B_3	7.6^{bc}	8.5^{abc}	8.1^{bc}	8.4^{abc}	8.5^{c-e}	8.5^{def}	9.1^{b-e}	10.3^{bcd}	9.7^{cd}	9.5^{bcd}	10.7^{cd}	10.1^{de}
R_1B_4	6.8^{c}	7.6^{c}	7.2^{c}	7.2^{c}	7.7^{e}	7.5^{f}	8.0^{e}	9.8^{bcd}	8.9^{d}	8.6^{d}	10.2^{d}	9.4^{e}
R_2B_1	8.6^{ab}	9.0^{abc}	8.8^{ab}	9.4^{ab}	9.4^{a-d}	9.4^{a-d}	10.8^{ab}	11.8^{abc}	11.3^{ab}	11.4^{a}	12.1^{a-d}	11.8^{abc}
R_2B_2	8.5^{ab}	8.9^{abc}	8.7^{ab}	8.6^{abc}	9.1^{b-e}	8.8^{abc}	10.0^{a-c}	11.1^{a-d}	10.6^{bc}	11.0^{ab}	11.4^{bcd}	11.2^{bcd}
R_2B_3	9.0^{ab}	9.5^{a}	9.3^{a}	9.8^{a}	9.8^{abc}	9.8^{abc}	11.2^{a}	12.2^{ab}	11.7^{ab}	11.8^{a}	12.4^{abc}	12.1^{abc}
R_2B_4	8.6^{ab}	8.6^{abc}	8.6^{ab}	8.4^{abc}	8.7^{c-e}	8.5^{def}	9.8^{a-d}	11.0^{a-d}	10.4^{bc}	10.4^{abc}	11.4^{bcd}	10.9^{cd}
R_3B_1	8.9^{ab}	9.8^{a}	9.4^{a}	9.6^{a}	10.3^{ab}	10.0^{ab}	11.1^{a}	12.3^{ab}	11.7^{ab}	11.8^{a}	12.8^{ab}	12.3^{ab}
R_3B_2	8.5^{ab}	9.4^{ab}	9.0^{ab}	8.7^{abc}	9.5^{abc}	9.1^{bcd}	10.4^{ab}	11.2^{a-d}	10.8^{bc}	11.2^{ab}	12.0^{a-d}	11.6^{bc}
R_3B_3	9.3^{a}	9.7^{a}	9.5^{a}	9.90^{a}	10.7^{a}	10.3^{a}	11.6^{a}	13.5^{a}	12.6^{a}	12.0^{a}	13.8^{a}	12.9^{a}
R_3B_4	8.5^{ab}	8.7^{abc}	8.6^{ab}	8.6^{abc}	8.8^{c-e}	8.7^{de}	10.0^{a-c}	11.6^{a-d}	10.8^{bc}	10.6^{abc}	11.8^{bcd}	11.2^{bcd}
S.Em±	0.45	0.44	o.32	0.50	0.45	0.33	0.54	0.75	0.46	0.55	0.58	0.40
C.D. at 5%	1.32	1.30	0.90	1.47	1.33	0.94	1.59	2.21	1.32	1.61	1.70	1.14
Control	5.1	4.1	4.6	5.1	4.1	4.6	5.0	5.4	5.2	5.0	5.4	5.2
S.Em±	0.44	0.43	0.31	0.49	0.44	0.33	0.53	0.73	0.45	0.53	0.53	0.39
C.D. at 5%	1.30	1.25	0.88	1.44	1.29	0.94	1.46	2.13	1.28	1.28	1.54	1.10

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among the barrier crops evaluated, fodder sorghum as a barrier recorded significantly more number of secondary branches per plant (3.8, 7.6, 9.5 and 11.7 in the leeward side and 3.5, 6.9, 8.9 and 11.3 in the windward side at 30, 60 and 90 DAT and at final picking, respectively) followed by grain sorghum. However, chilli with fodder maize as barrier crop recorded lower number of secondary branches per plant (3.2, 6.5, 8.2 and 10.5 in the leeward side and 3.2, 6.0, 8.1 and 10.0 in the windward side at 30,60 and 90 DAT and at final picking, respectively). The trend remained same throughout the crop growth period. Unlike fodder barrier species the differences between grain purpose barriers were more or less statistically on par.

The interaction effect revealed that chilli plants with nine rows of fodder sorghum (R_3B_3) recorded significantly higher number of secondary branches per plant at all the stages of plant growth in the leeward side (4.2, 8.0, 10.3 and 12.9 at 30, 60 and 90 DAT and at final picking, respectively) followed by windward side. While, the number of secondary branches per plant with three rows of grain (R_1B_4) and fodder maize (R_1B_2) were lower compared to other treatment combinations. However, the differences among different treatment combinations were not too conspicuous to be highlighted. Irrespective of number of rows of barriers, the number of secondary branches were always higher with fodder species particularly fodder sorghum. The number of secondary branches per plant under barriers was significantly superior to chilli without barrier crops (2.3, 3.5, 4.6 and 5.2 at 30,60 and 90 DAT and at final picking on the leeward side, respectively)

4.1.1.3 Leaf area (cm² hill^{-1}) at peak growth stages (100 DAT)

Leaf area of chilli differed significantly due to number of rows of barrier crops, barrier species evaluated and their interaction (Table 13). Generally, plants in the leeward side recorded higher leaf area compared to the plants in the windward side.

Barrier with maximum number (9) of rows recorded highest leaf area (1692 and 1318 cm² hill^{-1} in the leeward and windward side, respectively). As the number of rows decreased the leaf area per hill decreased recording the lowest with minimum number (3) of rows (1322 and 1077 cm² hill^{-1} in the leeward and windward sides, respectively). However, the differences in leaf area between six and nine rows were non significant in the leeward side.

Among the species used as barriers, chilli with fodder and grain sorghum produced significantly higher leaf area in the leeward side (1762 and 1644 cm² hill^{-1}, respectively) both were at par on the windward side. Chilli with fodder sorghum recorded significantly higher leaf area (1304 cm² hill^{-1}) on the windward side too compared to the rest of the barrier species, which were at par with one another.

Among the treatment combinations, chilli crop with nine rows of fodder sorghum (R_3B_3) recorded significantly higher leaf area (1944 and 1453 cm² hill^{-1} in the leeward and windward side, respectively). However, chilli with nine rows of grain sorghum (1860 and 1356 cm² hill^{-1} in the leeward and windward side, respectively) and fodder sorghum with six rows (1876 and 1307 cm² hill^{-1} in the leeward and windward side, respectively) were on par with the former treatment combinations (R_3xB_3). The leaf area produced by the chilli crop under barriers was significantly higher compared to the chilli crop without barriers (505 cm² hill^{-1}).

4.1.1.4 Dry matter production at final picking (g plant^{-1})

The data recorded significant differences in the dry matter production per plant due to number of rows of barrier crops, barrier species and their interactions (Table 14). The plants under leeward side produced more dry matter compared to the plants on the windward side.

The dry matter production increased significantly as the number of rows were increased from three to nine (44.6 g, 53.4 g and 56.0 g in the leeward and 43.3 g, 52.2 g and 56.7 g in the windward side with three, six and nine rows of barriers, respectively). However, no significant differences were observed between six and nine rows of barriers in the leeward side.

Dry matter production on the leeward side remained higher compared to the windward side even under different barrier species. Chilli with fodder sorghum as a barrier crop on the leeward side recorded significantly higher dry matter production compared to the

Table 13. Leaf area (cm^2 $hill^{-1}$) at peak growth stage (100 DAT) as influenced by number of rows of barrier and barrier species

Treatments	Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops						
R_1:3 rows	1022.5^{c}	1131.8^{ab}	1077.0^{c}	1287.5^{b}	1355.8^{b}	1322.0^{b}
R_2:6 rows	1158.3^{b}	1252.3^{b}	1205.0^{b}	1486.8^{a}	1670.8^{a}	1579.0^{a}
R_3:9 rows	1258.3^{a}	1377.8^{a}	1318.0^{a}	1549.5^{a}	1834.0^{a}	1692.0^{a}
SEm+/- C.D.at 5%	31.3 91.8	40.3 118.2	25.5 72.7	58.6 171.7	57.1 167.5	40.9 116.6
Barrier species						
B_1: GS	1147.3^{ab}	1293.6^{ab}	1220.0^{b}	1470.0^{ab}	1817.7^{a}	1644.0^{a}
B_2: GM	1098.3^{b}	1182.3^{b}	1140.0^{b}	1327.7^{b}	1375.3^{b}	1352.0^{b}
B_3: FS	1235.0^{a}	1372.7^{a}	1304.0^{a}	1621.0^{a}	1902.2^{a}	1762.0^{a}
B_4: FM	1104.7^{b}	1167.3^{b}	1136.0^{b}	1346.3^{b}	1385.3^{b}	1366.0^{b}
S.Em± C.D.at 5%	36.1 106.0	46.6 136.5	29.5 84.0	67.6 198.3	65.9 193.5	47.2 134.6
Interaction						
R_1B_1	1030.0^{cd}	1178.0^{bcd}	1104.0^{de}	1300.0^{abc}	1492.0^{cd}	1396.0^{de}
R_1B_2	968.0^{d}	1083.0^{cd}	1026.0^{e}	1138.0^{c}	1211.0^{d}	1175.0^{e}
R_1B_3	1098.0^{bcd}	1206.0^{bcd}	1152.0^{cde}	1498.0^{abc}	1430.0^{d}	1464.0^{cd}
R_1B_4	994.0^{d}	1060.0^{d}	1027.0^{e}	1214.0^{bc}	1290.0^{d}	1252.0^{de}
R_2B_1	1148.8^{a-d}	1254.0^{bcd}	1201.0^{bcd}	1528.0^{abc}	1822.0^{bc}	1675.0^{bc}
R_2B_2	1114.0^{bcd}	1206.0^{bcd}	1160.0^{cde}	1364.0^{abc}	1450.0^{d}	1407.0^{de}
R_2B_3	1261.0^{ab}	1352.0^{abc}	1307.0^{abc}	1674.0^{a}	2079.0^{ab}	1876.0^{ab}
R_2B_4	1110.0^{bcd}	1197.0^{bcd}	1154.0^{cde}	1381.0^{abc}	1332.0^{d}	1356.0^{de}
R_3B_1	1264.0^{ab}	1449.0^{ab}	1356.0^{ab}	1582.0^{ab}	2139.0^{ab}	1860.0^{ab}
R_3B_2	1213.0^{abc}	1258.0^{bcd}	1236.0^{bcd}	1481.0^{abc}	1465.0^{cd}	1473.0^{cd}
R_3B_3	1346.0^{a}	1560.0^{a}	1453.0^{a}	1691.0^{a}	2198.0^{a}	1944.0^{a}
R_3B_4	1210.0^{abc}	1245.0^{bcd}	1227.0^{bcd}	1444.0^{abc}	1534.0^{cd}	1489.0^{cd}
S.Em± C.D. at 5%	62.6 183.5	80.6 236.5	51.0 145.4	117.1 343.5	114.3 335.1	81.8 233.2
Control	498.0	512.0	505.0	498.0	512.0	505.0
S.Em± C.D. at 5%	60.7 177.1	79.4 231.6	49.9 142.0	113.0 329.8	109.6 320.0	78.7 223.8

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 14. Dry matter production plant^{-1} (g) at final picking as influenced by number of rows of barrier and barrier species

Treatments	Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops						
R_1:3 rows	43.2^{c}	43.4^{b}	43.3^{c}	45.3^{c}	44.0^{b}	44.6^{b}
R_2:6 rows	52.2^{b}	52.3^{a}	52.2^{b}	53.7^{b}	53.1^{a}	53.4^{a}
R_3:9 rows	56.6^{a}	56.7^{a}	56.7^{a}	57.8^{a}	53.9^{a}	56.0^{a}
SEm+/- C.D.at 5%	1.45 4.26	1.76 5.16	1.14 3.30	1.22 3.56	1.71 5.00	1.05 2.99
Barrier species						
B_1: GS	51.1^{abc}	52.8^{ab}	52.0^{ab}	53.7^{ab}	51.0^{ab}	52.4^{b}
B_2: GM	47.0^{c}	48.0^{bc}	47.5^{c}	48.3^{c}	46.9^{b}	47.6^{c}
B_3: FS	55.3^{a}	54.6^{a}	54.6^{a}	57.0^{a}	55.1^{a}	56.0^{a}
B_4: FM	48.6^{bc}	47.9^{bc}	47.9^{bc}	50.4^{bc}	48.3^{b}	49.4^{bc}
S.Em± C.D.at 5%	1.70 4.92	2.03 5.96	1.32 3.76	1.40 4.11	1.97 5.78	1.21 3.45
Interaction						
R_1B_1	46.8^{bc}	42.4^{de}	44.3^{cd}	48.4^{de}	46.2^{abc}	47.3^{de}
R_1B_2	38.6^{c}	40.9^{e}	38.8^{d}	39.4^{f}	38.2^{c}	39.8^{f}
R_1B_3	50.7^{ab}	47.0^{cde}	48.8^{bc}	51.4^{bcd}	50.6^{ab}	51.0^{cd}
R_1B_4	39.3^{c}	43.2^{cde}	41.3^{d}	42.1^{ef}	40.9^{bc}	41.5^{ef}
R_2B_1	52.8^{ab}	54.0^{a-d}	53.4^{ab}	54.6^{a-d}	52.5^{a}	53.6^{a-d}
R_2B_2	49.3^{ab}	52.5^{a-e}	50.9^{b}	50.1^{cd}	51.0^{ab}	50.5^{cd}
R_2B_3	56.4^{a}	53.9^{a-d}	55.2^{ab}	58.8^{ab}	57.2^{a}	58.0^{ab}
R_2B_4	50.1^{ab}	48.9^{b-e}	49.5^{bc}	51.4^{bcd}	57.7^{ab}	54.5^{bcd}
R_3B_1	56.4^{a}	62.0^{a}	59.2^{a}	58.1^{abc}	54.3^{a}	56.2^{abc}
R_3B_2	54.8^{a}	54.8^{abc}	54.8^{ab}	55.3^{a-d}	51.5^{ab}	53.4^{a-d}
R_3B_3	58.9^{a}	60.5^{ab}	59.7^{a}	60.7^{a}	57.6^{a}	59.1^{a}
R_3B_4	56.4^{a}	49.5^{b-e}	53.0^{ab}	57.8^{abc}	52.3^{a}	55.0^{abc}
S.Em± C.D. at 5%	2.91 8.53	3.52 10.32	2.28 6.51	2.43 7.13	3.42 10.0	2.10 5.97
Control	26.4	28.8	27.6	26.4	28.8	27.6
S.Em± C.D. at 5%	2.88 8.40	3.47 10.1	2.25 6.41	2.41 7.04	3.43 10.0	2.10 5.96

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

rest of the barrier species (56.0 g), however in the windward side no significant differences were observed between fodder and grain sorghum (54.6 g and 52.0 g, respectively).

Among the interaction treatments, nine rows of fodder sorghum (R_3B_3) recorded significantly higher dry matter production (59.1 g in the leeward and 59.7 g in the windward sides, respectively). However, it was on par with nine rows of barrier species and six rows of fodder and grain sorghum barrier crops. While, three rows of either fodder or grain maize resulted in lower dry matter production (41.5 g and 38.8 g in the leeward side and 41.3 g and 39.8 g in the windward side, respectively). The dry matter production of chilli with barriers was significantly higher compared to chilli without barrier crops (27.6 g).

4.1.2 Yield parameters and yield

4.1.2.1 Number of matured fruits per hill

The variations in number of matured fruits per hill as influenced by barrier intensity (number of rows), barrier species and their interactions were significant (Table 15).

The number of matured fruits per hill increased significantly with increase in the number of rows of barrier (44 and 47 fruits per hill in the leeward side and 45 and 47 fruits per hill in the windward with six and nine rows of barriers, respectively), while the number of fruits was minimum with barrier strip having three rows.

Among various species of barriers evaluated, chilli with fodder sorghum recorded significantly higher number of matured fruits per plant (47.0 and 49.0 fruits $hill^{-1}$ in the leeward and windward sides, respectively) followed by the barrier of grain sorghum, the differences between the two were non-significant on the leeward side. Chilli with fodder or grain maize recorded lower number of matured fruits per hill (38.0 and 41.0 in the leeward and 39.0 and 41.0 in the windward sides, respectively both being on par).

Among the interaction treatments, chilli with fodder sorghum in nine rows (R_3B_3) recorded significantly higher number of matured fruits per hill (51.0 and 53.0 fruits $hill^{-1}$ in the leeward and windward sides, respectively) compared to the rest of the treatment combinations except grain sorghum with nine rows (49.0 and 48.0 fruits $hill^{-1}$ in leeward and windward sides, respectively) and fodder sorghum with six rows (48.0 and 50.0 fruits $hill^{-1}$ in leeward and windward sides, respectively). The number of fruits with barrier crops, however, was higher than without barriers (22.0 fruits $hill^{-1}$).

4.1.2.2 Fruit length (cm)

Effects due to number of rows and species of barriers and their interactions were significant with regard to fruit length of chilli (Table 15).

Under intense rows (9) of barriers fruit length was maximum (12.2 cm in the leeward and 11.9 cm in the windward side). As the number of rows of barriers decreased the fruit length also decreased, recording lowest with minimum number (3) of rows (11.3 cm in the leeward and 11.1 cm in the windward side). However, the differences between six and nine rows were not significant.

Chilli with fodder sorghum as a barrier recorded significantly higher fruit length (12.4 cm and 12.0 cm in the leeward and windward sides, respectively) followed by grain sorghum, chilli with fodder maize as a barrier recorded lower fruit length (11.3 cm in the leeward and 11.2 cm in the windward side) and fruit length with grain maize was comparable.

Among the treatment combinations, chilli with fodder sorghum in nine rows (R_3B_3) and six rows (R_2B_3) recorded significantly higher fruit length (12.7 cm and 12.7 cm in the leeward and 12.4 cm and 12.2 cm in the windward side, respectively), while fruit length with three rows of fodder maize (R_1B_4) as a barrier was lower (11.0 cm and 10.8 cm in leeward and windward sides, respectively). However, the differences among treatment combinations were not too conspicuous to be highlighted. Irrespective of number of rows of barrier, the fruit length was always higher with fodder sorghum. Nevertheless, fruit length of chilli under barriers was significantly higher compared to chilli without barrier crops (9.2 cm).

Table 15. Number of matured fruits per hill and fruit length (cm) as influenced by number of rows of barrier and barrier species

Treatments	Number of matured fruits per hill						Fruit length (cm)					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R$_1$:3 rows	34.7^{b}	40.0^{b}	37.0^{b}	36.8^{b}	40.1^{b}	38.0^{c}	10.7^{b}	11.5^{b}	11.1^{b}	10.9^{b}	11.7^{b}	11.3^{b}
R$_2$:6 rows	42.9^{a}	46.0^{a}	45.0^{a}	44.0^{a}	43.8^{ab}	44.0^{b}	11.3^{a}	12.1^{a}	11.7^{a}	11.9^{a}	12.3^{a}	12.1^{a}
R$_3$:9 rows	46.4^{b}	48.0^{a}	47.0^{a}	47.2^{a}	45.8^{a}	47.0^{a}	11.6^{a}	12.3^{a}	11.9^{a}	12.1^{a}	12.4^{a}	12.2^{a}
SEm+/- C.D.at 5%	1.22 3.57	1.88 5.51	1.12 3.19	1.27 3.71	1.40 4.10	0.90 2.70	0.28 0.83	0.19 0.54	0.17 0.48	0.28 0.83	0.20 0.58	0.17 0.49
Barrier species												
B$_1$: GS	42.3^{b}	46.7^{ab}	45.0^{b}	43.9^{ab}	46.9^{a}	45.0^{a}	11.3^{a}	12.1^{ab}	11.7^{ab}	11.9^{ab}	12.3^{ab}	12.1^{ab}
B$_2$: GM	37.5^{c}	42.0^{bc}	40.0^{c}	39.9^{bc}	41.9^{bc}	41.0^{b}	11.0^{a}	11.7^{b}	11.4^{b}	11.4^{ab}	11.9^{b}	11.7^{bc}
B$_3$: FS	46.9^{a}	50.0^{a}	49.0^{a}	48.1^{a}	46.3^{ab}	47.0^{a}	11.6^{a}	12.4^{a}	12.0^{a}	12.2^{a}	12.6^{a}	12.4^{a}
B$_4$: FM	38.5^{bc}	40.0^{c}	39.0^{c}	38.7^{c}	37.9^{c}	38.0^{b}	10.8^{a}	11.6^{b}	11.2^{b}	10.9^{b}	11.7^{b}	11.3^{c}
S.Em± C.D.at 5%	1.40 3.57	2.17 6.36	1.29 3.68	1.46 4.29	1.60 4.80	1.10 3.10	0.32 NS	0.21 0.63	0.19 0.55	0.33 0.96	0.23 0.66	0.20 0.57
Interaction												
R$_1$B$_1$	35.9^{de}	42.0^{a-d}	39.0	38.2^{cd}	45.0^{a-d}	42.0^{de}	10.8^{a}	11.7^{abc}	11.30^{abc}	11.0^{ab}	11.9^{ab}	11.5^{bcd}
R$_1$B$_2$	30.5^{e}	38.0^{cd}	34.0	32.8^{d}	38.0^{cd}	35.0f	10.6^{a}	11.4^{bc}	11.0^{bc}	10.6^{b}	11.6^{ab}	11.1^{d}
R$_1$B$_3$	40.5^{bcd}	44.0^{a-d}	42.0	42.8^{bc}	41.0^{a-d}	42.0^{de}	11.0^{a}	11.8^{abc}	11.4^{abc}	11.4^{ab}	12.0^{ab}	11.7^{a-d}
R$_1$B$_4$	31.8^{e}	36.0^{d}	34.0	33.4^{d}	36.0^{d}	35.0f	10.4^{a}	11.2^{c}	10.8^{c}	10.6^{b}	11.4^{b}	11.0^{d}
R$_2$B$_1$	44.3^{bc}	48.0^{a-d}	46.0	45.4^{abc}	46.0^{abc}	46.0^{a-d}	11.4^{a}	12.2^{abc}	11.8^{abc}	12.2^{ab}	12.4^{ab}	12.3^{abc}
R$_2$B$_2$	39.6^{cd}	43.0^{a-d}	41.0	42.4^{bc}	43.0^{a-d}	43.0^{cde}	11.0^{a}	11.8^{abc}	11.4^{abc}	11.7^{ab}	12.1^{ab}	11.9^{a-d}
R$_2$B$_3$	47.8^{ab}	52.0^{ab}	50.0	48.6^{ab}	48.0^{ab}	48.0^{abc}	11.8^{a}	12.6^{ab}	12.2^{a}	12.6^{a}	12.8^{a}	12.7^{a}
R$_2$B$_4$	39.9^{bcd}	41.0^{bcd}	40.0	39.4^{cd}	38.0^{cd}	39.0^{ef}	11.0^{a}	11.6^{abc}	11.3^{abc}	11.0^{ab}	12.1^{ab}	11.4^{cd}
R$_3$B$_1$	46.7^{abc}	50.0^{abc}	48.0	48.1^{ab}	49.0^{ab}	49.0^{ab}	11.8^{a}	12.4^{abc}	12.1^{ab}	12.6^{a}	12.6^{ab}	12.6^{ab}
R$_3$B$_2$	42.5^{bcd}	45.0^{a-d}	44.0	44.6^{abc}	44.0^{a-d}	44.0^{b-e}	11.4^{a}	12.0^{abc}	11.7^{abc}	12.0^{ab}	12.1^{ab}	12.1^{a-d}
R$_3$B$_3$	52.4^{a}	54.0^{a}	53.0	52.8^{a}	50.0^{a}	51.0^{a}	12.0^{a}	12.8^{a}	12.4^{a}	12.6^{a}	12.9^{a}	12.7^{a}
R$_3$B$_4$	43.8^{bcd}	43.0^{a-d}	43.0	43.4^{bc}	40.0^{bcd}	42.0^{de}	11.0^{a}	12.0^{abc}	11.5^{abc}	11.2^{ab}	12.0^{ab}	11.6^{a-d}
S.Em± C.D. at 5%	2.43 7.13	3.80 11.0	2.24 6.38	2.53 7.42	2.80 8.20	1.90 5.40	0.06 NS	0.37 1.09	0.34 0.96	0.57 1.66	0.39 1.15	0.34 0.98
Control	20.0	23.0	22.0	20.0	23.0	22.0	9.40	9.00	9.2	9.4	9.0	9.2
S.Em± C.D. at 5%	2.47 7.20	3.80 11.1	2.3 6.4	2.51 7.3	2.80 8.1	1.9 5.3	0.50 1.67	0.35 1.00	0.34 0.95	0.56 1.64	0.38 1.11	0.34 0.96

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

4.1.2.3 100-fruit weight (g)

Barrier row intensity and barrier species and their interactions had significant influence on 100-fruit weight of the crop (Table 16). The leeward side plants had higher 100-fruit weight compared to the windward side.

As the row intensity of barriers increased beyond three rows the fruit weight increased significantly recording highest fruit weight with nine rows followed by six rows, both were on par (125.0 g and 121.0 g with nine and six rows in the leeward side and 120.0 g and 117.0 g with nine and six rows in the windward side, respectively).

Among the species used as barriers, sorghum both fodder and grain type recorded higher fruit weight (123.0 g and 125.0 g in the leeward side and 121.0 g and 117.0 g in the windward side, respectively), while maize as a barrier had lower 100-fruit weight and the differences between grain and fodder were non-significant.

The interaction effects indicated higher fruit weight with nine rows of grain sorghum (R_3B_1) as a barrier (132.0 g) followed by others, however no clear cut trend could be made out. The lowest 100-fruit weight was recorded with three rows of fodder maize as a barrier (109.0 g). Nevertheless, fruit weight of chilli under barriers was significantly higher compared to chilli without barrier crops (76.8 g).

4.1.2.4 1000-seed weight (g)

The differences in 1000-seed weight as influenced by barrier intensity (number of rows) barrier species and their interactions were significant (Table 16). In general, plants under leeward side of the barrier recorded higher seed weight compared to the windward side.

Under intense rows (9) of barriers, the 1000-seed weight of chilli was maximum (7.4 g in the leeward side and 7.5 g in the windward side) closely followed by six rows of barrier and the barrier with nine rows was significantly superior to barrier with three rows (6.6 g in the leeward side and 6.5 g in the windward side).

Among the barrier species, chilli grown with fodder sorghum as a barrier crop recorded significantly higher seed weight (7.5 g) followed by grain sorghum (7.2 g), however chilli with fodder maize as a barrier crop recorded lower seed weight (6.7 g). Unlike the fodder barrier species, the differences between grain purposes were more or less statistically on par.

The interaction effect revealed significantly higher seed weight with nine rows of barrier species particularly with fodder sorghum (R_3B_3) (7.8 g and 7.9 g in the leeward and windward sides, respectively) compared to rest of the treatment combinations except chilli with six rows of fodder and grain sorghum (7.7 g and 7.4 g in the leeward side and 7.8 and 7.4 g in the windward sides, respectively). The 1000-seed weight with three rows irrespective of barrier species recorded lower seed weight. In general, chilli plants grown with barrier crops recorded higher seed weight compared to chilli without barrier crops (5.2 g).

4.1.2.5 Seed to pod ratio

Data revealed significant differences in seed to pod ratio due to number of rows of barrier crops, barrier species and their interactions (Table 17). In general, plants under leeward side of the barriers had higher seed to pod ratio compared to the plants on the windward side.

Under intense rows (9) of barriers, the seed to pod ratio of chilli was maximum (37.7 and 36.8 in the leeward and windward sides, respectively). As the number of rows decreased the seed to pod ratio decreased with the lowest in the three rows of barrier (32.8 and 31.1 with leeward and windward sides, respectively).

Among the barrier species, in the leeward side, chilli with fodder and grain sorghum as a barrier resulted in significantly higher seed to pod ratio (36.8 and 36.7, respectively) compared to chilli with both grain and fodder types. But in the windward side chilli with fodder sorghum as a barrier recorded significantly higher seed to pod ratio (37.4) compared to the rest of the barrier species.

Table 16. 100-fruit weight (g) and 1000-seed weight (g) as influenced by number of rows of barrier and barrier species

Treatments	100-fruit weight (g)						1000-seed weight (g)					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	101.8^{b}	111.2^{b}	107.0^{b}	108.5^{b}	118.0^{b}	113.0^{b}	6.50^{b}	6.50^{b}	6.50^{b}	6.60^{b}	6.70^{b}	6.60^{b}
R_2:6 rows	113.0^{a}	120.2^{a}	117.0^{a}	117.2^{a}	124.3^{ab}	121.0^{a}	7.20^{ab}	7.20^{ab}	7.20^{ab}	7.10^{ab}	7.40^{a}	7.30^{a}
R_3:9 rows	118.0^{a}	122.8^{a}	120.0^{a}	121.5^{a}	128.8^{a}	125.0^{a}	7.30^{b}	7.50^{a}	7.40^{a}	7.30^{a}	7.60^{a}	7.50^{a}
SEm+/-	2.00	2.38	1.55	2.27	2.54	1.70	0.24	0.16	0.14	0.18	0.15	0.12
C.D.at 5%	5.87	6.97	4.38	6.65	7.40	4.80	0.71	0.46	0.41	0.54	0.44	0.34
Barrier species												
B_1: GS	114.0^{ab}	120.0^{ab}	117.0^{a}	119.3^{ab}	129.7^{a}	125.0^{a}	7.0^{ab}	7.3^{a}	7.2^{ab}	7.1^{ab}	7.4^{a}	7.2^{ab}
B_2: GM	107.7^{bc}	114.8^{b}	111.0^{b}	112.6^{bc}	122.0^{ab}	117.0^{b}	6.6^{ab}	7.0^{ab}	6.8^{bc}	6.9^{b}	7.1^{ab}	7.0^{b}
B_3: FS	117.3^{a}	124.2^{a}	121.0^{a}	121.7^{a}	124.7^{ab}	123.0^{a}	7.6^{a}	7.3^{a}	7.5^{a}	7.4^{b}	7.6^{a}	7.5^{a}
B_4: FM	104.7^{c}	113.1^{b}	109.0^{b}	109.3^{c}	119.4^{b}	114.0^{b}	6.7^{b}	6.7^{b}	6.7^{c}	6.7^{b}	6.8^{b}	6.7^{b}
S.Em±	2.31	2.74	1.79	2.62	2.93	1.96	0.28	0.18	0.17	0.20	0.17	0.14
C.D.at 5%	6.78	8.05	5.06	7.67	8.60	5.54	0.82	0.54	0.47	0.63	0.51	0.39
Interaction												
R_1B_1	103.0^{efg}	112.0^{ab}	108.0^{efg}	110.0^{bcd}	121.0^{b}	116.0^{b-e}	6.7^{ab}	6.5^{cd}	6.6^{bcd}	6.6^{ab}	6.8^{bcd}	6.7^{cde}
R_1B_2	100.0^{fg}	107.0^{b}	104.0^{fg}	106.0^{cd}	116.0^{b}	111.0^{de}	6.2^{b}	6.2^{b}	6.2^{cd}	6.4^{ab}	6.6^{cd}	6.5^{de}
R_1B_3	108.0^{c-g}	119.7^{ab}	114.0^{cde}	116.0^{a-d}	120.0^{b}	118.0^{b-e}	7.0^{ab}	7.0^{ab}	7.0^{bcd}	7.0^{ab}	7.0^{a-d}	7.0^{b-e}
R_1B_4	96.0^{g}	106.0^{b}	101.0^{g}	102.0^{d}	115.0^{b}	109.0^{e}	6.2^{b}	6.2^{b}	6.2^{d}	6.3^{b}	6.4^{d}	6.3^{e}
R_2B_1	117.0^{a-d}	121.7^{ab}	119.0^{a-d}	122.0^{ab}	130.0^{ab}	126.0^{abc}	7.4^{ab}	7.4^{ab}	7.4^{ab}	7.2^{ab}	7.6^{abc}	7.4^{abc}
R_2B_2	109.0^{b-g}	118.3^{ab}	114.0^{cde}	114.0^{a-d}	121.0^{b}	117.0^{b-e}	6.9^{ab}	6.9^{ab}	6.9^{bcd}	7.0^{ab}	7.2^{a-d}	7.1^{a-d}
R_2B_3	120.0^{abc}	125.0^{a}	123.0^{abc}	123.0^{ab}	126.0^{ab}	125.0^{abc}	7.8^{a}	7.8^{a}	7.8^{aab}	7.5^{ab}	7.8^{ab}	7.7^{ab}
R_2B_4	106.0^{d-g}	115.7^{ab}	111.0^{def}	110.0^{bcd}	120.0^{b}	115.0^{cde}	6.9^{ab}	6.9^{ab}	6.9^{bcd}	6.8^{ab}	6.9^{bcd}	6.8^{cde}
R_3B_1	122.0^{ab}	126.3^{a}	124.0^{ab}	126.0^{a}	138.0^{a}	132.0^{a}	7.5^{ab}	7.5^{ab}	7.5^{ab}	7.4^{ab}	7.8^{ab}	7.6^{ab}
R_3B_2	114.0^{a-e}	119.0^{ab}	117.0^{a-e}	118.0^{abc}	126.0^{ab}	122.0^{a-d}	6.8^{ab}	6.8^{ab}	6.8^{abc}	7.3^{ab}	7.5^{abc}	7.4^{abc}
R_3B_3	124.0^{a}	128.0^{a}	126.0^{a}	126.0^{a}	128.0^{ab}	127.0^{ab}	7.9^{a}	7.9^{a}	7.9^{a}	7.6^{a}	8.0^{a}	7.8^{a}
R_3B_4	112.0^{a-f}	117.7^{ab}	115.0^{b-e}	116.0^{a-d}	123.0^{ab}	120.0^{b-e}	7.0^{ab}	7.0^{ab}	7.0^{a-d}	6.9^{ab}	7.2^{a-d}	7.1^{a-d}
S.Em±	4.00	4.75	3.10	4.53	5.08	3.40	0.49	0.49	0.29	0.37	0.30	0.24
C.D. at 5%	11.74	13.94	8.80	13.29	14.89	9.60	1.43	1.43	0.83	1.08	0.88	0.68
Control	78.0	75.7	76.8	78.0	75.7	76.8	5.1	5.3	5.2	5.1	5.3	5.2
S.Em±	4.27	4.62	3.15	4.7	5.0	3.43	0.47	0.31	0.28	0.37	0.30	0.24
C.D. at 5%	12.46	13.50	8.94	13.8	14.5	9.77	1.38	0.91	0.81	1.07	0.87	0.67

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 17. Seed to pod ratio as influenced by number of rows of barrier and barrier species

Treatments	Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops						
R_1:3 rows	29.1^{b}	33.1^{b}	31.1^{b}	31.5^{b}	34.0^{b}	32.8^{c}
R_2:6 rows	33.9^{a}	36.8^{a}	35.3^{a}	35.8^{a}	36.3^{a}	36.0^{b}
R_3:9 rows	35.4^{a}	38.3^{a}	36.8^{a}	37.4^{a}	38.1^{a}	37.7^{a}
SEm+/- C.D.at 5%	1.25 3.66	0.63 1.85	0.70 1.99	0.83 2.43	0.77 2.26	0.57 1.61
Barrier species						
B_1: GS	32.6^{ab}	36.6^{b}	34.6^{b}	35.4^{ab}	37.9^{a}	36.7^{a}
B_2: GM	31.3^{b}	34.9^{bc}	33.1^{b}	33.3^{b}	34.9^{b}	34.1^{b}
B_3: FS	35.9^{a}	38.9^{a}	37.4^{a}	36.8^{a}	36.9^{ab}	36.8^{a}
B_4: FM	31.4^{b}	33.8^{c}	32.6^{b}	33.9^{ab}	34.8^{b}	34.4^{b}
S.Em± C.D.at 5%	1.44 4.22	0.73 2.14	0.81 2.30	0.96 2.80	0.89 2.61	0.65 1.86
Interaction						
R_1B_1	29.4^{bc}	32.7^{def}	31.0^{def}	31.8^{cd}	35.0^{bc}	33.4^{cd}
R_1B_2	26.8^{c}	31.7^{ef}	29.2^{f}	29.8^{d}	33.7^{c}	31.7^{d}
R_1B_3	31.4^{abc}	36.7^{a-d}	34.0^{cde}	33.6^{bcd}	34.0^{c}	33.8^{bcd}
R_1B_4	28.6^{c}	31.3^{f}	30.0^{ef}	30.9^{cd}	33.3^{c}	32.1^{d}
R_2B_1	33.8^{abc}	37.7^{abc}	35.7^{abc}	36.4^{abc}	38.3^{abc}	37.4^{ab}
R_2B_2	32.4^{abc}	35.7^{b-e}	34.0^{cde}	34.4^{a-d}	34.7^{bc}	34.5^{bcd}
R_2B_3	37.4^{ab}	39.7^{ab}	38.5^{ab}	37.4^{ab}	37.0^{abc}	37.2^{ab}
R_2B_4	32.1^{abc}	34.0^{c-f}	33.1^{c-f}	34.8^{a-d}	35.0^{bc}	34.9^{bcd}
R_3B_1	34.7^{abc}	39.3^{ab}	37.0^{abc}	38.1^{ab}	40.3^{a}	39.2^{a}
R_3B_2	34.6^{abc}	37.3^{abc}	36.0^{abc}	35.8^{abc}	36.3^{abc}	36.1^{abc}
R_3B_3	38.8^{a}	40.3^{a}	39.6^{a}	39.4^{a}	39.7^{ab}	39.5^{a}
R_3B_4	33.4^{abc}	36.0^{bcd}	34.7^{bcd}	36.1^{abc}	36.0^{abc}	36.1^{abc}
S.Em± C.D. at 5%	2.49 7.31	1.26 3.71	1.40 3.98	1.65 4.85	1.54 4.53	1.13 3.23
Control	24.6	23.3	24.0	24.6	23.3	24.0
S.Em± C.D. at 5%	2.47 7.21	1.44 4.21	1.43 4.06	1.68 4.91	1.69 4.93	1.19 3.34

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among the treatment combinations, nine rows of fodder sorghum (R_3B_3) recorded significantly higher seed to pod ratio (39.5 in the leeward and 39.6 in the windward sides) followed by grain sorghum in nine rows and six rows of grain and fodder sorghum. Irrespective of number of rows of barriers the seed to pod ratio always remained higher with fodder species, particularly fodder sorghum. The seed to pod ratio under barriers was significantly higher compared to chilli without barriers (24.0), in general.

4.1.2.6 Dry fruit yield (kg ha^{-1})

Barrier row intensity and barrier species and their interactions had significant influence on the yield of the chilli crop (Table 18). As observed in the growth and yield parameters the general trend remained same. Chilli on the leeward side produced higher yield than the crop on the windward side.

Chilli yield increased significantly as the intensity of the barrier rows increased beyond three rows (1244 and 1189 kg ha^{-1} in the leeward side and 1146 and 1084 kg ha^{-1} in the windward side with nine and six rows of barriers, respectively), the differences between six and nine rows were non-significant.

Among the barrier crops, chilli with fodder and grain sorghum as barriers recorded significantly higher dry fruit yield (1225 and 1255 in the leeward side and 1174 and 1137 kg ha^{-1} in the windward side, respectively) compared to chilli with both grain and fodder types of maize as barrier crops.

The interaction effects revealed significantly higher dry pod yield with nine rows of fodder (R_3B_3) as well on grain sorghum (R_3B_1) (1305 and 1317 kg ha^{-1} in the leeward side and 1238 and 1206 kg ha^{-1} in the windward side, respectively) and the yield with these species with six rows on either side of the barrier and nine rows of grain maize on the windward side were at par. The lower dry chilli yield was recorded with three rows of fodder maize (R_1B_4) as a barrier (1009 and 889 kg ha^{-1} on the leeward and windward sides, respectively), however yield in general was lower with three rows of barrier irrespective of the species (Fig. 5). The chilli yield with barrier crops, however, was higher than without barrier (468 kg ha^{-1}).

4.1.3 Entomological observations

4.1.3.1 Thrips population (number $leaf^{-1}$)

Barrier row intensity and species of barriers and their interactions had significant influence on thrips population (Table 19 and 20). In general, thrips population on the leeward side was lower compared to the population on the windward side.

Among the barrier row intensity, nine rows of barrier recorded minimum thrips population at all the stages of observations (0.67, 0.32, 0.30 and 0.24 in the leeward side and 0.71, 0.42, 0.37 and 0.20 in the windward side at 30, 60 and 90 DAT and at final picking, respectively) and was significantly superior to three rows of barrier (0.93, 0.55, 0.47 and 0.38 in the leeward side and 1.13, 0.60, 0.57 and 0.35 in the windward side at 30, 60 and 90 DAT and at final picking, respectively).

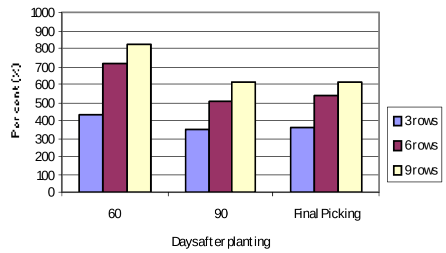
Among the barrier species, thrips populations with fodder and grain sorghum as barriers were the lowest on either side of the barrier and the differences were much conspicuous with advancement of crop age (0.60, 0.34, 0.30 and 0.21 with fodder sorghum and 0.71, 0.33, 0.32 and 0.28 with grain sorghum in the leeward side and 0.71, 0.35, 0.35 and 0.20 with fodder sorghum and 0.85, 0.46, 0.35 and 0.23 with grain sorghum in the windward side at 30, 60 and 90 DAT and at final picking, respectively) (Fig. 6).

Among the treatment combinations, chilli plants with fodder as well as grain sorghum in six and nine rows of barriers resulted in significantly lower thrips population per leaf on the leeward side at all the stages of observation (0.60, 0.30, 0.30 and 0.20 with fodder and 0.67, 0.28, 0.33 and 0.26 with grain sorghum in six rows and 0.53, 0.28, 0.31 and 0.17 with fodder and 0.60, 0.25, 0.30 and 0.20 with grain sorghum with nine rows at 30, 60 and 90 DAT and at final picking, respectively). Trend remained same on the windward side also, however the differences among the treatment combinations were marginal and often overlapping. Maize both fodder as well as grain in general had higher thrips population particularly under minimum (3) number of rows. The population of thrips reduced with increased row intensity on

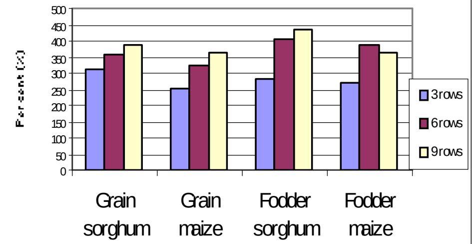
Table 18. Dry fruit yield (kg ha^{-1}) as influenced by number of rows of barrier and barrier species

Treatments	Wind ward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops						
R_1:3 rows	887^{b}	1093^{b}	990^{b}	947^{b}	1210^{b}	1079^{b}
R_2:6 rows	982^{ab}	1187^{a}	1084^{a}	1039^{a}	1339^{a}	1189^{a}
R_3:9 rows	1060^{a}	1232^{a}	1146^{a}	1097^{a}	1391^{a}	1244^{a}
SEm+/- C.D.at 5%	33.3 97.7	31.0 90.9	22.8 64.8	25.1 73.7	31.2 91.5	20.0 57.1
Barrier species						
B_1: GS	1056^{a}	1219^{a}	1137^{a}	1109^{a}	1401^{a}	1255^{a}
B_2: GM	908^{b}	1108^{b}	1008^{b}	983^{b}	1226^{b}	1104^{b}
B_3: FS	1038^{a}	1309^{a}	1174^{a}	1079^{a}	1371^{a}	1225^{a}
B_4: FM	904^{b}	1046^{b}	975^{b}	940^{b}	1257^{b}	1098^{b}
S.Em± C.D.at 5%	38.5 112.8	35.8 105.0	26.3 129.7	29.0 85.1	36.0 105.6	23.1 65.9
Interaction						
R_1B_1	927^{bcd}	1183^{abc}	1055^{cde}	1047^{abc}	1332^{ab}	1190^{bcd}
R_1B_2	867^{cd}	1009^{cd}	938^{ef}	912^{cd}	1104^{c}	1008^{e}
R_1B_3	939^{a-d}	1216^{ab}	1078^{b-e}	962^{bcd}	1255^{abc}	1109^{de}
R_1B_4	815^{d}	962^{d}	889^{f}	868^{d}	1150^{bc}	1009^{e}
R_2B_1	1080^{abc}	1220^{ab}	1150^{abc}	1100^{ab}	1416^{a}	1258^{abc}
R_2B_2	856^{cd}	1100^{bcd}	978^{def}	984^{bcd}	1270^{abc}	1127^{de}
R_2B_3	1062^{abc}	1350^{a}	1206^{ab}	1112^{ab}	1410^{a}	1261^{abc}
R_2B_4	930^{bcd}	1076^{bcd}	1003^{def}	958^{bcd}	1260^{abc}	1109^{de}
R_3B_1	1160^{a}	1252^{ab}	1206^{ab}	1180^{a}	1454^{a}	1317^{a}
R_3B_2	1001^{a-d}	1216^{ab}	1109^{abc}	1052^{abc}	1304^{abc}	1178^{cd}
R_3B_3	1113^{ab}	1362^{a}	1238^{a}	1162^{a}	1447^{a}	1305^{ab}
R_3B_4	967^{a-d}	1099^{bcd}	1033^{cde}	994^{bcd}	1360^{a}	1177^{cd}
S.Em± C.D. at 5%	66.6 195.4	62.0 181.8	45.5 129.7	50.3 147.5	62.4 182.9	40.1 114.2
Control	477	459	468	477	459	468
S.Em± C.D. at 5%	64.8 189.1	59.5 173.8	44.0 125.1	51.2 149.4	59.9 174.9	39.4 112.0

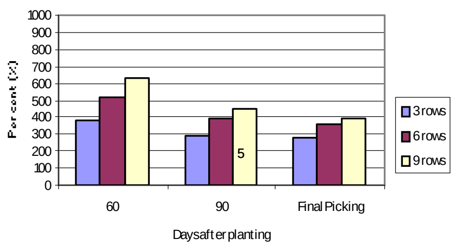
Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)



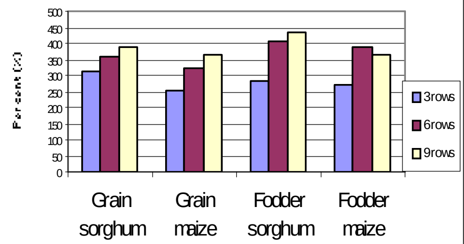
Per cent reduction in LCI with grain sorghum as barrier crop



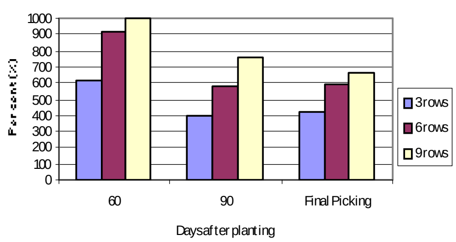
Per cent increase in oleoresin yield with different barrier crops over no barrier



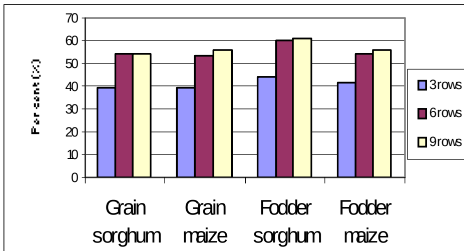
Per cent reduction in LCI with grain maize as barrier crop



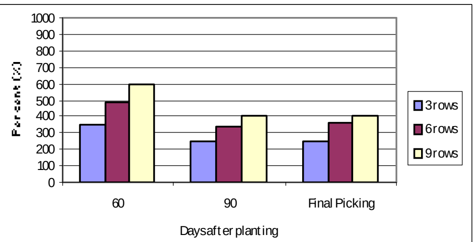
Per cent increase in oleoresin yield with different barrier crops over no barrier



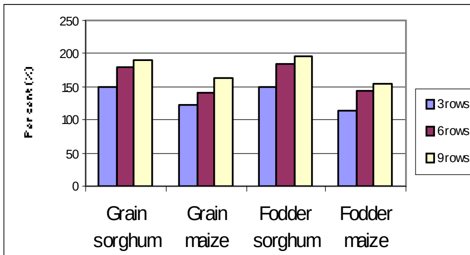
Per cent reduction in LCI with fodder sorghum as barrier crop



Per cent reduction in discoloured fruits with different barrier crops over no barrier



Per cent reduction in LCI with fodder maize as barrier crop



Per cent increase in yield of good quality fruits with different barrier crops over no barrier

Fig 5. Percent reduction in leaf curl induction (LCI) and per cent increase in yield of good quality fruits over control as influenced by number of rows and species of barriers

Table 19. Thrips leaf^{-1} at 30 and 60 DAT as influenced by number of rows of barrier and barrier species

Treatments	30 DAT						60 DAT					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	1.0 (1.41)^{a}	1.25 (1.50)^{a}	1.13 (1.46)^{a}	0.83 (1.35)^{a}	1.05 (1.43)^{a}	0.93 (1.39)^{a}	0.68 (1.30)^{a}	0.50 (1.22)^{a}	0.60 (1.26)^{a}	0.62 (1.27)^{a}	0.47 (1.21)^{a}	0.55 (1.24)^{a}
R_2:6 rows	0.70 (1.30)^{b}	0.93 (1.39)^{b}	0.83 (1.35)^{b}	0.64 (1.28)^{b}	0.84 (1.36)^{b}	0.75 (1.32)^{b}	0.51 (1.23)^{b}	0.42 (1.19)^{b}	0.46 (1.21)^{b}	0.36 (1.17)^{b}	0.35 (1.16)^{b}	0.36 (1.17)^{b}
R_3:9 rows	0.64 (1.28)^{b}	0.80 (1.34)^{b}	0.71 (1.31)^{b}	0.57 (1.25)^{b}	0.77 (1.33)^{b}	0.67 (1.29)^{b}	0.50 (1.22)^{b}	0.36 (1.17)^{b}	0.42 (1.19)^{b}	0.32 (1.15)^{b}	0.32 (1.15)^{b}	0.32 (1.15)^{b}
SEm+/- C.D.at 5%	0.02 0.07	0.02 0.07	0.02 0.05	0.02 0.05	0.02 0.07	0.01 0.04	0.02 0.05	0.02 0.05	0.01 0.03	0.02 0.05	0.01 0.03	0.01 0.03
Barrier species												
B_1: GS	0.77 (1.33)^{ab}	0.90 (1.38)^{bc}	0.85 (1.36)^{bc}	0.64 (1.28)^{b}	0.77 (1.33)^{b}	0.71 (1.31)^{b}	0.57 (1.25)^{a}	0.36 (1.17)^{bc}	0.46 (1.21)^{b}	0.36 (1.17)^{b}	0.29 (1.14)^{c}	0.33 (1.16)^{b}
B_2: GM	0.77 (1.33)^{ab}	1.08 (1.44)^{ab}	0.94 (1.39)^{ab}	0.74 (1.32)^{ab}	1.02 (1.42)^{a}	0.88 (1.37)^{a}	0.62 (1.27)^{ab}	0.53 (1.23)^{a}	0.56 (1.25)^{a}	0.46 (1.21)^{ab}	0.42 (1.19)^{ab}	0.44 (1.20)^{a}
B_3: FS	0.64 (1.28)^{b}	0.80 (1.34)^{b}	0.71 (1.31)^{c}	0.50 (1.22)^{c}	0.71 (1.31)^{b}	0.60 (1.26)^{b}	0.40 (1.18)^{b}	0.30 (1.14)^{ab}	0.35 (1.16)^{c}	0.35 (1.16)^{b}	0.32 (1.15)^{c}	0.34 (1.16)^{b}
B_4: FM	0.88 (1.37)^{a}	1.20 (1.48)^{a}	1.05 (1.43)^{a}	0.80 (1.34)^{a}	1.07 (1.44)^{a}	0.93 (1.39)^{a}	0.67 (1.29)^{a}	0.46 (1.21)^{ab}	0.56 (1.25)^{a}	0.57 (1.25)^{a}	0.46 (1.21)^{a}	0.52 (1.23)^{a}
S.Em± C.D.at 5%	0.03 0.08	0.03 0.08	0.02 0.05	0.02 0.05	0.03 0.08	0.02 0.04	0.02 0.05	0.02 0.05	0.01 0.04	0.02 0.05	0.01 0.03	0.01 0.03
Interaction												
R_1B_1	1.00 (1.41)^{abc}	1.10 (1.45)^{bc}	1.05 (1.43)^{bc}	0.80 (1.34)^{abc}	0.94 (1.39)^{abc}	0.88 (1.37)^{abc}	0.67 (1.29)^{ab}	0.46 (1.21)^{abc}	0.57 (1.25)^{abc}	0.57 (1.25)^{ab}	0.42 (1.19)^{bc}	0.50 (1.22)^{bc}
R_1B_2	1.08 (1.44)^{ab}	1.41 (1.55)^{ab}	1.25 (1.50)^{ab}	0.92 (1.39)^{ab}	1.23 (1.49)^{a}	1.07 (1.44)^{a}	0.74 (1.32)^{ab}	0.60 (1.26)^{a}	0.67 (1.29)^{ab}	0.66 (1.29)^{a}	0.50 (1.22)^{ab}	0.60 (1.26)^{ab}
R_1B_3	0.82 (1.35)$^{a-d}$	0.97 (1.40)^{cd}	0.88 (1.37)^{cde}	0.60 (1.26)$^{c-f}$	0.84 (1.36)^{abc}	0.71 (1.31)$^{b-e}$	0.54 (1.24)$^{a-d}$	0.35 (1.16)^{abc}	0.44 (1.20)^{cde}	0.52 (1.23)^{abc}	0.36 (1.17)^{bcd}	0.44 (1.20)^{c}
R_1B_4	1.10 (1.45)^{a}	1.60 (1.61)^{a}	1.35 (1.53)^{a}	1.00 (1.41)^{a}	1.20 (1.48)^{a}	1.08 (1.44)^{a}	0.80 (1.34)^{a}	0.57 (1.25)^{ab}	0.68 (1.30)^{a}	0.70 (1.30)^{a}	0.56 (1.25)^{a}	0.63 (1.28)^{a}
R_2B_1	0.74 (1.32)$^{a-d}$	0.84 (1.36)^{cd}	0.80 (1.34)$^{c-f}$	0.64 (1.28)$^{c-f}$	0.71 (1.31)^{bc}	0.67 (1.29)^{cde}	0.54 (1.24)$^{a-d}$	0.35 (1.16)^{abc}	0.45 (1.20)^{cde}	0.32 (1.15)^{bcd}	0.24 (1.11)^{de}	0.28 (1.13)^{d}
R_2B_2	0.70 (1.30)$^{a-d}$	1.00 (1.41)^{bcd}	0.85 (1.36)$^{c-f}$	0.70 (1.30)$^{b-e}$	0.97 (1.40)^{abc}	0.83 (1.35)^{bc}	0.58 (1.26)^{abc}	0.50 (1.22)^{abc}	0.53 (1.24)^{abc}	0.40 (1.18)^{bcd}	0.35 (1.16)^{bcd}	0.38 (1.17)^{cd}
R_2B_3	0.60 (1.26)^{cd}	0.73 (1.32)^{cd}	0.67 (1.29)^{ef}	0.46 (1.21)^{ef}	0.71 (1.31)^{bc}	0.60 (1.26)^{de}	0.34 (1.16)^{cd}	0.33 (1.15)^{bc}	0.34 (1.16)^{de}	0.28 (1.13)^{cd}	0.32 (1.15)^{cde}	0.30 (1.14)^{cd}
R_2B_4	0.80 (1.34)$^{a-d}$	1.14 (1.45)^{bc}	0.97 (1.40)^{cd}	0.76 (1.33)$^{a-d}$	1.07 (1.44)^{ab}	0.90 (1.38)^{ab}	0.64 (1.28)^{ab}	0.47 (1.21)^{abc}	0.55 (1.24)^{abc}	0.52 (1.23)^{abc}	0.44 (1.20)^{abc}	0.48 (1.21)^{bc}
R_3B_1	0.64 (1.28)^{cd}	0.80 (1.34)^{cd}	0.72 (1.31)^{def}	0.52 (1.23)^{def}	0.67 (1.29)^{bc}	0.60 (1.26)^{de}	0.50 (1.22)^{bcd}	0.30 (1.14)^{c}	0.40 (1.18)^{cde}	0.28 (1.13)^{cd}	0.22 (1.10)^{e}	0.25 (1.12)^{d}
R_3B_2	0.60 (1.26)^{cd}	0.81 (1.35)^{cd}	0.72 (1.31)^{def}	0.64 (1.28)$^{c-f}$	0.83 (1.35)^{abc}	0.75 (1.32)^{bcd}	0.58 (1.26)^{abc}	0.46 (1.21)^{abc}	0.51 (1.23)$^{a-d}$	0.36 (1.17)^{bcd}	0.36 (1.17)^{bcd}	0.36 (1.17)^{cd}
R_3B_3	0.53 (1.23)^{d}	0.67 (1.29)^{d}	0.60 (1.26)^{f}	0.40 (1.18)^{f}	0.61 (1.27)^{c}	0.53 (1.23)^{e}	0.30 (1.14)^{d}	0.30 (1.14)^{c}	0.30 (1.14)^{e}	0.25 (1.12)^{d}	0.30 (1.14)^{cde}	0.28 (1.13)^{d}
R_3B_4	0.78 (1.33)$^{a-d}$	0.90 (1.38)^{cd}	0.85 (1.36)$^{c-f}$	0.70 (1.30)$^{b-e}$	0.97 (1.40)$^{b-e}$	0.82 (1.35)^{bc}	0.58 (1.26)^{abc}	0.40 (1.18)^{abc}	0.50 (1.22)^{bcd}	0.46 (1.21)$^{a-d}$	0.42 (1.19)^{bc}	0.44 (1.20)^{c}
S.Em± C.D. at 5%	0.05 0.14	0.04 0.13	0.03 0.09	0.03 0.09	0.04 0.13	0.03 0.07	0.03 0.09	0.03 0.09	0.02 0.06	0.03 0.09	0.02 0.05	0.02 0.05
Control	2.30 (1.81)	2.80 (1.95)	2.60 (1.88)	2.30 (1.81)	2.80 (1.95)	2.60 (1.88)	1.70 (1.64)	1.90 (1.70)	1.80 (1.67)	1.70 (1.64)	1.90 (1.70)	1.80 (1.67)
S.Em± C.D. at 5%	0.05 0.14	0.05 0.14	0.34 0.97	0.04 0.10	0.05 0.14	0.03 0.08	0.04 0.11	0.04 0.11	0.03 0.07	0.03 0.09	0.03 0.07	0.02 0.06

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize

IIn a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

Table 20. Thrips leaf^{-1} at 90 DAT and at final picking as influenced by number of rows of barrier and barrier species

Treatments	90 DAT						At final picking					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	0.62 (1.27)[a]	0.52 (1.23)[a]	0.57 (1.25)[a]	0.52 (1.23)[a]	0.40 (1.18)[a]	0.47 (1.21)[a]	0.37 (1.17)[a]	0.33 (1.15)[a]	0.35 (1.16)[a]	0.38 (1.17)[a]	0.38 (1.17)[a]	0.38 (1.17)[a]
R_2:6 rows	0.42 (1.19)[b]	0.40 (1.18)[b]	0.41 (1.19)[b]	0.40 (1.18)[b]	0.32 (1.15)[ab]	0.32 (1.15)[b]	0.25 (1.12)[b]	0.26 (1.12)[ab]	0.26 (1.12)[b]	0.28 (1.13)[ab]	0.27 (1.13)[b]	0.28 (1.13)[b]
R_3:9 rows	0.40 (1.18)[b]	0.34 (1.16)[b]	0.37 (1.17)[b]	0.38 (1.17)[b]	0.31 (1.14)[b]	0.30 (1.14)[b]	0.20 (1.10)[b]	0.20 (1.10)[b]	0.20 (1.10)[b]	0.23 (1.11)[b]	0.25 (1.12)[b]	0.24 (1.11)[b]
SEm+/-	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
C.D.at 5%	0.05	0.05	0.03	0.05	0.04	0.03	0.03	0.04	0.03	0.05	0.04	0.03
Barrier species												
B_1: GS	0.36 (1.17)[b]	0.33 (1.15)[b]	0.35 (1.16)[c]	0.34 (1.16)[b]	0.31 (1.14)[ab]	0.32 (1.15)[b]	0.23 (1.11)[b]	0.22 (1.10)[b]	0.23 (1.11)[bc]	0.29 (1.14)[b]	0.28 (1.13)[ab]	0.28 (1.13)[bc]
B_2: GM	0.50 (1.22)[b]	0.46 (1.21)[a]	0.50 (1.22)[b]	0.44 (1.20)[ab]	0.36 (1.17)[ab]	0.42 (1.19)[a]	0.30 (1.14)[ab]	0.32 (1.15)[a]	0.31 (1.14)[ab]	0.44 (1.20)[ab]	0.32 (1.15)[a]	0.38 (1.17)[ab]
B_3: FS	0.34 (1.16)[b]	0.33 (1.15)[b]	0.35 (1.16)[c]	0.32 (1.15)[b]	0.27 (1.13)[b]	0.30 (1.14)[b]	0.23 (1.11)[b]	0.17 (1.08)[b]	0.20 (1.10)[c]	0.22 (1.10)[b]	0.21 (1.10)[b]	0.21 (1.10)[c]
B_4: FM	0.67 (1.29)[a]	0.56 (1.25)[a]	0.62 (1.27)[a]	0.56 (1.25)[a]	0.40 (1.18)[a]	0.50 (1.22)[a]	0.35 (1.16)[a]	0.33 (1.15)[a]	0.34 (1.16)[a]	0.56 (1.25)[a]	0.38 (1.17)[a]	0.47 (1.21)[a]
S.Em±	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.02	0.02	0.01
C.D.at 5%	0.06	0.05	0.04	0.05	0.04	0.03	0.03	0.04	0.03	0.05	0.04	0.05
Interaction												
R_1B_1	0.47 (1.21)[bc]	0.34 (1.16)[bcd]	0.42 (1.19)[d]e	0.42 (1.19)[bc]	0.34 (1.16)[ab]	0.39 (1.18)[bcd]	0.30 (1.14)[bcd]	0.28 (1.13)[abc]	0.30 (1.14)[bcd]	0.32 (1.15)[abc]	0.34 (1.16)[ab]	0.33 (1.15)[bc]
R_1B_2	0.72 (1.31)[ab]	0.60 (1.26)[ab]	0.66 (1.29)[ab]	0.62 (1.27)[ab]	0.40 (1.18)[ab]	0.52 (1.23)[ab]	0.40 (1.18)[ab]	0.34 (1.16)[ab]	0.36 (1.17)[ab]	0.42 (1.19)[ab]	0.38 (1.17)[ab]	0.40 (1.18)[ab]
R_1B_3	0.40 (1.18)[c]	0.38 (1.17)[bcd]	0.40 (1.18)[de]	0.38 (1.17)[bc]	0.32 (1.15)[ab]	0.35 (1.16)[cd]	0.28 (1.13)[bcd]	0.23 (1.11)[abc]	0.26 (1.12)[bcd]	0.28 (1.13)[abc]	0.30 (1.14)[ab]	0.29 (1.13)[bcd]
R_1B_4	0.84 (1.36)[a]	0.72 (1.31)[a]	0.77 (1.33)[a]	0.68 (1.30)[a]	0.50 (1.22)[a]	0.58 (1.26)[a]	0.48 (1.22)[a]	0.40 (1.18)[a]	0.45 (1.20)[a]	0.46 (1.21)[a]	0.46 (1.21)[a]	0.46 (1.21)[a]
R_2B_1	0.34 (1.16)[c]	0.31 (1.14)[cd]	0.32 (1.15)[d]e	0.34 (1.16)[c]	0.33 (1.15)[ab]	0.33 (1.15)[d]	0.23 (1.11)[cd]	0.19 (1.09)[bc]	0.20 (1.10)[cd]	0.23 (1.11)[abc]	0.28 (1.13)[abc]	0.26 (1.12)[bcd]
R_2B_2	0.42 (1.19)[c]	0.44 (1.20)[bcd]	0.43 (1.20)[cde]	0.40 (1.18)[bc]	0.34 (1.16)[ab]	0.36 (1.17)[cd]	0.26 (1.12)[cd]	0.33 (1.15)[ab]	0.30 (1.14)[bcd]	0.28 (1.13)[abc]	0.32 (1.15)[ab]	0.30 (1.14)[bc]
R_2B_3	0.34 (1.16)[c]	0.33 (1.15)[cd]	0.33 (1.15)[de]	0.31 (1.14)[c]	0.27 (1.13)[ab]	0.30 (1.14)[d]	0.23 (1.11)[cd]	0.17 (1.08)[bc]	0.19 (1.09)[cd]	0.20 (1.10)[bc]	0.20 (1.10)[bc]	0.20 (1.10)[cd]
R_2B_4	0.62 (1.27)[abc]	0.55 (1.24)[abc]	0.58 (1.26)[bc]	0.54 (1.24)[abc]	0.38 (1.17)[ab]	0.47 (1.21)[abc]	0.32 (1.15)[bc]	0.31 (1.14)[abc]	0.32 (1.15)[abc]	0.36 (1.17)[abc]	0.34 (1.16)[ab]	0.35 (1.16)[abc]
R_3B_1	0.32 (1.15)[c]	0.29 (1.13)[d]	0.30 (1.14)e	0.32 (1.15)[c]	0.27 (1.13)[ab]	0.30 (1.14)[d]	0.17 (1.08)[d]	0.17 (1.08)[bc]	0.17 (1.08)[d]	0.17 (1.08)[c]	0.25 (1.12)[bc]	0.20 (1.10)[cd]
R_3B_2	0.36 (1.17)[c]	0.38 (1.17)[bcd]	0.37 (1.17)[d]e	0.34 (1.16)[c]	0.34 (1.16)[ab]	0.34 (1.16)[cd]	0.23 (1.11)[cd]	0.27 (1.13)[abc]	0.26 (1.12)[bcd]	0.23 (1.11)[abc]	0.30 (1.14)[abc]	0.27 (1.13)[bcd]
R_3B_3	0.32 (1.15)[c]	0.30 (1.14)[cd]	0.32 (1.15)[d]e	0.31 (1.14)[c]	0.31 (1.14)[c]	0.31 (1.14)[d]	0.20 (1.10)[cd]	0.13 (1.06)[c]	0.17 (1.08)[d]	0.20 (1.10)[bc]	0.13 (1.06)[c]	0.17 (1.08)[d]
R_3B_4	0.54 (1.24)[bc]	0.44 (1.20)[bcd]	0.50 (1.22)[abc]	0.50 (1.22)[abc]	0.50 (1.22)[abc]	0.50 (1.22)[abc]	0.26 (1.12)[cd]	0.27 (1.13)[abc]	0.27 (1.13)[bcd]	0.34 (1.16)[abc]	0.30 (1.14)[abc]	0.32 (1.15)[a]
S.Em±	0.04	0.03	0.02	0.03	0.03	0.02	0.02	0.03	0.02	0.03	0.03	0.02
C.D. at 5%	0.11	0.09	0.06	0.09	0.08	0.05	0.05	0.08	0.05	0.09	0.08	0.05
Control	2.00 (1.73)	2.30 (1.82)	2.20 (1.78)	2.00 (1.73)	2.30 (1.82)	2.20 (1.79)	1.10 (1.44)	1.40 (1.54)	1.25 (1.49)	1.10 (1.44)	1.40 (1.54)	1.25 (1.49)
S.Em±	0.04	0.03	0.03	0.04	0.03	0.02	0.03	0.03	0.02	0.04	0.03	0.02
C.D. at 5%	0.12	0.09	0.07	0.11	0.08	0.06	0.09	0.09	0.06	0.11	0.09	0.06

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

the windward side. At all the stages of plant growth thrips population under barrier system was significantly lower compared to the chilli crop without barrier crop (2.60, 1.80, 2.20 and 1.25 per leaf at 30, 60 and 90 DAT and at final picking, respectively).

4.1.3.2 Mites population (number leaf^{-1})

Data revealed significant differences in the mites population due to number of rows of barriers, barrier species and their interaction (Table 21 and 22). In general, mites population under leeward side was lower compared to population on the windward side.

Among the barrier strips, nine rows of barrier strip recorded the minimum mites population at all the stages of observation (0.16, 0.20 and 0.26 in the leeward side and 0.20, 0.28 and 0.32 in the windward side at 60 and 90 DAT and at final picking, respectively) and was significantly superior to three rows of barrier strip (0.30, 0.34 and 0.42 in the leeward side and 0.33, 0.40 and 0.47 in the windward side at 30, 60 and 90 DAT and at final picking, respectively).

Among the barrier species, mites populations with fodder and grain sorghum as barrier were the lowest on either side of the barrier and the differences were minimum with the advancement of crop age (0.16, 0.22 and 0.21 with fodder sorghum 0.19, 0.20 and 0.26 with grain sorghum in the leeward side and 0.16, 0.28 and 0.31 with fodder sorghum and 0.23, 0.28 and 0.31 with grain sorghum in the windward side at 60 and 90 DAT and at final picking, respectively).

Among the treatment combinations, chilli plants with fodder as well as grain sorghum in six or nine rows of barrier resulted in significantly lower mites population per leaf on the leeward side at all stages of crop growth (0.15, 0.20 and 0.18 with fodder and 0.18, 0.20 and 0.20 with grain sorghums with six rows and 0.15, 0.18 and 0.15 with fodder and 0.15, 0.18 and 0.18 with grain sorghums with nine rows at 60 and 90 DAT and at final picking, respectively). Trend remained same on the windward side also, however the differences among the treatment combinations were marginal and often overlapping. Maize both fodder as well as grain in general had higher mites population particularly with narrower barrier width (3 rows) (Fig. 6). At all the stages of plant growth mites population under barrier system was significantly lower compared to the chilli crop without barrier crops (1.30, 1.40 and 1.40 leaf^{-1} at 60 and 90 DAT and at final picking, respectively).

4.1.3.3 Predator population in chilli

4.1.3.3.1 Coccinellids population (number plant^{-1})

Data revealed significant differences in the coccinellid population due to number of rows of barriers crops, barrier species and their interaction (Table 23 and 24). Plant under leeward side recorded greater population of coccinellids than the plants in the windward side.

With the maximum number of rows in the barrier (9), coccinellids population on either side of the barrier at all the stages of chilli was the highest (0.85, 0.93, 1.25 and 0.83 in the leeward side and 0.69, 0.73, 1.07 and 0.67 in the windward side at 30, 60 and 90 DAT and at final picking, respectively). However, no significant differences in coccinellids population were observed between six and nine rows of barriers.

Among the species of barriers evaluated, chilli with fodder and grain maize recorded significantly higher populations of coccinellids on either side of the maize barriers (0.97, 0.97, 1.23 and 0.60 with fodder maize 0.90, 0.88, 1.20 and 0.57 with grain maize in the leeward side and 0.80, 0.78, 0.97 and 0.45 with fodder maize and 0.60, 0.70, 0.90 and 0.45 with grain maize in the windward side at 30,60, 90 DAT and at final picking, respectively) than under sorghum barriers. However, in the leeward side at 90 DAT the differences among the barriers were not significant. Further, at final picking the trend changed completely and highest coccinellid population was observed with fodder and grain sorghum, which differed significantly over the population observed in maize.

The perusal of the interaction effects revealed higher coccinellids population with nine rows of fodder maize (R_3B_4) and six rows of grain maize (R_2B_2) and fodder maize (R_2B_4) were on par with the former treatment combination (R_3B_4) upto 60 DAT (1.08, 0.95 and 1.03 in the leeward side and 1.00, 0.66 and 0.80 in the windward side at 30 DAT and 1.13, 0.93 and 1.07

Table 21. Mites leaf^{-1} at 60 DAT and 90 DAT as influenced by number of rows of barrier and barrier species

Treatments	60 DAT						90 DAT					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	0.36 (1.17)^{a}	0.30 (1.14)^{a}	0.33 (1.15)^{a}	0.33 (1.15)^{a}	0.28 (1.13)^{a}	0.30 (1.14)^{a}	0.40 (1.18)^{a}	0.40 (1.18)^{a}	0.40 (1.18)^{a}	0.34 (1.16)^{a}	0.34 (1.16)^{a}	0.34 (1.16)^{a}
R_2:6 rows	0.25 (1.12)^{b}	0.20 (1.10)^{b}	0.23 (1.11)^{b}	0.23 (1.11)^{b}	0.18 (1.09)^{b}	0.20 (1.10)^{b}	0.28 (1.13)^{b}	0.30 (1.14)^{b}	0.29 (1.14)^{b}	0.23 (1.11)^{b}	0.23 (1.11)^{b}	0.23 (1.11)^{b}
R_3:9 rows	0.23 (1.11)^{b}	0.17 (1.08)^{b}	0.20 (1.10)^{b}	0.20 (1.10)^{b}	0.15 (1.07)^{b}	0.16 (1.08)^{c}	0.26 (1.12)^{b}	0.29 (1.13)^{b}	0.28 (1.13)^{b}	0.20 (1.10)^{b}	0.18 (1.09)^{b}	0.20 (1.10)^{b}
SEm+/- C.D.at 5%	0.02 0.05	0.01 0.04	0.01 0.04	0.01 0.03	0.01 0.03	0.01 0.02	0.01 0.03	0.01 0.03	0.01 0.02	0.01 0.04	0.01 0.03	0.01 0.02
Barrier species												
B_1: GS	0.25 (1.12)^{ab}	0.20 (1.10)^{ab}	0.23 (1.11)^{bc}	0.20 (1.10)^{b}	0.18 (1.09)^{ab}	0.19 (1.09)^{bc}	0.28 (1.13)^{bc}	0.28 (1.13)^{b}	0.28 (1.13)^{b}	0.20 (1.10)^{b}	0.20 (1.10)^{b}	0.20 (1.10)^{b}
B_2: GM	0.33 (1.15)^{ab}	0.27 (1.13)^{a}	0.30 (1.14)^{ab}	0.26 (1.12)^{ab}	0.23 (1.11)^{a}	0.25 (1.12)^{ab}	0.34 (1.16)^{ab}	0.34 (1.16)^{ab}	0.34 (1.16)^{a}	0.26 (1.12)^{ab}	0.28 (1.13)^{ab}	0.27 (1.13)^{a}
B_3: FS	0.20 (1.10)^{b}	0.13 (1.06)^{b}	0.16 (1.08)^{c}	0.20 (1.10)^{b}	0.12 (1.06)^{b}	0.16 (1.08)^{c}	0.26 (1.12)^{c}	0.30 (1.14)^{ab}	0.28 (1.13)^{b}	0.20 (1.10)^{b}	0.23 (1.11)^{ab}	0.22 (1.11)^{b}
B_4: FM	0.37 (1.17)^{a}	0.26 (1.12)^{a}	0.32 (1.15)^{a}	0.30 (1.14)^{a}	0.26 (1.12)^{a}	0.28 (1.13)^{a}	0.37 (1.17)^{a}	0.37 (1.17)^{a}	0.37 (1.17)^{a}	0.30 (1.14)^{a}	0.30 (1.14)^{a}	0.30 (1.14)^{a}
S.Em± C.D.at 5%	0.02 0.09	0.02 0.04	0.01 0.04	0.01 0.03	0.01 0.03	0.01 0.02	0.01 0.03	0.01 0.03	0.01 0.03	0.01 0.03	0.01 0.03	0.01 0.02
Interaction												
R_1B_1	0.34 (1.16)^{ab}	0.28 (1.13)^{ab}	0.30 (1.14)^{ab}	0.30 (1.14)^{ab}	0.26 (1.12)^{abc}	0.28 (1.13)^{bc}	0.36 (1.17)^{abc}	0.34 (1.16)^{ab}	0.35 (1.16)^{bc}	0.32 (1.15)^{abc}	0.28 (1.13)^{ab}	0.30 (1.14)^{b}
R_1B_2	0.42 (1.19)^{a}	0.38 (1.17)^{a}	0.40 (1.18)^{a}	0.34 (1.16)^{ab}	0.33 (1.15)^{ab}	0.34 (1.16)^{ab}	0.42 (1.19)^{ab}	0.40 (1.18)^{ab}	0.41 (1.19)^{ab}	0.40 (1.18)^{ab}	0.37 (1.17)^{a}	0.39 (1.18)^{a}
R_1B_3	0.25 (1.12)^{ab}	0.18 (1.09)^{abc}	0.20 (1.10)^{bc}	0.28 (1.13)^{abc}	0.15 (1.07)^{cd}	0.20 (1.10)^{cd}	0.32 (1.15)^{bc}	0.34 (1.16)^{ab}	0.33 (1.15)^{bc}	0.28 (1.13)^{abc}	0.30 (1.14)^{ab}	0.29 (1.14)^{b}
R_1B_4	0.45 (1.20)^{a}	0.34 (1.16)^{a}	0.40 (1.18)^{a}	0.34 (1.16)^{a}	0.38 (1.17)^{a}	0.35 (1.16)^{a}	0.43 (1.20)^{a}	0.40 (1.18)^{a}	0.42 (1.19)^{a}	0.43 (1.20)^{a}	0.37 (1.17)^{a}	0.40 (1.18)^{a}
R_2B_1	0.20 (1.10)^{ab}	0.20 (1.10)^{abc}	0.20 (1.10)^{bc}	0.20 (1.10)^{abc}	0.15 (1.07)^{cd}	0.18 (1.09)^{cd}	0.26 (1.12)^{cd}	0.26 (1.12)^{b}	0.26 (1.12)^{cd}	0.23 (1.11)^{bc}	0.18 (1.09)^{b}	0.20 (1.10)^{bc}
R_2B_2	0.30 (1.14)^{ab}	0.26 (1.12)^{abc}	0.28 (1.13)^{abc}	0.26 (1.12)^{abc}	0.20 (1.10)^{bcd}	0.23 (1.11)^{cd}	0.32 (1.15)^{bcd}	0.33 (1.15)^{ab}	0.33 (1.15)^{cd}	0.28 (1.13)^{abc}	0.26 (1.12)^{ab}	0.27 (1.13)^{bc}
R_2B_3	0.20 (1.10)^{ab}	0.13 (1.06)^{bc}	0.17 (1.08)^{bc}	0.18 (1.09)^{bc}	0.12 (1.06)^{cd}	0.15 (1.07)^{d}	0.23 (1.11)^{cd}	0.28 (1.13)^{b}	0.26 (1.12)^{cd}	0.20 (1.10)^{bc}	0.20 (1.10)^{b}	0.20 (1.10)^{bc}
R_2B_4	0.34 (1.16)^{ab}	0.27 (1.13)^{ab}	0.30 (1.14)^{ab}	0.30 (1.14)^{ab}	0.24 (1.11)^{bcd}	0.27 (1.13)^{bc}	0.32 (1.15)^{bcd}	0.34 (1.16)^{ab}	0.33 (1.15)^{cd}	0.28 (1.13)^{abc}	0.26 (1.12)^{ab}	0.27 (1.13)^{bc}
R_3B_1	0.20 (1.10)^{ab}	0.15 (1.07)^{bc}	0.18 (1.09)^{bc}	0.15 (1.07)^{c}	0.15 (1.07)^{cd}	0.15 (1.07)^{d}	0.23 (1.11)^{cd}	0.26 (1.12)^{b}	0.25 (1.11)^{d}	0.20 (1.10)^{bc}	0.16 (1.08)^{b}	0.18 (1.09)^{c}
R_3B_2	0.25 (1.12)^{ab}	0.20 (1.10)^{abc}	0.23 (1.11)^{abc}	0.20 (1.10)^{abc}	0.18 (1.09)^{cd}	0.19 (1.09)^{cd}	0.30 (1.14)^{bcd}	0.33 (1.15)^{ab}	0.32 (1.15)^{cd}	0.26 (1.12)^{abc}	0.20 (1.10)^{b}	0.23 (1.11)^{bc}
R_3B_3	0.16 (1.08)^{b}	0.10 (1.04)^{c}	0.13 (1.06)^{c}	0.18 (1.09)^{bc}	0.11 (1.05)^{d}	0.15 (1.07)^{d}	0.20 (1.10)^{d}	0.28 (1.13)^{b}	0.24 (1.12)^{cd}	0.18 (1.09)^{c}	0.18 (1.09)^{b}	0.18 (1.09)^{c}
R_3B_4	0.30 (1.14)^{ab}	0.18 (1.09)^{abc}	0.26 (1.12)^{abc}	0.26 (1.12)^{abc}	0.15 (1.07)^{cd}	0.20 (1.10)^{cd}	0.28 (1.13)^{bcd}	0.33 (1.15)^{ab}	0.30 (1.14)^{cd}	0.26 (1.12)^{abc}	0.23 (1.11)^{ab}	0.25 (1.12)^{bc}
S.Em± C.D. at 5%	0.03 0.09	0.03 0.08	0.02 0.06	0.02 0.05	0.02 0.05	0.01 0.04	0.02 0.05	0.01 0.03	0.01 0.04	0.03 0.08	0.02 0.05	0.01 0.04
Control	1.40 (1.54)	1.20 (1.48)	1.30 (1.51)	1.40 (1.54)	1.20 (1.48)	1.30 (1.51)	1.30 (1.51)	1.43 (1.56)	1.40 (1.54)	1.30 (1.51)	1.43 (1.56)	1.40 (1.54)
S.Em± C.D. at 5%	0.04 0.11	0.03 0.09	0.02 0.06	0.03 0.07	0.03 0.08	0.02 0.05	0.02 0.05	0.04 0.12	0.02 0.06	0.03 0.08	0.04 0.12	0.03 0.07

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)
Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

Table 22. Mites $leaf^{-1}$ at final picking as influenced by number of rows of barrier and barrier species

Treatments	Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops						
R_1:3 rows	0.51 (1.23)[a]	0.43 (1.20)[a]	0.47 (1.21)[a]	0.47 (1.21)[a]	0.37 (1.17)[a]	0.42 (1.19)[a]
R_2:6 rows	0.40 (1.18)[ab]	0.28 (1.13)[b]	0.34 (1.16)[b]	0.30 (1.14)[b]	0.26 (1.12)[b]	0.28 (1.13)[b]
R_3:9 rows	0.34 (1.16)[b]	0.30 (1.14)[b]	0.32 (1.15)[b]	0.28 (1.13)[b]	0.23 (1.11)[b]	0.26 (1.12)[b]
SEm+/- C.D.at 5%	0.02 0.06	0.01 0.03	0.01 0.03	0.02 0.06	0.01 0.03	0.01 0.03
Barrier species						
B_1: GS	0.34 (1.16)[ab]	0.28 (1.16)[ab]	0.31 (1.15)[b]	0.26 (1.12)[b]	0.26 (1.12)[bc]	0.26 (1.12)[b]
B_2: GM	0.47 (1.21)[ab]	0.40 (1.18)[a]	0.44 (1.20)[a]	0.43 (1.20)[a]	0.33 (1.15)[ab]	0.40 (1.18)[a]
B_3: FS	0.33 (1.15)[b]	0.30 (1.14)[b]	0.31 (1.14)[b]	0.23 (1.11)[b]	0.20 (1.10)[c]	0.21 (1.10)[b]
B_4: FM	0.51 (1.23)[a]	0.42 (1.19)[a]	0.47 (1.21)[a]	0.47 (1.21)[a]	0.37 (1.17)[a]	0.42 (1.19)[a]
S.Em± C.D.at 5%	0.02 0.07	0.01 0.03	0.01 0.04	0.02 0.07	0.01 0.03	0.01 0.04
Interaction						
R_1B_1	0.46 (1.21)[ab]	0.41 (1.19)[abc]	0.44 (1.20)[abc]	0.40 (1.18)[ab]	0.35 (1.16)[abc]	0.38 (1.17)[abc]
R_1B_2	0.56 (1.25)[ab]	0.47 (1.21)[ab]	0.51 (1.23)[ab]	0.54 (1.24)[a]	0.40 (1.18)[ab]	0.47 (1.21)[ab]
R_1B_3	0.40 (1.18)[ab]	0.39 (1.18)[a-d]	0.40 (1.18)[a-d]	0.34 (1.16)[ab]	0.30 (1.14)[bcd]	0.32 (1.15)[bcd]
R_1B_4	0.60 (1.27)[a]	0.51 (1.23)[a]	0.56 (1.25)[a]	0.57 (1.25)[a]	0.47 (1.21)[a]	0.52 (1.23)[a]
R_2B_1	0.34 (1.16)[ab]	0.34 (1.16)[b-e]	0.34 (1.16)[bcd]	0.18 (1.09)[b]	0.23 (1.11)[cde]	0.20 (1.10)[cde]
R_2B_2	0.44 (1.20)[ab]	0.38 (1.17)[a-e]	0.42 (1.19)[a-d]	0.42 (1.19)[ab]	0.30 (1.14)[bcd]	0.36 (1.17)[a-d]
R_2B_3	0.30 (1.14)[ab]	0.26 (1.12)[de]	0.28 (1.13)[cd]	0.18 (1.09)[b]	0.18 (1.09)[de]	0.18 (1.09)[de]
R_2B_4	0.50 (1.22)[ab]	0.41 (1.19)[abc]	0.46 (1.21)[ab]	0.42 (1.19)[ab]	0.35 (1.16)[abc]	0.39 (1.18)[ab]
R_3B_1	0.26 (1.12)[b]	0.27 (1.13)[cde]	0.26 (1.12)[d]	0.18 (1.09)[b]	0.18 (1.09)[de]	0.18 (1.09)[de]
R_3B_2	0.40 (1.18)[ab]	0.34 (1.16)[b-e]	0.37 (1.17)[bcd]	0.38 (1.17)[ab]	0.30 (1.14)[bcd]	0.34 (1.16)[a-d]
R_3B_3	0.26 (1.12)[b]	0.24 (1.11)[e]	0.25 (1.12)[d]	0.15 (1.07)[b]	0.15 (1.07)[e]	0.15 (1.07)[e]
R_3B_4	0.44 (1.20)[ab]	0.34 (1.16)[b-e]	0.39 (1.18)[a-d]	0.40 (1.18)[ab]	0.30 (1.14)[bcd]	0.35 (1.16)[a-d]
S.Em± C.D. at 5%	0.04 0.12	0.02 0.05	0.02 0.06	0.03 0.08	0.02 0.05	0.02 0.06
Control	1.20 (1.48)	1.60 (1.61)	1.40 (1.55)	1.20 (1.48)	1.60 (1.61)	1.40 (1.55)
S.Em± C.D. at 5%	0.04 0.12	0.02 0.05	0.02 0.06	0.04 0.12	0.03 0.08	0.02 0.06

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
IIn a column means followed by the same alphabet do not differ significantly by DMRT (0.05)
Figures in parenthesis indicate √x+1 transformation values

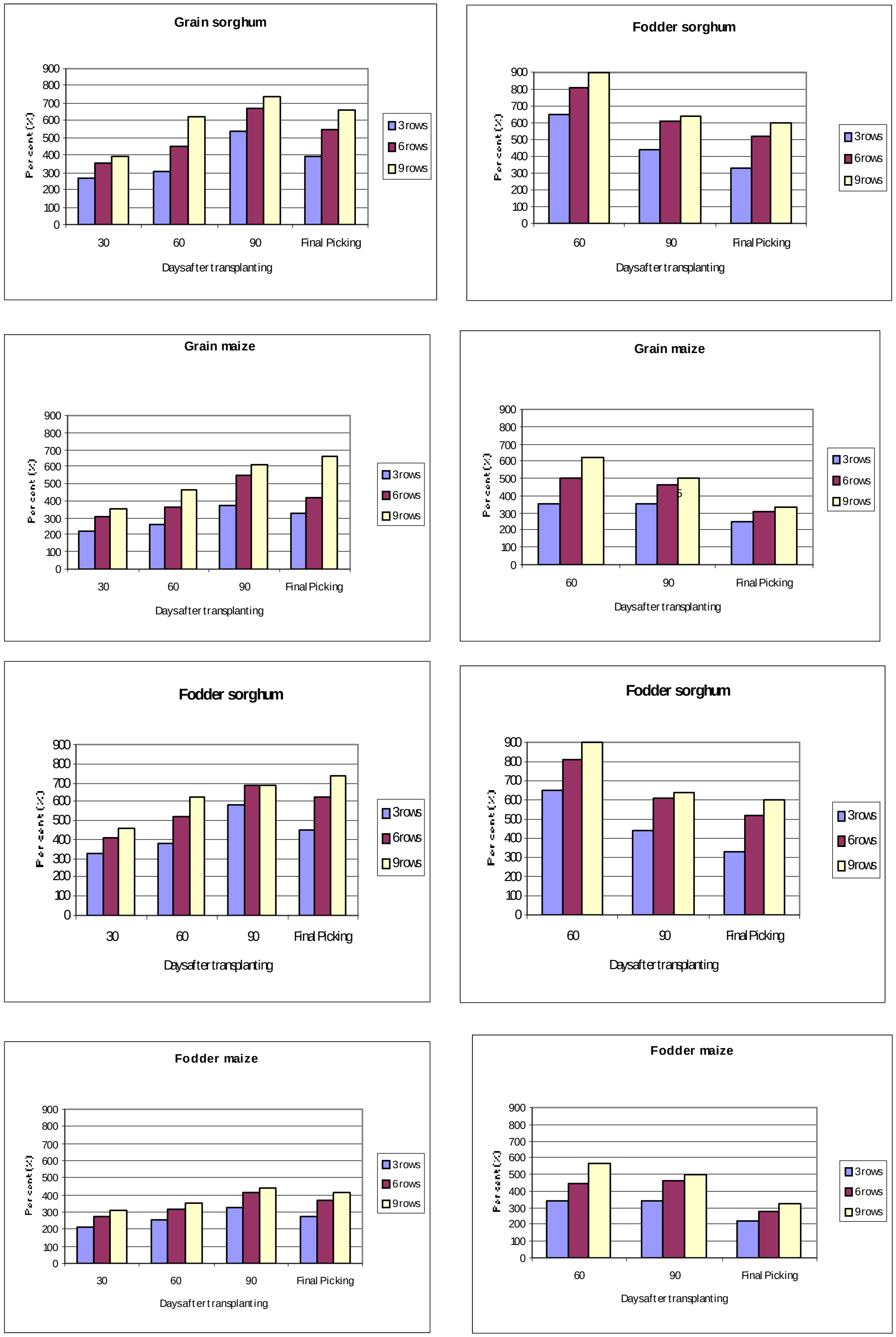


Fig. 6. Percent reduction in Thrips and mites population over control as influenced by row number and barrier species

Table 23. Coccinelloids population per plant at 30 DAT and 60 DAT as influenced by number of rows of barrier and barrier species

Treatments	30 DAT						60 DAT					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	0.37 (1.17)^{b}	0.40 (1.18)^{b}	0.39 (1.18)^{b}	0.51 (1.23)^{b}	0.71 (1.31)^{b}	0.62 (1.27)^{b}	0.47 (1.21)^{b}	0.52 (1.23)^{b}	0.50 (1.22)^{b}	0.62 (1.27)^{b}	0.67 (1.29)^{b}	0.65 (1.28)^{b}
R_2:6 rows	0.60 (1.26)^{a}	0.57 (1.25)^{a}	0.59 (1.26)^{a}	0.67 (1.29)^{a}	0.97 (1.40)^{a}	0.80 (1.34)^{a}	0.66 (1.28)^{ab}	0.72 (1.31)^{a}	0.70 (1.30)^{a}	0.80 (1.34)^{ab}	0.92 (1.39)^{a}	0.88 (1.37)^{a}
R_3:9 rows	0.67 (1.29)^{a}	0.70 (1.30)^{a}	0.69 (1.30)^{a}	0.71 (1.31)^{a}	1.00 (1.41)^{a}	0.85 (1.36)^{a}	0.71 (1.31)^{a}	0.77 (1.33)^{a}	0.73 (1.32)^{a}	0.83 (1.35)^{a}	1.03 (1.42)^{a}	0.93 (1.39)^{a}
SEm+/- C.D.at 5%	0.02 0.07	0.02 0.06	0.02 0.05	0.02 0.06	0.02 0.06	0.01 0.04	0.03 0.08	0.02 0.07	0.02 0.05	0.03 0.08	0.02 0.05	0.03 0.10
Barrier species												
B_1: GS	0.37 (1.17)^{b}	0.46 (1.21)^{b}	0.42 (1.19)^{c}	0.57 (1.25)^{b}	0.62 (1.27)^{b}	0.60 (1.26)^{b}	0.47 (1.21)^{b}	0.57 (1.25)^{b}	0.52 (1.23)^{c}	0.65 (1.28)^{b}	0.70 (1.30)^{c}	0.67 (1.29)^{b}
B_2: GM	0.63 (1.28)^{a}	0.57 (1.25)^{b}	0.60 (1.26)^{b}	0.70 (1.30)^{ab}	1.11 (1.45)^{a}	0.90 (1.38)^{a}	0.67 (1.29)^{ab}	0.72 (1.31)^{ab}	0.70 (1.30)^{ab}	0.83 (1.35)^{ab}	0.92 (1.39)^{ab}	0.88 (1.37)^{a}
B_3: FS	0.41 (1.19)^{b}	0.41 (1.19)^{b}	0.41 (1.19)^{c}	0.52 (1.23)^{b}	0.70 (1.30)^{b}	0.61 (1.27)^{b}	0.57 (1.25)^{ab}	0.60 (1.26)^{ab}	0.60 (1.26)^{bc}	0.65 (1.28)^{b}	0.80 (1.34)^{bc}	0.71 (1.31)^{b}
B_4: FM	0.80 (1.34)^{a}	0.80 (1.34)^{a}	0.80 (1.34)^{a}	0.78 (1.33)^{a}	1.17 (1.47)^{a}	0.97 (1.40)^{a}	0.73 (1.32)^{a}	0.80 (1.34)^{a}	0.78 (1.33)^{a}	0.90 (1.38)^{a}	1.05 (1.43)^{a}	0.97 (1.40)^{a}
S.Em± C.D.at 5%	0.03 0.08	0.02 0.07	0.02 0.05	0.02 0.07	0.02 0.07	0.02 0.05	0.03 0.09	0.03 0.08	0.02 0.06	0.03 0.09	0.02 0.06	0.02 0.06
Interaction												
R_1B_1	0.30 (1.14)^{d}	0.33 (1.15)^{d}	0.32 (1.15)^{ef}	0.47 (1.31)^{bc}	0.47 (1.21)^{e}	0.47 (1.21)^{f}	0.33 (1.15)^{b}	0.46 (1.21)^{ab}	0.40 (1.18)^{c}	0.50 (1.22)^{b}	0.50 (1.22)^{f}	0.50 (1.22)^{f}
R_1B_2	0.40 (1.18)^{cd}	0.40 (1.18)^{d}	0.40 (1.18)^{ef}	0.58 (1.26)^{abc}	0.88 (1.37)^{bcd}	0.73 (1.32)^{cde}	0.54 (1.24)^{ab}	0.60 (1.26)^{ab}	0.57 (1.25)^{bc}	0.70 (1.30)^{ab}	0.70 (1.30)^{def}	0.70 (1.30)^{def}
R_1B_3	0.27 (1.13)^{d}	0.30 (1.14)^{cd}	0.28 (1.13)^{f}	0.40 (1.18)^{c}	0.60 (1.26)^{de}	0.50 (1.22)^{ef}	0.43 (1.20)^{ab}	0.40 (1.18)^{b}	0.42 (1.19)^{c}	0.53 (1.24)^{ab}	0.64 (1.28)^{ef}	0.60 (1.26)^{ef}
R_1B_4	0.50 (1.22)^{bcd}	0.60 (1.26)^{bcd}	0.55 (1.24)^{cde}	0.64 (1.28)^{abc}	0.97 (1.40)^{abc}	0.80 (1.34)	0.60 (1.26)^{ab}	0.64 (1.28)^{ab}	0.62 (1.27)^{abc}	0.75 (1.32)^{ab}	0.80 (1.34)^{cde}	0.77 (1.33)^{cde}
R_2B_1	0.40 (1.18)^{cd}	0.47 (1.21)^{bcd}	0.43 (1.19)^{def}	0.58 (1.26)^{abc}	0.67 (1.29)^{cde}	0.62 (1.27)^{def}	0.50 (1.22)^{ab}	0.60 (1.26)^{ab}	0.55 (1.24)^{bc}	0.70 (1.30)^{ab}	0.78 (1.33)^{def}	0.71 (1.31)$^{e-f}$
R_2B_2	0.71 (1.31)^{abc}	0.60 (1.26)^{bcd}	0.66 (1.29)^{bcd}	0.70 (1.30)^{abc}	1.20 (1.48)^{ab}	0.95 (1.40)^{abc}	0.71 (1.31)^{ab}	0.77 (1.33)^{ab}	0.73 (1.32)^{ab}	0.85 (1.36)^{ab}	1.00 (1.41)$^{a-d}$	0.93 (1.39)$^{a-d}$
R_2B_3	0.47 (1.21)^{bcd}	0.46 (1.21)^{bcd}	0.47 (1.21)^{def}	0.53 (1.24)^{abc}	0.71 (1.31)^{cde}	0.62 (1.27)^{def}	0.60 (1.26)^{ab}	0.67 (1.29)^{ab}	0.65 (1.28)^{abc}	0.67 (1.29)^{ab}	0.88 (1.37)$^{a-e}$	0.77 (1.33)^{cde}
R_2B_4	0.80 (1.34)^{ab}	0.80 (1.34)^{ab}	0.80 (1.34)^{ab}	0.80 (1.34)^{ab}	1.25 (1.50)^{ab}	1.03 (1.42)^{ab}	0.77 (1.33)^{a}	0.85 (1.36)^{a}	0.83 (1.35)^{ab}	0.97 (1.40)^{a}	1.17 (1.47)^{ab}	1.07 (1.44)^{ab}
R_3B_1	0.43 (1.20)^{bcd}	0.60 (1.26)^{bcd}	0.52 (1.23)^{def}	0.64 (1.28)^{abc}	0.71 (1.31)^{cde}	0.67 (1.29)^{def}	0.60 (1.26)^{ab}	0.67 (1.29)^{ab}	0.65 (1.28)^{abc}	0.73 (1.32)^{ab}	0.82 (1.35)$^{b-e}$	0.80 (1.34)$^{b-e}$
R_3B_2	0.80 (1.34)^{ab}	0.71 (1.31)^{abc}	0.76 (1.33)^{abc}	0.80 (1.34)^{ab}	1.25 (1.50)^{ab}	1.03 (1.42)^{ab}	0.77 (1.33)^{a}	0.83 (1.35)^{a}	0.80 (1.34)^{ab}	0.90 (1.38)^{ab}	1.12 (1.46)^{abc}	1.03 (1.42)^{abc}
R_3B_3	0.50 (1.22)^{bcd}	0.50 (1.22)^{bcd}	0.50 (1.22)^{def}	0.60 (1.26)^{abc}	0.71 (1.31)^{cde}	0.66 (1.29)^{def}	0.67 (1.29)^{ab}	0.73 (1.32)^{ab}	0.71 (1.31)^{ab}	0.70 (1.30)^{ab}	0.92 (1.39)$^{a-e}$	0.83 (1.35)$^{b-e}$
R_3B_4	1.00 (1.41)^{a}	1.00 (1.41)^{a}	1.00 (1.41)^{a}	0.85 (1.36)^{a}	1.30 (1.52)^{a}	1.08 (1.44)^{a}	0.88 (1.37)^{a}	0.89 (1.37)^{a}	0.88 (1.37)^{a}	1.00 (1.41)^{a}	1.18 (1.48)^{a}	1.13 (1.46)^{a}
S.Em± C.D. at 5%	0.04 0.13	0.04 0.12	0.03 0.09	0.04 0.12	0.04 0.12	0.03 0.08	0.03 0.09	0.05 0.14	0.03 0.10	0.05 0.15	0.04 0.11	0.03 0.10
Control	0.37 (1.17)	0.30 (1.14)	0.33 (1.15)	0.37 (1.17)	0.30 (1.14)	0.33 (1.15)	0.23 (1.11)	0.27 (1.13)	0.25 (1.12)	0.23 (1.11)	0.27 (1.13)	0.25 (1.12)
S.Em± C.D. at 5%	0.04 0.12	0.04 0.12	0.03 0.08	0.04 0.12	0.04 0.11	0.03 0.08	0.05 0.14	0.04 0.13	0.03 0.10	0.06 0.17	0.04 0.11	0.03 0.10

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)
Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

Table 24. Coccinelloids population per plant at 90 DAT and at final picking as influenced by number of rows of barrier and barrier species

Treatments	90 DAT						At final picking					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	0.62 (1.27)^{b}	0.87 (1.37)^{b}	0.75 (1.32)^{b}	0.83 (1.35)^{b}	1.08 (1.44)^{b}	0.95 (1.40)^{b}	0.42 (1.19)^{b}	0.50 (1.22)^{b}	0.45 (1.20)^{b}	0.52 (1.23)^{b}	0.61 (1.27)^{b}	0.57 (1.25)^{b}
R_2:6 rows	0.83 (1.35)^{ab}	1.20 (1.48)^{a}	1.02 (1.42)^{a}	1.10 (1.45)^{a}	1.30 (1.52)^{a}	1.20 (1.48)^{a}	0.61 (1.27)^{a}	0.64 (1.28)^{a}	0.62 (1.27)^{a}	0.63 (1.28)^{ab}	0.88 (1.37)^{a}	0.75 (1.32)^{a}
R_3:9 rows	0.85 (1.36)^{a}	1.29 (1.51)^{a}	1.07 (1.44)^{a}	1.14 (1.46)^{a}	1.38 (1.54)^{a}	1.25 (1.50)^{a}	0.61 (1.27)^{a}	0.70 (1.30)^{a}	0.67 (1.29)^{a}	0.72 (1.31)^{a}	0.91 (1.38)^{a}	0.83 (1.35)^{a}
SEm+/- C.D.at 5%	0.03 0.08	0.03 0.08	0.02 0.06	0.02 0.07	0.02 0.07	0.02 0.05	0.02 0.06	0.02 0.07	0.01 0.04	0.03 0.08	0.02 0.06	0.02 0.05
Barrier species												
B_1: GS	0.83 (1.35)^{a}	1.10 (1.45)^{a}	0.97 (1.40)^{a}	0.90 (1.38)^{b}	1.23 (1.49)^{a}	1.05 (1.43)^{b}	0.67 (1.29)^{a}	0.67 (1.29)^{ab}	0.67 (1.29)^{a}	0.76 (1.33)^{a}	0.84 (1.36)^{ab}	0.83 (1.35)^{a}
B_2: GM	0.64 (1.28)^{a}	1.17 (1.47)^{a}	0.90 (1.38)^{a}	1.17 (1.47)^{a}	1.23 (1.49)^{a}	1.20 (1.48)^{ab}	0.42 (1.19)^{b}	0.47 (1.21)^{c}	0.45 (1.20)^{b}	0.46 (1.21)^{b}	0.67 (1.29)^{b}	0.57 (1.25)^{b}
B_3: FS	0.88 (1.37)^{a}	0.97 (1.40)^{a}	0.93 (1.39)^{a}	0.85 (1.36)^{b}	1.26 (1.50)^{a}	1.05 (1.43)^{b}	0.72 (1.31)^{a}	0.76 (1.33)^{a}	0.75 (1.32)^{a}	0.80 (1.34)^{a}	0.97 (1.40)^{a}	0.88 (1.37)^{a}
B_4: FM	0.72 (1.31)^{a}	1.23 (1.49)^{a}	0.97 (1.40)^{a}	1.17 (1.47)^{a}	1.30 (1.52)^{a}	1.23 (1.49)^{a}	0.40 (1.18)^{b}	0.52 (1.23)^{bc}	0.45 (1.20)^{b}	0.50 (1.22)^{b}	0.70 (1.30)^{b}	0.60 (1.26)^{b}
S.Em± C.D.at 5%	0.03 NS	0.03 NS	0.02 NS	0.03 0.08	0.03 NS	0.02 0.06	0.02 0.07	0.03 0.08	0.02 0.05	0.03 0.09	0.02 0.07	0.02 0.05
Interaction												
R_1B_1	0.67 (1.29)^{ab}	0.87 (1.37)^{ab}	0.77 (1.33)^{ab}	0.72 (1.31)^{b}	1.10 (1.45)^{a}	0.91 (1.38)^{c}	0.50 (1.22)$^{a-d}$	0.52 (1.23)^{bc}	0.52 (1.23)^{cd}	0.67 (1.29)^{abc}	0.68 (1.29)^{bc}	0.67 (1.20)$^{b-e}$
R_1B_2	0.50 (1.22)^{b}	0.87 (1.37)^{ab}	0.69 (1.30)^{b}	0.93 (1.39)^{ab}	1.00 (1.41)^{a}	0.97 (1.40)^{bc}	0.30 (1.14)^{d}	0.40 (1.18)^{c}	0.35 (1.16)^{d}	0.33 (1.15)^{c}	0.53 (1.24)^{c}	0.44 (1.20)^{e}
R_1B_3	0.70 (1.30)^{ab}	0.83 (1.35)^{b}	0.77 (1.33)^{ab}	0.70 (1.30)^{b}	1.13 (1.46)^{a}	0.91 (1.38)^{c}	0.56 (1.25)$^{a-d}$	0.60 (1.26)^{abc}	0.59 (1.26)^{bc}	0.70 (1.30)^{abc}	0.73 (1.32)^{abc}	0.71 (1.31)^{bcd}
R_1B_4	0.60 (1.26)^{ab}	1.00 (1.41)^{ab}	0.80 (1.34)^{ab}	0.94 (1.39)^{ab}	1.10 (1.45)^{a}	1.03 (1.42)^{abc}	0.28 (1.16)^{d}	0.40 (1.18)^{c}	0.36 (1.17)^{cd}	0.37 (1.17)^{bc}	0.52 (1.23)^{c}	0.45 (1.20)^{e}
R_2B_1	0.90 (1.38)^{ab}	1.20 (1.48)^{ab}	1.05 (1.43)^{a}	0.97 (1.40)^{ab}	1.26 (1.50)^{a}	1.11 (1.45)^{abc}	0.76 (1.33)^{abc}	0.72 (1.31)^{abc}	0.73 (1.32)^{ab}	0.76 (1.33)^{ab}	0.93 (1.39)^{ab}	0.85 (1.36)$^{a-d}$
R_2B_2	0.70 (1.30)^{ab}	1.29 (1.51)^{ab}	1.00 (1.41)^{ab}	1.26 (1.50)^{a}	1.30 (1.52)^{a}	1.28 (1.51)^{ab}	0.46 (1.21)^{bcd}	0.50 (1.22)^{bc}	0.48 (1.22)^{cd}	0.46 (1.21)^{abc}	0.70 (1.30)^{bc}	0.59 (1.26)^{de}
R_2B_3	0.97 (1.40)^{ab}	1.00 (1.41)^{ab}	1.00 (1.41)^{ab}	0.88 (1.37)^{ab}	1.26 (1.50)^{a}	1.07 (1.44)^{abc}	0.80 (1.34)^{ab}	0.83 (1.35)^{ab}	0.82 (1.35)^{a}	0.83 (1.35)^{a}	1.07 (1.44)^{a}	0.94 (1.39)^{ab}
R_2B_4	0.78 (1.33)^{ab}	1.32 (1.52)^{ab}	1.05 (1.43)^{a}	1.29 (1.51)^{a}	1.40 (1.55)^{a}	1.34 (1.53)^{a}	0.42 (1.19)^{d}	0.52 (1.23)^{bc}	0.47 (1.21)^{cd}	0.52 (1.23)^{abc}	0.77 (1.33)^{abc}	0.65 (1.28)^{cde}
R_3B_1	0.90 (1.38)^{ab}	1.29 (1.51)^{ab}	1.10 (1.45)^{a}	1.03 (1.42)^{ab}	1.30 (1.52)^{a}	1.17 (1.47)^{abc}	0.76 (1.33)^{abc}	0.80 (1.34)^{ab}	0.78 (1.33)^{ab}	0.83 (1.35)^{a}	1.00 (1.41)^{ab}	0.91 (1.38)^{abc}
R_3B_2	0.73 (1.32)^{ab}	1.38 (1.54)^{ab}	1.05 (1.43)^{a}	1.29 (1.51)^{a}	1.38 (1.54)^{a}	1.34 (1.53)^{a}	0.50 (1.22)$^{a-d}$	0.52 (1.23)^{b}	0.51 (1.23)^{cd}	0.60 (1.26)^{abc}	0.76 (1.33)^{abc}	0.69 (1.30)$^{b-e}$
R_3B_3	1.00 (1.41)^{a}	1.10 (1.45)^{ab}	1.05 (1.43)^{a}	1.00 (1.41)^{ab}	1.34 (1.53)^{a}	1.17 (1.47)^{abc}	0.83 (1.35)^{a}	0.90 (1.38)^{a}	0.87 (1.37)^{a}	0.88 (1.37)^{a}	1.10 (1.45)^{a}	1.00 (1.41)^{a}
R_3B_4	0.83 (1.35)^{ab}	1.40 (1.55)^{a}	1.11 (1.45)^{a}	1.29 (1.51)^{a}	1.42 (1.56)^{a}	1.35 (1.53)^{a}	0.44 (1.20)^{cd}	0.60 (1.26)^{abc}	0.52 (1.23)^{cd}	0.60 (1.26)^{abc}	0.80 (1.34)^{abc}	0.70 (1.30)$^{b-e}$
S.Em± C.D. at 5%	0.05 0.16	0.06 0.17	0.04 0.11	0.05 0.14	0.04 0.13	0.03 0.10	0.04 0.12	0.04 0.13	0.03 0.08	0.05 0.15	0.04 0.12	0.03 0.10
Control	0.27 (1.13)	0.40 (1.18)	0.33 (1.15)	0.27 (1.13)	0.40 (1.18)	0.33 (1.15)	0.33 (1.15)	0.30 (1.14)	0.32 (1.15)	0.33 (1.15)	0.30 (1.14)	0.32 (1.15)
S.Em± C.D. at 5%	0.05 0.16	0.05 0.16	0.04 0.11	0.05 0.14	0.04 0.13	0.03 0.09	0.04 0.13	0.04 0.13	0.03 0.09	0.05 0.15	0.04 0.11	0.03 0.09

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)
Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

in the leeward and 0.88, 0.73 and 0.83 in windward side at 60 DAT, respectively). Thereafter, coccinellid population with sorghum increased and the effects were comparable with those of maize at 90 DAT (Fig. 7).

Further, at final picking coccinellid population increased significantly with both grain and fodder sorghum in six and nine rows (0.85 and 0.94 in leeward and 0.73 and 0.82 in the windward sides with six rows and 0.90 and 1.00 in leeward and 0.76 and 0.87 in windward sides with nine rows at final picking) and was the highest with the latter treatment (R_3B_3) at final picking. The coccinellid population per plant of chilli under barriers was significantly higher compared to chilli without barriers at all the stages of plant growth (0.33, 0.25, 0.33 and 0.32 at 30, 60 and 90 DAT and at final picking, respectively).

4.1.3.3.2 Spider population (number plant^{-1})

Spider population in chilli varied significantly due to number of rows of barrier crops, barrier species and their interactions (Table 25 and 26). In general, plants under leeward side of barriers recorded more spider population compared to the windward side.

As the number of rows of barriers increased beyond three rows, spider population increased significantly in the leeward areas and the differences between six and nine rows were non-significant (0.60, 0.72 and 0.75 with nine rows and 0.55, 0.66 and 0.70 with six rows at 60 and 90 DAT and at final picking, respectively). The same trend was observed in the windward side also.

Among the barrier species evaluated, both fodder and grain sorghum as barrier recorded significantly more spider population in the leeward side and both were on par (0.67, 0.72 and 0.80 with fodder sorghum and 0.60, 0.67 and 0.77 with grain sorghum at 60 and 90 DAT and at final picking, respectively). Similar trend was also observed in the windward side. However, the populations of spiders in chilli with fodder and grain purpose barrier species were statistically on par.

Among the treatment combinations, chilli with nine rows of fodder sorghum (R_3B_3) recorded significantly higher spider population in the leeward side at all the stages of plant growth (0.78, 0.88 and 0.95 at 60 and 90 DAT and at final picking, respectively). Chilli with grain sorghum with same number of rows (R_3B_1) was on par and grain and fodder sorghum in six rows were on par with the former treatment at all the stages of plant growth. While, the lower spider population was recorded in chilli with three rows of barriers irrespective of barrier species (Fig. 7). The spider population under barriers was significantly higher compared to the chilli crop without barriers at all the stages of plant growth (0.23, 0.24 and 0.22 at 60 and 90 DAT and at final picking, respectively).

4.1.3.4 Predators in barrier crops (number plant^{-1})

4.1.3.4.1 Coccinellids, spiders and *Chrysoperla cornea* population in the barrier crops at 70 DAT

The differences in the coccinellids populations as influenced by barrier intensity (number of rows), barriers species and their interactions were significant (Table 27).

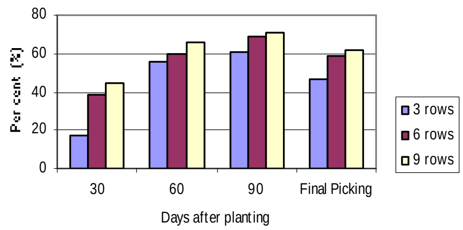
Under dense strips of barriers (nine rows) the coccinellid population in the barrier crop was higher (5.8). As the row density decreased coccinellid population also decreased significantly with lowest in three rows of barrier (3.70).

Among the barrier species both grain and fodder maize recorded comparable and significantly higher coccinellid population (5.50 and 5.60 plant^{-1}, respectively) than grain and fodder sorghum barriers (4.3).

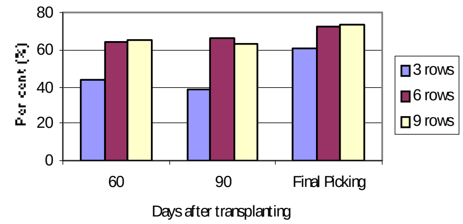
Among the treatment combinations also fodder maize at all the barrier width and grain maize with six rows onwards and sorghum in nine rows were comparable and higher population of coccinellids was observed in maize with maximum number of rows.

Similar to coccinellids, population of spiders with barriers was highest with nine rows of barriers (1.87), while the lowest was observed with three rows of barriers (1.03).

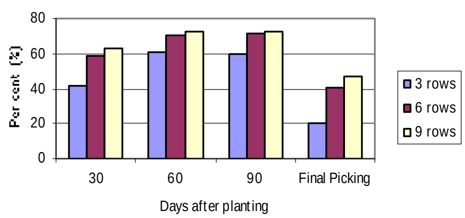
Unlike coccinellids population, barrier species differed with regard to spider population, wherein both grain and fodder type of sorghum recorded higher population of



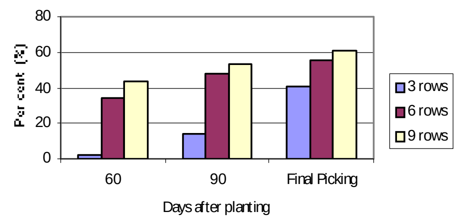
Per cent increase in the Coccinellids with grain sorghum as barrier crop



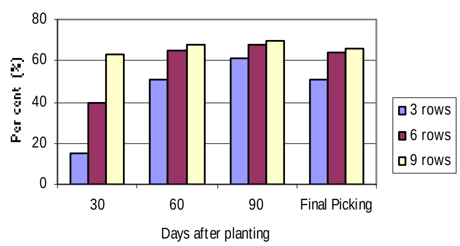
Per cent increase in Spiders with grain sorghum as barrier crop



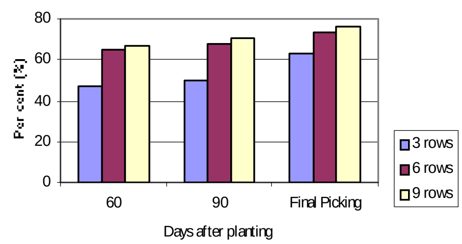
Per cent increase in Coccinellids with grain maize as barrier crop



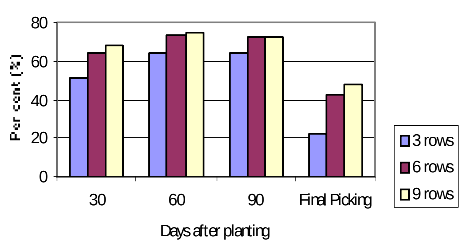
Per cent increase in Spiders with grain maize as barrier crop



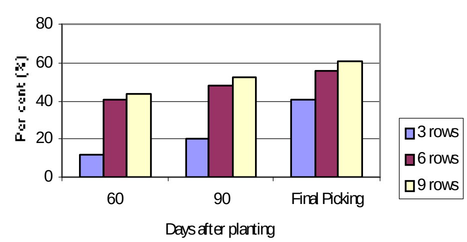
Per cent increase in Coccinellids with fodder sorghum as barrier crop



Per cent increase in Spiders with fodder sorghum as barrier crop



Per cent increase in Coccinellids with fodder maize as barrier crop



Per cent increase in Spiders with fodder maize as barrier crop

Fig.7: Percent increase in Coccinellids and Spiders population over control as influenced by number of rows and species of barriers

Table 25. Spider population per plant at 60 DAT and 90 DAT as influenced by number of rows of barrier and barrier species

Treatments	60 DAT						90 DAT					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	0.30 (1.14)^{b}	0.28 (1.13)^{b}	0.29 (1.14)^{b}	0.36 (1.17)^{b}	0.40 (1.18)^{b}	0.38 (1.17)^{b}	0.28 (1.13)^{b}	0.33 (1.15)^{b}	0.31 (1.14)^{b}	0.33 (1.15)^{b}	0.52 (1.23)^{b}	0.42 (1.19)^{b}
R_2:6 rows	0.47 (1.21)^{a}	0.46 (1.21)^{a}	0.47 (1.21)^{a}	0.54 (1.24)^{ab}	0.55 (1.24)^{a}	0.55 (1.24)^{a}	0.50 (1.22)^{a}	0.54 (1.24)^{a}	0.52 (1.23)^{a}	0.60 (1.26)^{a}	0.72 (1.31)^{a}	0.66 (1.29)^{a}
R_3:9 rows	0.50 (1.22)^{a}	0.50 (1.22)^{a}	0.50 (1.22)^{a}	0.57 (1.25)^{a}	0.62 (1.27)^{a}	0.60 (1.26)^{a}	0.54 (1.24)^{a}	0.60 (1.26)^{a}	0.57 (1.25)^{a}	0.65 (1.28)^{a}	0.80 (1.34)^{a}	0.72 (1.31)^{a}
SEm+/-	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.024	0.02	0.02
C.D.at 5%	0.06	0.07	0.05	0.08	0.05	0.05	0.08	0.07	0.05	0.07	0.06	0.05
Barrier species												
B_1: GS	0.52 (1.23)^{a}	0.54 (1.24)^{a}	0.53 (1.24)^{a}	0.60 (1.26)^{a}	0.60 (1.26)^{ab}	0.60 (1.26)^{a}	0.50 (1.23)^{b}	0.57 (1.25)^{ab}	0.54 (1.24)^{a}	0.60 (1.26)^{ab}	0.75 (1.32)^{a}	0.67 (1.29)^{a}
B_2: GM	0.30 (1.14)^{b}	0.38 (1.18)^{abc}	0.34 (1.15)^{b}	0.33 (1.15)^{b}	0.34 (1.16)^{c}	0.34 (1.16)^{b}	0.36 (1.17)^{b}	0.33 (1.15)^{c}	0.35 (1.16)^{b}	0.40 (1.18)^{b}	0.55 (1.24)^{b}	0.48 (1.21)^{b}
B_3: FS	0.56 (1.25)^{a}	0.54 (1.24)^{abc}	0.55 (1.24)^{a}	0.70 (1.30)^{a}	0.64 (1.28)^{a}	0.67 (1.29)^{a}	0.60 (1.26)^{a}	0.67 (1.29)^{a}	0.63 (1.27)^{a}	0.62 (1.27)^{a}	0.83 (1.35)^{a}	0.72 (1.31)^{a}
B_4: FM	0.28 (1.13)^{b}	0.45 (1.20)^{abc}	0.36 (1.17)^{b}	0.33 (1.15)^{b}	0.47 (1.21)^{bc}	0.40 (1.18)^{b}	0.28 (1.13)^{c}	0.37 (1.17)^{bc}	0.33 (1.15)^{b}	0.44 (1.20)^{ab}	0.57 (1.25)^{b}	0.51 (1.23)^{b}
S.Em±	0.03	0.03	0.02	0.03	0.02	0.02	0.03	0.03	0.02	0.03	0.02	0.02
C.D.at 5%	0.08	0.08	0.05	0.09	0.06	0.05	0.08	0.08	0.05	0.08	0.07	0.05
Interaction												
R_1B_1	0.37 (1.17)^{ab}	0.38 (1.17)^{abc}	0.38 (1.17)$^{a-d}$	0.47 (1.21)$^{a-d}$	0.43 (1.20)^{abc}	0.45 (1.20)^{def}	0.30 (1.14)^{abc}	0.33 (1.15)^{cd}	0.32 (1.15)^{d}	0.37 (1.17)^{bcd}	0.52 (1.23)^{cd}	0.45 (1.20)^{de}
R_1B_2	0.20 (1.10)^{b}	0.18 (1.09)^{c}	0.19 (1.09)^{d}	0.23 (1.11)^{d}	0.28 (1.13)^{c}	0.26 (1.12)^{f}	0.18 (1.09)^{c}	0.27 (1.13)^{d}	0.23 (1.11)^{d}	0.24 (1.11)^{d}	0.40 (1.18)^{d}	0.32 (1.15)^{e}
R_1B_3	0.40 (1.18)^{ab}	0.30 (1.14)^{abc}	0.35 (1.60)^{bcd}	0.50 (1.22)$^{a-d}$	0.52 (1.23)^{abc}	0.51 (1.23)$^{b-e}$	0.40 (1.18)^{abc}	0.42 (1.19)^{bcd}	0.41 (1.19)^{cd}	0.40 (1.18)$^{a-d}$	0.67 (1.29)$^{a-d}$	0.54 (1.24)^{cde}
R_1B_4	0.20 (1.10)^{b}	0.24 (1.11)^{bc}	0.22 (1.10)^{d}	0.28 (1.13)^{cd}	0.33 (1.15)^{bc}	0.30 (1.14)^{ef}	0.20 (1.10)^{bc}	0.27 (1.13)^{d}	0.23 (1.11)^{d}	0.30 (1.14)^{cd}	0.43 (1.20)^{d}	0.37 (1.17)^{de}
R_2B_1	0.58 (1.26)^{a}	0.64 (1.28)^{a}	0.61 (1.27)^{a}	0.67 (1.29)^{abc}	0.60 (1.27)^{ab}	0.64 (1.28)$^{a-d}$	0.60 (1.26)^{ab}	0.67 (1.29)$^{a-d}$	0.64 (1.28)^{abc}	0.70 (1.30)^{abc}	0.83 (1.35)^{abc}	0.77 (1.33)^{abc}
R_2B_2	0.33 (1.15)^{ab}	0.33 (1.15)^{abc}	0.33 (1.15)^{cd}	0.36 (1.17)^{bcd}	0.36 (1.17)^{bc}	0.36 (1.17)^{ef}	0.44 (1.20)^{abc}	0.33 (1.15)^{cd}	0.39 (1.18)^{cd}	0.47 (1.21)$^{a-d}$	0.58 (1.26)^{bcd}	0.53 (1.24)^{cde}
R_2B_3	0.62 (1.27)^{a}	0.50 (1.22)^{abc}	0.56 (1.25)^{abc}	0.77 (1.33)^{ab}	0.70 (1.30)^{a}	0.74 (1.32)^{ab}	0.65 (1.28)^{a}	0.75 (1.32)^{ab}	0.70 (1.30)^{ab}	0.70 (1.30)^{abc}	0.89 (1.37)^{ab}	0.80 (1.34)^{abc}
R_2B_4	0.30 (1.14)^{a}	0.38 (1.18)^{abc}	0.35 (1.16)^{bcd}	0.33 (1.15)^{cd}	0.50 (1.22)^{abc}	0.42 (1.19)^{def}	0.30 (1.14)^{abc}	0.40 (1.18)^{bcd}	0.35 (1.16)^{d}	0.52 (1.23)$^{a-d}$	0.59 (1.26)^{bcd}	0.56 (1.25)^{cde}
R_3B_1	0.62 (1.27)^{a}	0.60 (1.27)^{ab}	0.61 (1.27)^{a}	0.70 (1.30)^{abc}	0.70 (1.30)^{a}	0.70 (1.30)^{abc}	0.67 (1.29)^{a}	0.72 (1.31)^{abc}	0.69 (1.30)^{ab}	0.75 (1.32)^{ab}	0.90 (1.38)^{ab}	0.82 (1.35)^{ab}
R_3B_2	0.38 (1.17)^{ab}	0.40 (1.18)^{abc}	0.39 (1.18)$^{a-d}$	0.40 (1.18)$^{a-d}$	0.43 (1.20)^{abc}	0.42 (1.19)^{def}	0.50 (1.23)^{abc}	0.40 (1.18)^{bcd}	0.45 (1.20)^{bcd}	0.48 (1.22)$^{a-d}$	0.65 (1.27)$^{a-d}$	0.57 (1.25)^{cde}
R_3B_3	0.67 (1.29)^{a}	0.54 (1.24)^{abc}	0.60 (1.26)^{ab}	0.83 (1.35)^{a}	0.73 (1.32)^{a}	0.78 (1.33)^{a}	0.70 (1.30)^{a}	0.83 (1.35)^{a}	0.77 (1.33)^{a}	0.80 (1.34)^{a}	0.97 (1.40)^{a}	0.88 (1.37)^{a}
R_3B_4	0.34 (1.16)^{ab}	0.45 (1.20)^{abc}	0.40 (1.18)$^{a-d}$	0.36 (1.17)^{bcd}	0.56 (1.25)^{abc}	0.46 (1.21)$^{c-f}$	0.33 (1.15)^{abc}	0.44 (1.20)$^{a-d}$	0.39 (1.18)^{cd}	0.53 (1.24)$^{a-d}$	0.67 (1.29)$^{a-d}$	0.60 (1.26)^{bcd}
S.Em±	0.05	0.05	0.03	0.05	0.04	0.03	0.05	0.05	0.03	0.05	0.04	0.03
C.D. at 5%	0.13	0.14	0.09	0.15	0.11	0.10	0.14	0.14	0.10	0.14	0.12	0.09
Control	0.20 (1.09)	0.27 (1.13)	0.23 (1.11)	0.20 (1.09)	0.27 (1.14)	0.23 (1.11)	0.20 (1.10)	0.28 (1.13)	0.24 (1.11)	0.20 (1.10)	0.28 (1.13)	0.24 (1.11)
S.Em±	0.04	0.04	0.03	0.05	0.04	0.03	0.04	0.04	0.03	0.05	0.04	0.03
C.D. at 5%	0.13	0.13	0.09	0.15	0.11	0.09	0.13	0.13	0.09	0.14	0.12	0.09

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)
Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

Table 26. Spider population per plant at final picking as influenced by number of rows of barrier and barrier species

Treatments	Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops						
R_1:3 rows	0.26 (1.12)[a]	0.65 (1.28)[b]	0.45 (1.20)[b]	0.26 (1.12)[b]	0.73 (1.32)[b]	0.50 (1.22)[b]
R_2:6 rows	0.34 (1.16)[a]	0.85 (1.36)[a]	0.60 (1.26)[a]	0.42 (1.19)[ab]	1.00 (1.41)[a]	0.70 (1.30)[a]
R_3:9 rows	0.42 (1.19)[a]	0.93 (1.39)[a]	0.67 (1.29)[a]	0.47 (1.21)[a]	1.05 (1.43)[a]	0.75 (1.32)[a]
SEm+/-	0.02	0.03	0.02	0.03	0.02	0.02
C.D.at 5%	0.06	0.08	0.05	0.08	0.07	0.05
Barrier species						
B_1: GS	0.50 (1.22)[a]	0.90 (1.38)[a]	0.70 (1.30)[a]	0.54 (1.24)[a]	1.00 (1.41)[ab]	0.77 (1.33)[ab]
B_2: GM	0.23 (1.11)[b]	0.63 (1.28)[b]	0.43 (1.19)[b]	0.26 (1.12)[b]	0.77 (1.33)[c]	0.52 (1.23)[bc]
B_3: FS	0.50 (1.22)[a]	0.97 (1.40)[a]	0.73 (1.31)[a]	0.50 (1.23)[a]	1.10 (1.45)[a]	0.80 (1.34)[a]
B_4: FM	0.16 (1.08)[b]	0.71 (1.31)[b]	0.43 (1.19)[b]	0.20 (1.10)[b]	0.82 (1.35)[bc]	0.51 (1.22)[c]
S.Em±	0.03	0.03	0.02	0.03	0.03	0.02
C.D.at 5%	0.07	0.09	0.06	0.09	0.08	0.06
Interaction						
R_1B_1	0.37 (1.17)[abc]	0.71 (1.31)[ab]	0.54 (1.24)[cd]	0.40 (1.18)[abc]	0.80 (1.34)[bc]	0.60 (1.26)[bc]
R_1B_2	0.15 (1.07)[c]	0.53 (1.24)[b]	0.34 (1.15)[d]	0.18 (1.09)[bc]	0.60 (1.26)[c]	0.39 (1.18)[c]
R_1B_3	0.38 (1.17)[abc]	0.76 (1.33)[ab]	0.57 (1.25)[bcd]	0.30 (1.14)[abc]	0.90 (1.38)[abc]	0.60 (1.26)[bc]
R_1B_4	0.15 (1.07)[c]	0.57 (1.25)[b]	0.35 (1.16)[d]	0.15 (1.07)[c]	0.64 (1.28)[c]	0.39 (1.17)[c]
R_2B_1	0.54 (1.24)[a]	0.97 (1.40)[ab]	0.76 (1.32)[abc]	0.60 (1.26)[ab]	1.10 (1.45)[ab]	0.85 (1.36)[ab]
R_2B_2	0.20 (1.10)[bc]	0.70 (1.30)[ab]	0.45 (1.20)[d]	0.27 (1.13)[abc]	0.82 (1.35)[abc]	0.55 (1.24)[c]
R_2B_3	0.50 (1.23)[bc]	1.00 (1.41)[ab]	0.75 (1.32)[abc]	0.60 (1.26)[ab]	1.20 (1.48)[ab]	0.90 (1.37)[ab]
R_2B_4	0.15 (1.07)[c]	0.78 (1.33)[ab]	0.46 (1.20)[d]	0.18 (1.09)[bc]	0.90 (1.38)[abc]	0.54 (1.24)[c]
R_3B_1	0.60 (1.26)[a]	1.05 (1.43)[a]	0.83 (1.35)[ab]	0.67 (1.29)[a]	1.12 (1.46)[ab]	0.89 (1.37)[ab]
R_3B_2	0.32 (1.15)[abc]	0.71 (1.31)[ab]	0.52 (1.23)[cd]	0.32 (1.15)[abc]	0.88 (1.37)[abc]	0.60 (1.26)[bc]
R_3B_3	0.60 (1.26)[a]	1.10 (1.45)[a]	0.85 (1.36)[a]	0.64 (1.28)[a]	1.26 (1.50)[a]	0.95 (1.39)[a]
R_3B_4	0.18 (1.09)[c]	0.83 (1.35)[ab]	0.50 (1.22)[cd]	0.27 (1.13)[abc]	0.96 (1.40)[abc]	0.61 (1.26)[bc]
S.Em±	0.04	0.05	0.03	0.05	0.05	0.04
C.D. at 5%	0.12	0.15	0.10	0.16	0.13	0.10
Control	0.15 (1.07)	0.30 (1.14)	0.22 (1.10)	0.15 (1.07)	0.30 (1.14)	0.22 (1.10)
S.Em±	0.04	0.05	0.03	0.05	0.04	0.03
C.D. at 5%	0.12	0.15	0.10	0.15	0.13	0.10

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

Table 27. Population of *Coccineloids*, spider and *Chyrsoperla carnea* per plant at 70 DAT as influenced by number of rows of barrier and barrier species

Treatments	*Coccineloids* / plant			Spider population/plant			*Chyrsoperla carnea* /plant		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops									
R_1:3 rows	3.50 (2.12)^{c}	3.90 (2.21)^{c}	3.70 (2.17)^{c}	1.00 (1.41)^{b}	1.05 (1.43)^{b}	1.03 (1.42)^{c}	1.14 (1.46)^{b}	1.08 (1.44)^{b}	1.10 (1.45)^{b}
R_2:6 rows	5.10 (2.47)^{b}	4.90 (2.43)^{b}	5.00 (2.45)^{b}	1.63 (1.62)^{a}	1.63 (1.62)^{a}	1.63 (1.62)^{b}	1.67 (1.63)^{a}	1.50 (1.58)^{a}	1.60 (1.61)^{a}
R_3:9 rows	6.10 (2.67)^{a}	5.50 (2.55)^{a}	5.80 (2.61)^{a}	1.87 (1.69)^{a}	1.87 (1.69)^{a}	1.87 (1.69)^{a}	1.87 (1.69)^{a}	1.63 (1.62)^{a}	1.77 (1.66)^{a}
SEm+/- C.D.at 5%	0.06 0.17	0.03 0.09	0.03 0.09	0.03 0.09	0.03 0.08	0.02 0.06	0.03 0.10	0.02 0.07	0.02 0.06
Barrier species									
B_1: GS	4.30 (2.29)^{b}	4.30 (2.30)^{b}	4.30 (2.29)^{b}	1.67 (1.63)^{a}	1.80 (1.67)^{a}	1.73 (1.65)^{a}	1.25 (1.50)^{b}	1.23 (1.49)^{b}	1.24 (1.50)^{b}
B_2: GM	5.80 (2.51)^{a}	5.20 (2.49)^{a}	5.50 (2.54)^{a}	1.05 (1.43)^{b}	1.25 (1.50)^{b}	1.13 (1.46)^{b}	1.85 (1.68)^{a}	1.60 (1.61)^{a}	1.73 (1.65)^{a}
B_3: FS	4.40 (2.31)^{b}	4.10 (2.25)^{b}	4.30 (2.29)^{b}	2.00 (1.73)^{a}	1.77 (1.66)^{a}	1.87 (1.69)^{a}	1.13 (1.45)^{b}	1.08 (1.44)^{b}	1.10 (1.45)^{b}
B_4: FM	5.70 (2.58)^{a}	5.50 (2.54)^{a}	5.60 (2.56)^{a}	1.25 (1.50)^{b}	1.20 (1.48)^{b}	1.23 (1.49)^{b}	2.05 (1.74)^{a}	1.64 (1.62)^{a}	1.87 (1.69)^{a}
S.Em± C.D.at 5%	0.07 0.19	0.03 0.10	0.04 0.11	0.04 0.10	0.03 0.09	0.02 0.06	0.04 0.12	0.03 0.08	0.02 0.07
Interaction									
R_1B_1	2.80 (1.95)^{f}	3.20 (2.05)^{e}	3.00 (2.00)^{e}	1.20 (1.48)^{cd}	1.20 (1.48)^{cd}	1.20 (1.48)^{c}	0.80 (1.34)^{e}	1.00 (1.41)^{ef}	0.90 (1.37)^{de}
R_1B_2	3.80 (2.19)^{def}	4.40 (2.33)^{cd}	4.10 (2.26)^{d}	0.60 (1.26)^{e}	0.60 (1.26)^{e}	0.60 (1.26)^{d}	1.40 (1.54)^{cde}	1.20 (1.48)^{ef}	1.30 (1.51)^{c}
R_1B_3	3.00 (2.00)^{ef}	3.20 (2.05)^{e}	3.10 (2.02)^{e}	1.37 (1.54)^{e}	1.37 (1.54)^{e}	1.37 (1.54)^{c}	0.80 (1.34)^{e}	0.80 (1.34)^{f}	0.80 (1.34)^{e}
R_1B_4	4.60 (2.36)^{cde}	4.80 (2.40)^{bcd}	4.70 (2.38)^{bcd}	0.80 (1.34)^{de}	0.80 (1.34)^{de}	0.80 (1.34)^{d}	1.60 (1.61)^{bcd}	1.30 (1.52)^{cde}	1.45 (1.56)^{bc}
R_2B_1	4.40 (2.31)$^{c-f}$	4.70 (2.38)^{cd}	4.60 (2.35)^{bcd}	1.80 (1.67)^{abc}	1.80 (1.67)^{abc}	1.80 (1.67)^{b}	1.40 (1.55)^{cde}	1.29 (1.51)^{de}	1.35 (1.53)^{c}
R_2B_2	5.60 (2.57)^{abc}	5.30 (2.52)^{abc}	5.50 (2.54)^{ab}	1.20 (1.48)^{cd}	1.20 (1.48)^{cd}	1.20 (1.48)^{c}	2.00 (1.73)^{abc}	1.70 (1.64)$^{a-d}$	1.84 (1.68)^{ab}
R_2B_3	4.80 (2.41)^{bcd}	4.00 (2.23)^{d}	4.40 (2.32)^{cd}	2.20 (1.79)^{a}	2.20 (1.79)^{a}	2.20 (1.78)^{ab}	1.20 (1.48)^{de}	1.20 (1.48)^{ef}	1.20 (1.48)^{cd}
R_2B_4	5.80 (2.61)^{abc}	5.80 (2.60)^{ab}	5.80 (2.60)^{a}	1.40 (1.55)^{e}	1.40 (1.55)^{e}	1.40 (1.55)^{c}	2.20 (1.78)^{ab}	1.80 (1.67)^{abc}	2.00 (1.73)^{a}
R_3B_1	5.80 (2.60)^{abc}	5.10 (2.47)^{abc}	5.40 (2.54)^{ab}	2.07 (1.75)^{ab}	2.07 (1.75)^{ab}	2.07 (1.75)^{ab}	1.60 (1.61)^{bcd}	1.40 (1.55)$^{b-e}$	1.50 (1.58)^{bc}
R_3B_2	6.70 (2.78)^{ab}	5.90 (2.62)^{a}	6.30 (2.70)^{a}	1.37 (1.54)^{c}	1.37 (1.54)^{c}	1.37 (1.54)^{c}	2.20 (1.78)^{ab}	1.90 (1.70)^{ab}	2.04 (1.74)^{a}
R_3B_3	5.40 (2.53)$^{a-d}$	5.10 (2.48)^{abc}	5.30 (2.50)^{abc}	2.40 (1.84)^{a}	2.40 (1.84)^{a}	2.40 (1.84)^{a}	1.40 (1.54)^{cde}	1.29 (1.51)^{de}	1.35 (1.53)^{c}
R_3B_4	6.80 (2.79)^{a}	5.80 (2.61)^{a}	6.30 (2.70)^{a}	1.60 (1.61)^{bc}	1.60 (1.61)^{bc}	1.60 (1.61)^{c}	2.40 (1.84)^{a}	2.00 (1.73)^{a}	2.20 (1.79)^{a}
S.Em± C.D. at 5%	0.11 0.33	0.06 0.18	0.06 0.18	0.06 0.18	0.06 0.18	0.04 0.11	0.07 0.20	0.05 0.14	0.04 0.12
Control	0.20 (1.10)	0.27 (1.13)	0.23 (1.11)	0.20 (1.09)	0.27 (1.14)	0.23 (1.11)	0.20 (1.09)	0.27 (1.13)	0.23 (1.11)
S.Em± C.D. at 5%	0.04 0.13	0.04 0.13	0.03 0.09	0.05 0.15	0.04 0.11	0.03 0.09	0.04 0.13	0.04 0.13	0.03 0.09

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)
Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

spider (1.73 and 1.87, respectively) than grain and fodder maize (1.13 and 1.23, respectively) Maize and sorghum species among themselves were comparable.

Among the treatment combinations, nine rows of fodder sorghum (R_3B_3) recorded higher spider population (2.40) while, six rows of fodder sorghum (R_2B_3 2.20) and nine rows of grain sorghum (R_3B_1, 2.07) were comparable.

Under dense rows of barrier strips (9) the chrysopid population in the barriers was higher (1.77 plant^{-1}) which was significantly superior to six and three rows of barriers. While the population in six rows of barrier was comparable and the lowest population of C*hrysoperla* was recorded with minimum density (3) of barriers (1.10).

Among the barrier species, both grain and fodder maize recorded comparable and significantly higher C*hrysoperla* population (1.73 and 1.87 plant^{-1}, respectively) than grain and fodder sorghum barriers (1.24 and 1.10 plant^{-1}, respectively).

Among the treatment combinations, grain and fodder maize in nine and six rows recorded higher populations of C*hrysoperla* and the values were numerically higher with maximum number of rows while the population with sorghum particularly in three rows was the lowest.

4.1.3.5 Leaf curl index (LCI)

At all the stages of observation, variations in leaf curl index as influenced by barrier intensity (number of rows), barrier species and their interactions were significant and the values were lower on the leeward side than on the windward side of the barrier (Table 28 and 29).

Among the row densities, LCI with nine rows was the lowest (0.30, 0.40 and 0.33 in the leeward side at 60 and 90 DAT and at final picking, respectively). The LCI was influenced significantly the row density decreased and was highest with three rows of barrier width. More or less similar trend was observed on the windward side, the differences between six and nine rows were not significant except at 90 DAT (0.40 and 0.61 with nine rows and 0.49 and 0.72 with six rows with leeward and windward, respectively).

Among the barrier species on both windward and leeward sides fodder sorghum recorded lower LCI at all the stages of crop growth (0.27, 0.38 and 0.28 in the leeward side and 0.48, 0.59 and 0.45 in the windward side, at 60 and 90 DAT and at final picking, respectively) followed by grain sorghum, while maize barrier recorded higher LCI at all the stages, and different maize species differed significantly in their effect only at 90 DAT.

Among the treatment combinations, fodder sorghum in nine rows (R_3B_3) recorded lower LCI at all the stages of observation (0.20, 0.27 and 0.23 in the leeward side and 0.43, 0.43 and 0.37 in the windward side at 60 and 90 DAT and at final picking, respectively). Grain sorghum in nine rows (R_3B_1) and fodder sorghum in six rows (R_2B_3) at 60 and 90 DAT and at final picking and grain sorghum in six rows (R_2B_1) at final picking were at par with the former treatment (R_3B_3). While, higher LCI was observed in three rows of fodder maize and sorghum barriers at all the stages of plant growth. In chilli, LCI without barriers were the highest at all the stages of observation compared to any treatment combination-involving barrier.

4.1.4 Quality parameters

4.1.4.1 Ascorbic acid content (mg 100 g^{-1})

Ascorbic acid content in chilli fruits (green) did not differ significantly due to number of rows of barriers, barrier species and their interactions (Table 30).

The ascorbic acid content of chilli fruits ranged from 188.8 mg 100 g^{-1} with three rows of barriers to the highest of 201.7 mg 100 g^{-1} with nine rows of barriers.

Among the barrier species, ascorbic acid content in chilli fruits ranged from 192.4 mg 100 g^{-1} to 198.3 mg 100 g^{-1} in fodder maize and fodder sorghum, respectively. While, in the treatment combinations it ranged from 186.7 mg 100 g^{-1} with grain sorghum in three rows (R_1B_1) to 205.7 mg 100 g^{-1} in grain sorghum with nine rows (R_3B_1). However, the difference in ascorbic acid content with barrier was significantly higher than chilli without barriers (141.9 mg 100 g^{-1}).

Table 28. Leaf curl index at 60 DAT and 90 DAT as influenced by number of rows of barrier and barrier species

Treatments	60 DAT						90 DAT					
	Windward			Leeward			Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops												
R_1:3 rows	0.62^{a}	0.87^{a}	0.74^{a}	0.50^{a}	0.63^{a}	0.57^{a}	1.17^{a}	0.89^{a}	1.00^{a}	0.80^{a}	0.56^{a}	0.68^{a}
R_2:6 rows	0.45^{b}	0.68^{b}	0.57^{b}	0.33^{b}	0.40^{b}	0.37^{b}	0.78^{b}	0.66^{b}	0.72^{b}	0.58^{b}	0.40^{a}	0.49^{b}
R_3:9 rows	0.45^{b}	0.58^{b}	0.52^{b}	0.32^{b}	0.29^{c}	0.30^{c}	0.66^{c}	0.57^{b}	0.61^{c}	0.46^{c}	0.35^{b}	0.40^{c}
SEm+/- C.D.at 5%	0.08 0.27	0.04 1.11	0.02 0.07	0.02 0.06	0.02 0.07	0.02 0.05	0.03 0.09	0.03 1.10	0.02 0.06	0.026 0.076	0.02 0.06	0.02 0.05
Barrier species												
B_1: GS	0.44^{b}	0.67^{ab}	0.56^{c}	0.33^{c}	0.42^{b}	0.38^{b}	0.79^{c}	0.67^{b}	0.72^{c}	0.53^{c}	0.36^{b}	0.44^{c}
B_2: GM	0.53^{b}	0.76^{ab}	0.64^{b}	0.40^{b}	0.58^{a}	0.49^{a}	0.91^{b}	0.77^{ab}	0.84^{b}	0.66^{b}	0.52^{a}	0.59^{b}
B_3: FS	0.31^{c}	0.64^{b}	0.48^{d}	0.24^{d}	0.29^{c}	0.27^{c}	0.64^{d}	0.53^{c}	0.59^{d}	0.40^{d}	0.36^{b}	0.38^{d}
B_4: FM	0.73^{a}	0.78^{a}	0.76^{a}	0.56^{a}	0.48^{b}	0.52^{a}	1.08^{a}	0.86^{a}	0.97^{a}	0.80^{a}	0.57^{a}	0.68^{a}
S.Em± C.D.at 5%	0.03 0.09	0.04 0.13	0.03 0.08	0.02 0.07	0.03 0.08	0.02 0.05	0.035 0.103	0.04 0.12	0.03 0.07	0.03 0.09	0.02 0.07	0.02 0.06
Interaction												
R_1B_1	0.53^{bc}	0.87^{ab}	0.70^{bc}	0.47^{b}	0.67^{a}	0.57^{bc}	1.00^{c}	0.87^{ab}	0.93^{b}	0.73^{bc}	0.47^{c}	0.60^{cd}
R_1B_2	0.67^{b}	0.93^{a}	0.80^{ab}	0.53^{b}	0.73^{a}	0.63^{b}	1.20^{b}	0.97^{a}	1.08^{a}	0.87^{ab}	0.60^{b}	0.73^{b}
R_1B_3	0.40^{cd}	0.73^{abc}	0.57^{cde}	0.33^{c}	0.40^{b}	0.37^{d}	0.87^{cd}	0.73^{bc}	0.80^{bc}	0.60^{cd}	0.43^{cd}	0.52^{de}
R_1B_4	0.87^{a}	0.93^{a}	0.90^{a}	0.67^{a}	0.73^{a}	0.70^{a}	1.40^{a}	1.00^{a}	1.20^{a}	1.00^{a}	0.73^{a}	0.87^{a}
R_2B_1	0.40^{cd}	0.67^{bcd}	0.53^{de}	0.27^{c}	0.33^{bc}	0.30^{de}	0.73^{de}	0.60^{cd}	0.67^{cd}	0.47^{def}	0.33^{de}	0.40^{fg}
R_2B_2	0.47^{c}	0.73^{abc}	0.60^{cd}	0.33^{c}	0.60^{a}	0.47^{c}	0.80^{d}	0.73^{bc}	0.77^{c}	0.60^{cd}	0.50^{bc}	0.55^{cde}
R_2B_3	0.27^{d}	0.60^{cd}	0.43^{e}	0.20^{c}	0.27^{bc}	0.23^{ef}	0.60^{ef}	0.47^{d}	0.53^{ef}	0.47^{def}	0.27^{ef}	0.37^{gh}
R_2B_4	0.67^{b}	0.73^{abc}	0.70^{bc}	0.53^{b}	0.40^{b}	0.47^{c}	1.00^{c}	0.83^{ab}	0.92^{b}	0.80^{b}	0.50^{bc}	0.65^{bc}
R_3B_1	0.40^{cd}	0.47^{d}	0.43^{e}	0.27^{c}	0.27^{bc}	0.27^{ef}	0.60^{ef}	0.53^{cd}	0.56^{ef}	0.40^{ef}	0.27^{ef}	0.33^{gh}
R_3B_2	0.47^{b}	0.60^{cd}	0.53^{de}	0.33^{c}	0.40^{b}	0.37^{d}	0.73^{de}	0.60^{cd}	0.67^{cd}	0.50^{de}	0.47^{c}	0.48^{ef}
R_3B_3	0.27^{d}	0.60^{cd}	0.43^{e}	0.20^{c}	0.20^{c}	0.20^{f}	0.47^{f}	0.40^{d}	0.43^{f}	0.33^{f}	0.20^{f}	0.27^{h}
R_3B_4	0.67^{b}	0.67^{bcd}	0.67^{bcd}	0.47^{b}	0.30^{bc}	0.38^{cd}	0.83^{cd}	0.73^{bcd}	0.78^{c}	0.60^{cd}	0.47^{c}	0.53^{de}
S.Em± C.D. at 5%	0.06 0.16	0.08 0.22	0.05 0.13	0.04 0.12	0.05 0.14	0.03 0.09	0.061 0.178	0.06 0.20	0.04 0.13	0.05 0.15	0.04 0.12	0.03 0.10
Control	2.53	2.93	2.73	2.53	2.93	2.73	2.87	2.20	2.53	2.87	2.20	2.53
S.Em± C.D. at 5%	0.10 0.28	0.08 0.24	0.06 0.18	0.09 0.27	0.09 0.26	0.06 0.16	0.07 0.21	0.06 0.18	0.05 0.14	0.05 0.14	0.06 0.17	0.04 0.11

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 29. Leaf curl index at final picking as influenced by number of rows of barrier and barrier species

Treatments	Windward			Leeward		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops						
R_1:3 rows	0.73[a]	0.65[a]	0.69[a]	0.53[a]	0.53[a]	0.53[a]
R_2:6 rows	0.56[b]	0.51[b]	0.53[b]	0.36[b]	0.36[b]	0.36[b]
R_3:9 rows	0.51[b]	0.47[b]	0.49[b]	0.33[b]	0.32[b]	0.33[b]
SEm+/- C.D.at 5%	0.03 1.09	0.02 0.06	0.02 0.05	0.018 0.054	0.02 0.06	0.01 0.04
Barrier species						
B_1: GS	0.56[b]	0.49[b]	0.52[b]	0.31[b]	0.33[b]	0.32[b]
B_2: GM	0.62[ab]	0.63[a]	0.63[a]	0.50[a]	0.51[a]	0.51[a]
B_3: FS	0.52[b]	0.38[c]	0.45[c]	0.32[b]	0.24[c]	0.28[c]
B_4: FM	0.70[a]	0.67[a]	0.68[a]	0.47[a]	0.54[a]	0.51[a]
S.Em± C.D.at 5%	0.03 0.10	0.024 0.069	0.02 0.06	0.02 0.07	0.021 0.062	0.02 0.05
Interaction						
R_1B_1	0.67[bc]	0.53[b]	0.60[b]	0.47[b]	0.47[c]	0.47[b]
R_1B_2	0.73[ab]	0.80[a]	0.77[a]	0.60[a]	0.60[b]	0.60[a]
R_1B_3	0.63[bcd]	0.47[bc]	0.55[bc]	0.40[bcd]	0.33[de]	0.37[c]
R_1B_4	0.90[a]	0.80[a]	0.85[a]	0.63[a]	0.73[a]	0.68[a]
R_2B_1	0.53[bcd]	0.47[bc]	0.50[bcd]	0.27[de]	0.27[ef]	0.27[d]
R_2B_2	0.60[bcd]	0.60[b]	0.60[b]	0.47[b]	0.47[c]	0.47[b]
R_2B_3	0.50[cd]	0.37[cd]	0.43[de]	0.30[cde]	0.20[f]	0.25[d]
R_2B_4	0.60[bcd]	0.60[b]	0.60[b]	0.40[bcd]	0.50[bc]	0.45[bc]
R_3B_1	0.47[cd]	0.47[bc]	0.47[cde]	0.20[e]	0.27[ef]	0.23[d]
R_3B_2	0.53[bcd]	0.50[bc]	0.52[bcd]	0.43[bc]	0.47[c]	0.45[bc]
R_3B_3	0.43[d]	0.30[d]	0.37[e]	0.27[de]	0.20[f]	0.23[d]
R_3B_4	0.60[bcd]	0.60[b]	0.60[b]	0.37[bcd]	0.40[cd]	0.38[bc]
S.Em± C.D. at 5%	0.06 0.18	0.04 0.12	0.04 0.10	0.04 0.12	0.037 0.11	0.03 0.10
Control	1.80	1.93	1.87	1.80	1.93	1.87
S.Em± C.D. at 5%	0.05 0.15	0.06 0.18	0.04 0.12	0.04 0.13	0.04 0.13	0.03 0.09

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

4.1.4.2 Capsaicin content (%) and scovielle heat units (SHU)

The capsaicin content and SHU of chilli fruits followed similar trend as that of the ascorbic acid content. Barrier density, barrier species and their interactions were not significant (Table 30).

Among row density capsaicin content varied from 0.159 per cent in three rows to 0.164 per cent in nine rows. Among different barrier species, it varied from 0.159 per cent in grain sorghum to 0.165 per cent in fodder maize and among treatment combinations it ranged from 0.155 per cent with grain sorghum (R_1B_1) and grain maize (R_1B_2) in three rows to 0.170 per cent with grain maize in six rows (R_2B_2) and fodder maize in nine rows (R_2B_4). However, capsaicin content of chilli under barriers irrespective of row density and barrier species was the highest compared to chilli grown without barriers (0.095%).

Among the width of barriers, the SHU varied from 23810 with three rows to 24560 in nine rows. Among different barrier species it varied from 23920 in grain sorghum to 24750 in fodder maize and among the treatment combination, it ranged from 23250 with grain sorghum (R_1B_1) and grain maize in three rows (R_1B_2) to 25500 with grain maize in six rows (R_2B_2) and fodder maize (R_3B_4) in nine rows. However, SHU of chilli under barriers irrespective of row density and barrier species was the highest compared to chilli grown without barriers (14000).

4.1.4.3 Per cent discoloured fruits (%)

Width of the barriers influenced the per cent discoloued fruits significantly. While, barrier species were comparable and at par in their effects, however, the interactions effects of these two factors was significant (Table 31). Larger width barrier (9 rows) recorded significantly lower per cent of discoloured fruits (11.8%). Barrier with six rows was on par with the former treatment, while barrier with three rows was least effective (13.1%). Among the treatment combinations lowest per cent was observed with nine rows with grain sorghum (R_3B_3) and six rows of grain sorghum (R_2B_3) (11.5 and 11.6 per cent, respectively). However, most of the treatments were statistically at par. Grain sorghum and maize in three rows recorded higher per cent discoloured fruits (13.3).Per cent discoloured fruits was the highest under no barrier situation (18.5 %)

4.1.4.4 Yield of good quality fruits (kg ha^{-1})

Yield of good quality fruits almost followed opposite trend of per cent discoloured fruit and besides row width, and barrier species interaction effects of barrier species also resulted in significant variation (Table 31).

Among the row width nine rows barrier recorded the highest yield of good quality chilli fruits (1054 kg ha^{-1}) followed by six rows and the yield was the lowest with three rows (894 kg ha^{-1}).

Among the barrier species, both grain and fodder sorghum produced higher yield of good quality chilli fruits both were at par and were significantly superior (1041 and 1058 kg ha^{-1}, respectively) to both grain and fodder maize barriers (926 and 909 kg ha^{-1}, respectively).

Interaction effects revealed significantly higher yield of good quality chilli fruits (1126 kg ha^{-1}) with nine rows of fodder sorghum (R_3B_3). The treatment combinations of R_3B_1, R_2B_3 and R_2B_1 (1109, 1092 and 1060 kg ha^{-1}, respectively) were on par with the former treatment. The lowest yield of good quality fruits was recorded with three rows of grain maize (R_1B_2) and fodder maize (R_1B_4) barriers (845 and 822 kg ha^{-1}, respectively). Overall, the good quality fruits under barriers were significantly higher compared to chilli without barrier crops (382 kg ha^{-1}).

4.1.4.5 Oleoresin content (%)

Effects due to number of rows and barrier species and their interaction were significant with regard to oleoresin per cent of chilli fruits (Table 32).

Oleoresin per cent increased significantly as the number of rows of barrier crops increased beyond three rows (16.2 and 16.0 with 9 and 6 rows of barriers, respectively), the lowest oleoresin per cent was recorded with three rows of barriers (14.8). However, the differences in oleoresin per cent between six and nine rows were non-significant.

Table 30. Ascorbic acid content (mg 100 g^{-1}), capsaicin content (%) and scovielle heat units (SHU) as influenced by number of rows of barrier and barrier species

Treatments	Ascorbic acid content (mg/100g)			Capsaicin content (%)			Scovielle heat units(SHU)		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops									
R_1:3 rows	187.9[a]	189.7[a]	188.8[a]	0.158[a]	0.160[a]	0.159[a]	23625[a]	24000[a]	23810[a]
R_2:6 rows	195.3[a]	196.5[a]	195.9[a]	0.162[a]	0.165[a]	0.163[a]	24250[a]	24750[a]	24500[a]
R_3:9 rows	202.0[a]	201.5[a]	201.7[a]	0.165[a]	0.163[a]	0.164[a]	24750[a]	24375[a]	24560[a]
SEm+/- C.D.at 5%	5.3 NS	7.8 NS	4.70 NS	0.01 NS	0.01 NS	0.006 NS	1036 NS	977 NS	712 NS
Barrier species									
B_1: GS	197.9[a]	194.5[a]	196.2[a]	0.156[a]	0.163[a]	0.159[a]	23330[a]	24500[a]	23920[a]
B_2: GM	194.5[a]	195.5[a]	195.0[a]	0.170[a]	0.157[a]	0.163[a]	25500[a]	23500[a]	24500[a]
B_3: FS	198.1[a]	198.5[a]	198.3[a]	0.157[a]	0.163[a]	0.160[a]	23500[a]	24500[a]	24000[a]
B_4: FM	189.7[a]	195.2[a]	192.4[a]	0.163[a]	0.167[a]	0.165[a]	24500[a]	25000[a]	24750[a]
S.Em± C.D.at 5%	6.1 NS	9.0 NS	5.5 NS	0.01 NS	0.01 NS	0.007 NS	1196 NS	1128 NS	822 NS
Interaction									
R_1B_1	184.8[a]	188.6[a]	186.7[a]	0.15[a]	0.16[a]	0.155[a]	22500[a]	24000[a]	23250[a]
R_1B_2	188.4[a]	190.2[a]	189.3[a]	0.16[a]	0.15[a]	0.155[a]	24000[a]	22500[a]	23250[a]
R_1B_3	192.1[a]	192.1[a]	192.1[a]	0.16[a]	0.16[a]	0.160[a]	24000[a]	24000[a]	24000[a]
R_1B_4	186.1[a]	188.0[a]	187.1[a]	0.16[a]	0.17[a]	0.165[a]	24000[a]	25500[a]	24750[a]
R_2B_1	198.1[a]	194.2[a]	196.2[a]	0.16[a]	0.17[a]	0.165[a]	23500[a]	25500[a]	24500[a]
R_2B_2	194.4[a]	196.8[a]	195.6[a]	0.18[a]	0.16[a]	0.170[a]	27000[a]	24000[a]	25500[a]
R_2B_3	198.4[a]	198.8[a]	198.6[a]	0.15[a]	0.17[a]	0.160[a]	22500[a]	25500[a]	24000[a]
R_2B_4	190.3[a]	196.2[a]	193.3[a]	0.16[a]	0.16[a]	0.160[a]	24000[a]	24000[a]	24000[a]
R_3B_1	210.8[a]	200.6[a]	205.7[a]	0.16[a]	0.16[a]	0.160[a]	24000[a]	24000[a]	24000[a]
R_3B_2	200.6[a]	199.4[a]	200.0[a]	0.17[a]	0.16[a]	0.165[a]	25500[a]	24000[a]	24750[a]
R_3B_3	203.8[a]	204.6[a]	204.2[a]	0.16[a]	0.16[a]	0.160[a]	24000[a]	24000[a]	24000[a]
R_3B_4	192.6[a]	201.4[a]	197.0[a]	0.17[a]	0.17[a]	0.170[a]	25500[a]	25500[a]	25500[a]
S.Em± C.D. at 5%	10.6 NS	15.6 NS	9.40 NS	0.02 NS	0.01 NS	0.013 NS	2072 NS	1954 NS	1424 NS
Control	143.4	140.4	141.9	0.09	0.10	0.095	13000	15000	14000
S.Em± C.D. at 5%	10.3 30.0	15.0 43.7	9.10 25.80	0.02 0.05	0.02 0.05	0.01 0.04	1988 5804	2027 5918	1420 4037

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 31. Per cent discoloured fruits and yield of good fruits (kg ha^{-1}) as influenced by number of rows of barrier and barrier species

Treatments	Discoloured fruits (%)			Yield of good fruits (kg ha^{-1})		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops						
R_1:3 rows	13.6^{a}	12.6^{a}	13.1^{a}	793^{c}	995^{b}	894^{c}
R_2:6 rows	12.2^{b}	11.6^{a}	11.9^{b}	888^{b}	1117^{a}	1002^{b}
R_3:9 rows	12.1^{b}	11.5^{a}	11.8^{b}	947^{a}	1161^{a}	1054^{a}
SEm+/- C.D.at 5%	0.31 0.89	0.27 0.78	0.20 0.58	17.7 51.9	19.6 57.4	13.2 37.6
Barrier species						
B_1: GS	12.7^{a}	12.1^{ab}	12.4^{a}	944^{a}	1138^{a}	1041^{a}
B_2: GM	12.6^{a}	12.2^{a}	12.4^{a}	827^{b}	1025^{b}	926^{b}
B_3: FS	12.6^{a}	11.2^{b}	11.9^{a}	925^{a}	1190^{a}	1058^{a}
B_4: FM	12.5^{a}	12.1^{ab}	12.3^{a}	808^{b}	1010^{b}	909^{b}
S.Em± C.D.at 5%	0.35 NS	0.31 0.90	0.23 NS	20.5 60.0	22.6 66.3	15.3 43.5
Interaction						
R_1B_1	13.9^{a}	12.6^{abc}	13.3^{a}	851^{cde}	1055^{de}	953^{c}
R_1B_2	13.6^{a}	12.9^{a}	13.3^{a}	769^{ef}	921^{f}	845^{d}
R_1B_3	13.5^{a}	12.1^{abc}	12.8^{abc}	823^{def}	1087^{cde}	955^{c}
R_1B_4	13.4^{a}	12.7^{ab}	13.0^{ab}	729^{f}	915^{f}	822^{d}
R_2B_1	12.2^{a}	11.8^{abc}	12.0^{abc}	958^{abc}	1162^{a-d}	1060^{ab}
R_2B_2	12.2^{a}	11.9^{abc}	12.1^{abc}	808^{def}	1044^{de}	926^{c}
R_2B_3	12.3^{a}	10.9^{bc}	11.6^{c}	954^{abc}	1230^{ab}	1092^{a}
R_2B_4	12.1^{a}	11.9^{abc}	12.0^{abc}	830^{def}	1030^{ef}	930^{c}
R_3B_1	12.2^{a}	11.7^{abc}	12.0^{abc}	1022^{a}	1195^{abc}	1109^{a}
R_3B_2	12.0^{a}	11.9^{abc}	11.9^{bc}	904^{bcd}	1111^{b-e}	1007^{bc}
R_3B_3	12.2^{a}	10.8^{c}	11.5^{c}	999^{ab}	1254^{a}	1126^{a}
R_3B_4	11.9^{a}	11.8^{abc}	11.9^{bc}	865^{cde}	1084^{cde}	975^{c}
S.Em± C.D. at 5%	0.61 NS	0.53 1.56	0.40 1.15	35.4 103.9	39.2 114.9	26.4 75.3
Control	19.0	18.0	18.5	387.0	376.0	382.0
S.Em± C.D. at 5%	0.72 2.10	0.59 1.72	0.46 1.32	36.7 107.2	37.6 109.6	26.3 74.7

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among the barrier species, chilli with fodder maize recorded significantly higher oleoresin per cent (16.4) over rest of the barrier species, which were at par with one another.

Among the treatment combinations, chilli with nine (R_3B_4) and six rows (R_2B_4) of fodder maize (16.7 each) and nine (R_3B_3) and six (R_2B_3) rows of fodder sorghum (16.6 and 16.2, respectively) recorded higher and at par oleoresin percentage. While, three rows of barrier particularly fodder sorghum (R_1B_3) recorded lower oleoresin per cent (14.1). Similarly, grain sorghum both at six and nine rows were below par than best performing treatment. Irrespective of number of rows, the oleoresin per cent was always higher with fodder species, particularly fodder maize. The oleoresin per cent with barrier crops, however, was higher than without barrier (9.0%).

4.1.4.6 Oleoresin yield (kg ha^{-1})

Barrier row intensity, barrier species and their interactions had significant influence on oleoresin yield (Table 32).

As far the effect of row width was concerned oleoresin yield followed the trend of oleoresin per cent. Oleoresin yield was the highest with nine rows (171 kg ha^{-1}) and the lowest was with three rows (133 kg ha^{-1}), while it was moderate with six rows (161 kg ha^{-1}). Influence of barrier species did not follow similar trend in fruit oleoresin content. Chilli with fodder sorghum as a barrier crop recorded significantly higher oleoresin yield (166 kg ha^{-1}), followed by grain sorghum both were at par. Significantly lower oleoresin yield was recorded with grain maize (145 kg ha^{-1}).

Among the treatment combinations, chilli with nine rows of fodder sorghum (R_3B_3) recorded significantly higher oleoresin yield (187 kg ha^{-1}) compared to the rest of the treatment combinations except chilli with six rows of fodder sorghum (R_2B_3) and nine rows of grain sorghum (R_3B_1) (178 and 171 kg ha^{-1}, respectively). While, the lowest oleoresin yield was recorded with three rows of grain maize (R_1B_2) as a barrier (124 kg ha^{-1}). Overall, the oleoresin yield under barrier was significantly higher compared to chilli crop without barrier (35 kg ha^{-1}).

4.1.5 Economic analysis

4.1.5.1 Gross return

The differences in gross return as influenced by barrier intensity (number of rows), barrier species and their interactions were significant (Table 33).

Gross return increased significantly with the increase in number of rows of barriers beyond three rows. The differences between six and nine rows of barriers were non-significant (Rs.53360 and Rs.53570 ha^{-1} with nine and six rows, respectively).

Among the barrier species, chilli with fodder sorghum recorded significantly higher gross return (Rs.57760 ha^{-1}) compared to the rest of the barrier species except grain sorghum (Rs.56190 ha^{-1}). Lower gross returns were recorded with fodder (Rs.47820 ha^{-1}) and grain maize barriers (Rs.48400 ha^{-1}).

The interaction effect revealed significantly higher gross return (Rs. 58180 ha^{-1}) with six rows of fodder sorghum (R_2B_3) recorded compared to the rest of the treatment combinations except chilli with six rows of grain sorghum (R_2B_1) and chilli with nine rows of grain and fodder sorghum (R_3B_1 and R_3B_3) as a barriers (Rs. 57280, Rs.57730 and Rs.57560 ha^{-1}, respectively). However, the lowest gross return was recorded with the treatment combination consisted of chilli with three rows of grain and fodder maize (R_1B_2 and R_1B_4) as barriers (Rs. 45770 and Rs.45980 ha^{-1}, respectively). In general, the gross return under barrier was significantly higher compared to the chilli crop without barrier (Rs. 23400 ha^{-1}).

4.1.5.2 Net return (Rs. ha^{-1})

Net return differed significantly due to number of rows of barriers, species of barriers and their interactions (Table 33).

Under intense rows of barriers (6 and 9) significantly higher net returns were recorded (Rs.36130 and Rs.35410 ha^{-1}, respectively) compared to three rows of barrier (Rs.32780 ha^{-1}). The differences in net returns between six and nine rows of barriers were not significant.

Table 32. Oleoresin content (%) and oleoresin yield (kg ha^{-1}) as influenced by number of rows of barrier and barrier species

Treatments	Oleoresin content (%)			Oleoresin yield (kg ha^{-1})		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops						
R_1:3 rows	14.7^{b}	15.0^{b}	14.8^{b}	117^{c}	149^{b}	133^{c}
R_2:6 rows	16.0^{a}	16.1^{a}	16.0^{a}	141^{b}	180^{a}	161^{b}
R_3:9 rows	16.2^{a}	16.3^{a}	16.2^{a}	153^{a}	189^{a}	171^{a}
SEm+/- C.D.at 5%	0.25 0.74	0.24 0.70	0.17 0.49	3.74 10.97	4.30 12.7	2.9 8.2
Barrier species						
B_1: GS	15.0^{b}	15.3^{b}	15.2^{b}	142^{a}	174^{ab}	158^{ab}
B_2: GM	15.5^{ab}	15.7^{ab}	15.6^{b}	128^{b}	162^{b}	145^{c}
B_3: FS	15.6^{ab}	15.7^{ab}	15.6^{b}	145^{a}	187^{a}	166^{a}
B_4: FM	16.3^{a}	16.5^{a}	16.4^{a}	132^{ab}	167^{b}	150^{bc}
S.Em± C.D.at 5%	0.29 0.85	0.28 0.81	0.20 0.57	4.3 12.7	5.0 14.7	3.3 9.4
Interaction						
R_1B_1	14.9^{cd}	15.0^{abc}	15.0^{cde}	127^{cd}	159^{c-f}	143^{efg}
R_1B_2	14.6^{cd}	14.7^{bc}	14.7^{de}	112^{d}	136^{f}	124^{h}
R_1B_3	14.2^{d}	14.0^{c}	14.1^{e}	116^{d}	152^{def}	134^{fgh}
R_1B_4	15.2^{bcd}	16.2^{ab}	15.7^{a-d}	111^{d}	149^{ef}	130^{gh}
R_2B_1	15.1^{bcd}	15.1^{abc}	15.1^{b-e}	145^{abc}	175^{b-c}	160^{b-e}
R_2B_2	15.8^{a-d}	16.2^{ab}	16.0^{abc}	128^{cd}	170^{cde}	149^{def}
R_2B_3	16.0^{abc}	16.5^{a}	16.2^{ab}	153^{ab}	202^{ab}	178^{ab}
R_2B_4	16.9^{a}	16.6^{a}	16.7^{a}	140^{bc}	173^{cde}	157^{cde}
R_3B_1	15.1^{bcd}	15.6^{ab}	15.4^{bcd}	154^{ab}	187^{abc}	171^{abc}
R_3B_2	16.0^{abc}	16.2^{ab}	16.1^{abc}	145^{abc}	181^{a-d}	163^{bcd}
R_3B_3	16.6^{ab}	16.6^{a}	16.6^{a}	167^{a}	208^{a}	187^{a}
R_3B_4	16.9^{a}	16.6^{a}	16.7^{a}	146^{abc}	180^{a-d}	163^{bcd}
S.Em± C.D. at 5%	0.50 1.47	0.48 1.40	0.35 0.99	7.50 21.9	8.7 25.4	5.7 16.3
Control	9.15	8.92	9.0	35	34	35
S.Em± C.D. at 5%	0.49 1.42	0.46 1.34	0.34 0.96	7.3 21.4	8.4 24.6	5.6 15.9

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 33. Gross return (Rs. ha^{-1}) and net return (Rs. ha^{-1}) and B:C ratio as influenced by number of rows of barrier and barrier species

Treatments	Gross return (Rs. ha^{-1})			Net return (Rs. ha^{-1})			B:C ratio		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Number of rows of barrier crops									
R_1:3 rows	44020^{b}	55150^{b}	45590^{b}	27290^{b}	38270^{b}	32780^{b}	2.60^{b}	3.27^{b}	2.93^{b}
R_2:6 rows	48200^{a}	58950^{a}	53570^{a}	30750^{a}	41500^{a}	36130^{a}	2.76^{a}	3.42^{a}	3.09^{a}
R_3:9 rows	49090^{c}	57630^{ab}	53360^{a}	31140^{a}	39680^{ab}	35410^{a}	2.73^{a}	3.21^{ab}	2.97^{b}
SEm+/- C.D.at 5%	886 2598	1106 3243	708 2019	900 2641	930 2727	647 1844	0.05 0.15	0.07 0.19	0.04 0.11
Barrier species									
B_1: GS	51360^{a}	61020^{b}	56190^{a}	33820^{a}	43480^{a}	38650^{a}	2.93^{a}	3.49^{a}	3.21^{a}
B_2: GM	43680^{b}	53120^{c}	48400^{b}	26580^{b}	35800^{b}	31200^{b}	2.52^{b}	3.08^{b}	2.80^{b}
B_3: FS	50000^{a}	65520^{a}	57760^{a}	32470^{a}	45010^{a}	38740^{a}	2.85^{a}	3.58^{a}	3.22^{a}
B_4: FM	43380^{b}	52270^{c}	47820^{b}	26040^{b}	34930^{b}	30490^{b}	2.50^{b}	3.03^{b}	2.77^{b}
S.Em± C.D.at 5%	1023 3000	1277 3744	818 2331	1040 3049	1074 3149	742 2130	0.06 0.17	0.08 0.22	0.05 0.13
Interaction									
R_1B_1	48120^{bcd}	59000^{abc}	53650^{bc}	31120^{ab}	42000^{ab}	36560^{b}	2.83^{abc}	3.47^{abc}	3.15^{b}
R_1B_2	40900^{e}	50650^{d}	45770^{d}	34780^{c}	33850^{c}	29320^{d}	2.43^{d}	3.02^{de}	2.73^{c}
R_1B_3	46220^{cde}	59850^{abc}	53030^{c}	29220^{bc}	42920^{a}	36070^{bc}	2.72^{a-d}	3.53^{ab}	3.13^{b}
R_1B_4	40850^{e}	51120^{d}	45980^{d}	24050^{c}	34320^{c}	29180^{d}	2.43^{d}	3.04^{de}	2.74^{c}
R_2B_1	52000^{ab}	62550^{a}	57280^{ab}	34500^{a}	45050^{a}	39780^{ab}	2.97^{a}	3.59^{a}	3.28^{ab}
R_2B_2	44280^{de}	54150^{cd}	49220^{cd}	26900^{bc}	36750^{bc}	31820^{d}	2.55^{bcd}	3.16^{b-e}	2.85^{c}
R_2B_3	51670^{abc}	64700^{a}	58180^{a}	34170^{a}	47200^{a}	40680^{a}	2.95^{a}	3.74^{a}	3.43^{a}
R_2B_4	44850^{e}	54380^{bcd}	49620^{cd}	27450^{bc}	36980^{bc}	32220^{cd}	2.58^{bcd}	3.16^{b-e}	2.87^{c}
R_3B_1	53950^{a}	61500^{ab}	57730^{ab}	33850^{a}	43400^{a}	39630^{ab}	2.98^{a}	3.40^{a-d}	3.19^{ab}
R_3B_2	45870^{de}	54700^{bcd}	50280^{cd}	28070^{bc}	36900^{bc}	32480^{cd}	2.58^{bcd}	3.07^{cde}	2.82^{c}
R_3B_3	52120^{ab}	63000^{a}	57560^{ab}	34020^{a}	44900^{a}	39460^{ab}	2.88^{ab}	3.48^{abc}	3.18^{ab}
R_3B_4	44430^{de}	51300^{d}	47870^{d}	26630^{bc}	33500^{c}	30070^{d}	2.50^{cd}	2.88^{e}	2.69^{c}
S.Em± C.D. at 5%	1772 5196	2211 6485	1417 4038	1801 5282	1859 5453	1294 3689	0.10 0.30	0.13 0.38	0.08 0.23
Control	23850	22950	23400	7550	6650	7100	1.46	1.41	1.44
S.Em± C.D. at 5%	1835 5355	2119 6184	1401 3984	1866 5440	1786 5212	1291 3672	0.11 0.31	0.12 0.36	0.08 0.23

Note: GS: Grain sorghum, GM:Grain maize, FS:Fodder sorghum, FM: Fodder maize
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among the barrier species, chilli with fodder and grain sorghum recorded significantly higher net returns (Rs. 38740 and 38650 ha^{-1}, respectively). On the other hand, significantly lower net returns were recorded with grain maize and fodder maize as barriers (Rs.31200 and Rs.30490 ha^{-1}, respectively) and both were at par.

Among the treatment combinations chilli with six rows of fodder sorghum (R_2B_3) recorded significantly higher net return (Rs.40680 ha^{-1}) compared to the rest of the treatment combinations except chilli with six rows of grain (R_2B_1) and nine rows grain R_3B_1) and fodder sorghum (R_3B_3) as barriers (Rs. 39780, Rs. 39630 and Rs. 39460 ha^{-1}, respectively). While, chilli with fodder and grain maize recorded lower net return. Overall, the net returns under barriers were significantly higher compared to chilli without barrier crops (Rs.7100 ha^{-1}).

4.1.5.3 B: C ratio

The data revealed significant differences in the B: C ratio due to number of rows of barriers, barrier species and their interactions (Table 33).

Among the barrier widths, chilli with six rows of barriers recorded significantly higher B: C ratio (3.09) compared to nine and three rows of barriers.

In barrier species, fodder and grain sorghum recorded significantly higher B:C ratios (3.22 and 3.21, respectively), while chilli with fodder and grain maize as barriers recorded lower B:C ratios (2.77 and 2.80, respectively). The differences within grain and fodder species were statistically at par for particular crops.

Interaction effects revealed higher B: C ratio (3.43) with six rows of fodder sorghum (R_2B_3). Six rows of grain sorghum (R_2B_1) and nine rows of fodder and grain sorghum (R_3B_3 and R_3B_1) as barriers (3.28, 3.18 and 3.19, respectively) were on par with the former treatment. While, chilli with nine rows of fodder maize (R_3B_4) recorded lowest B: C ratio (2.69). Among all, the B: C ratio under barriers was significantly higher compared to chilli without barrier crops (1.44).

4.1.6 Correlation studies

A significant correlation was observed between chilli yield (kg ha^{-1}) and yield parameters, entomological and quality parameters averaged over the sides (Table 33a).

Among growth and yield parameters dry matter production (0.87), fruit yield $hill^{-1}$ (0.96), fruit length (0.84), 100-fruit weight (0.95) and seed to pod ratio (0.92) were significantly and highly correlated with chilli yield. Among the entomological parameters thrips $leaf^{-1}$, mites $leaf^{-1}$ and LCI were significantly and highly negatively correlated with chilli yield at all the stages of observation.

Among the quality parameters yield of good quality fruits (0.48) and oleoresin yield (0.87) were significantly and positively correlated but yield of discoloured fruits was negatively correlated (-0.69).

4.2 EXPERIMENT II: EFFECT OF INTERCROPPING, N SUBSTITUTION AND GRADED LEVELS OF K ON THE PERFORMANCE OF CHILLI AND BEHAVIOUR OF *MURDA* COMPLEX

4.2.1 Growth parameters

4.2.1.1 Plant height (cm)

Plant height differed significantly due to intercropping, N substitution, graded levels K and their interactions at all the stages of observation (Table 34).

Chilli + garlic intercropping system recorded significantly higher plant height (26.4, 42.2, 68.1 and 71.5 cm, at 30, 60 and 90 DAT and at final picking, respectively). Under intercropping plant height was reduced significantly with coriander inter crop, while there was no adverse effect of garlic on plant height and chilli under garlic was almost similar to sole chilli if not superior.

Table 33a. Correlation coefficient (r) between chilli yield (kg ha^{-1}) and growth parameters, yield parameters, entomological and quality parameters

Parameters	Correlation coefficient (r) (pooled data)	
	Leeward	Windward
1. Growth parameters		
Dry matter production (g $hill^{-1}$)	0.88**	0.85**
2. Yield parameters		
Fruit yield $hill^{-1}$ (g $hill^{-1}$)	0.96**	0.95**
Fruit length (cm)	0.92**	0.76**
100-fruit weight (g)	0.95**	0.94**
Seed to pod ratio	0.94**	0.90**
3. Entomological parameters		
Thrips $leaf^{-1}$ 30 DAT	-0.91**	-0.88**
Thrips $leaf^{-1}$ 60 DAT	-0.92**	-0.94**
Thrips $leaf^{-1}$ 90 DAT	-0.88**	-0.91**
Thrips $leaf^{-1}$ At final picking	-0.90**	-0.92**
Mites $leaf^{-1}$ 60 DAT	-0.88**	-0.96**
Mites $leaf^{-1}$ 90 DAT	-0.94**	-0.67**
Mites $leaf^{-1}$ At final picking	-0.94**	-0.92**
Leaf curl index 60 DAT	-0.88**	-0.97**
Leaf curl index 90 DAT	-0.94**	-0.94**
Leaf curl index At final picking	-0.93**	-0.95**
4. Quality parameters		
Discoloured fruits (%)	-0.69*	
Yield of good fruits (kg ha^{-1})	0.48*	
Oleoresin per cent (%)	0.20	
Oleoresin yield (kg ha^{-1})	0.87**	

* - Significant at 0.05 level
** - Significant at 0.01 level

Among various nutrient levels, NPK in 1:1:1 ratio (S_3) recorded taller plants from the beginning, while S_4 ($N_{25}P_{50}K_{75}$) fared at par during later stages (90 DAT and at final picking). Total substitution of N through inorganics recorded lower plant height at all the stages and was significantly inferior to S_3 ($N_{50}P_{50}K_{50}$).

Among the treatment combinations, chilli under garlic intercrop receiving equal doses of nitrogen through organics and inorganics (I_1S_3) recorded significantly taller plants at all the stages of plant growth. While, crop with coriander as an intercrop and zero level of inorganic nitrogen (I_2S_0) recorded significantly dwarf plants, while performance of other treatment combinations were intermediate.

Table 34. Plant height (cm) of bydagi chilli (*dabbi*) at 30, 60, 90 DAT and at final picking as influenced by intercropping, N substitution and graded levels of K

Treatments	30 DAT			60 DAT			90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping												
I_0: Sole chilli	24.4^{ab}	27.5^{a}	26.0^{a}	42.1^{a}	42.6^{a}	42.3^{a}	68.5^{a}	61.8^{b}	65.2^{b}	70.8^{a}	67.6^{b}	69.2^{a}
I_1: Chilli+Garlic	26.2^{a}	26.5^{a}	26.4^{a}	42.2^{a}	42.5^{a}	42.2^{a}	67.7^{a}	68.5^{a}	68.1^{a}	69.8^{a}	73.1^{a}	71.5^{a}
I_2: Chilli+Coriander	22.8^{b}	23.3^{b}	23.1^{b}	37.0^{b}	39.7^{b}	38.4^{b}	52.1^{b}	53.8^{c}	52.9^{c}	54.6^{b}	62.9^{c}	58.8^{b}
S.Em.±	0.81	0.55	0.49	1.12	0.78	0.68	1.38	1.37	0.97	1.44	1.46	1.03
LSD (0.05)	2.37	1.61	1.39	3.26	2.27	1.93	4.04	4.01	2.77	4.21	4.23	2.92
N substitution and graded levels of K												
S_1: N_0:P_{50}:K_{100}	23.8^{b}	23.8^{a}	23.8^{b}	38.4^{b}	38.7^{c}	38.5^{c}	56.6^{c}	54.1^{c}	55.4^{c}	62.0^{b}	61.3^{c}	66.6^{c}
S_2: N_{25}:P_{50}:K_{75}	24.8^{ab}	24.9^{ab}	24.9^{b}	40.3^{ab}	40.7^{bc}	40.5^{b}	62.9^{ab}	63.0^{ab}	63.0^{ab}	64.0^{ab}	65.4^{bc}	64.7^{bc}
S_3: N_{50}:P_{50}:K_{50}	27.2^{a}	27.6^{abc}	27.4^{a}	44.3^{a}	45.1^{a}	44.5^{a}	67.0^{a}	65.7^{a}	66.3^{a}	69.0^{a}	73.1^{a}	71.0^{a}
S_4: N_{75}:P_{50}:K_{25}	24.2^{ab}	26.6^{bc}	25.4^{b}	40.3^{ab}	42.9^{b}	41.6^{b}	62.3^{ab}	65.2^{a}	63.8^{a}	67.4^{ab}	71.8^{a}	69.6^{ab}
S_5: N_{100}:P_{50}:K_0	22.5^{b}	25.9^{c}	24.2^{b}	38.7^{b}	40.9^{bc}	39.8^{b}	61.0^{bc}	58.9^{bc}	60.0^{b}	63.0^{b}	67.8^{ab}	65.5^{c}
S.Em.±	1.05	0.71	0.62	1.44	1.00	0.88	1.79	1.77	1.26	1.86	1.89	1.33
LSD (0.05)	3.05	2.08	1.80	4.21	2.92	2.50	5.21	5.18	3.58	5.44	5.51	3.77
Interaction												
I_0S_1	23.0^{abc}	25.8^{b-f}	24.4^{c-f}	39.8^{abc}	40.0^{b-d}	39.9^{b-e}	63.2^{abc}	51.4^{f}	57.3^{de}	69.5^{abc}	57.4^{f}	63.4^{cde}
I_0S_2	24.9^{abc}	26.7^{b-e}	25.8^{b-e}	41.9^{abc}	43.4^{a-c}	42.7^{ab}	67.4^{abc}	64.3^{a-d}	65.9^{abc}	68.4^{abc}	65.4^{c-f}	66.9^{bcd}
I_0S_3	28.6^{ab}	31.5^{a}	30.1^{a}	46.0^{a}	45.3^{ab}	45.7^{a}	72.0^{a}	67.9^{abc}	70.0^{a}	74.1^{a}	74.8^{abc}	74.5^{a}
I_0S_4	23.2^{abc}	27.6^{a-d}	25.4^{b-f}	42.2^{abc}	43.0^{a-c}	42.6^{abc}	71.7^{a}	66.1^{a-d}	68.9^{ab}	73.2^{a}	70.7^{a-d}	72.0^{ab}
I_0S_5	22.4^{bc}	25.7^{b-f}	24.1^{c-f}	40.4^{abc}	41.0^{a-d}	40.7^{a-d}	68.1^{ab}	57.3^{def}	62.7^{bcd}	68.8^{abc}	69.6^{a-d}	69.2^{a-d}
I_1S_1	25.8^{abc}	23.6^{def}	24.7^{b-f}	40.3^{abc}	39.8^{bcd}	40.1^{b-e}	60.9^{bcd}	61.5^{b-e}	61.2^{cd}	67.8^{abc}	68.6^{a-e}	68.2^{a-d}
I_1S_2	26.0^{abc}	24.8^{b-f}	25.4^{b-f}	42.8^{abc}	41.2^{a-d}	42.0^{abc}	68.8^{ab}	68.3^{abc}	68.5^{ab}	69.2^{abc}	69.3^{a-d}	69.3^{a-d}
I_1S_3	28.8^{a}	27.5^{b-d}	28.2^{ab}	44.8^{ab}	45.9^{a}	45.3^{a}	70.8^{ab}	70.3^{ab}	70.5^{a}	72.8^{a}	77.4^{ab}	75.1^{a}
I_1S_4	26.4^{abc}	27.8^{a-c}	27.1^{abc}	41.9^{abc}	44.2^{ab}	43.0^{ab}	69.6^{ab}	73.7^{a}	71.7^{a}	70.3^{ab}	79.0^{a}	74.6^{a}
I_1S_5	24.1^{abc}	28.9^{ab}	26.5^{bcd}	41.0^{abc}	41.5^{a-d}	41.3^{a-d}	68.4^{ab}	68.6^{abc}	68.5^{ab}	69.2^{abc}	71.4^{a-d}	70.3^{abc}
I_2S_1	22.6^{abc}	22.1^{f}	22.3^{ef}	35.0^{c}	36.4^{d}	35.7^{e}	45.8^{e}	49.3^{f}	47.6^{f}	48.6^{e}	57.9^{ef}	53.2^{f}
I_2S_2	23.5^{abc}	23.2^{ef}	23.4^{def}	36.2^{c}	37.6^{cd}	36.9^{de}	52.5^{de}	54.5^{ef}	53.5^{ef}	54.5^{de}	61.4^{def}	58.0^{ef}
I_2S_3	24.1^{abc}	23.7^{c-f}	23.9^{c-f}	42.0^{abc}	43.0^{a-c}	42.5^{abc}	58.1^{cd}	58.8^{c-f}	58.5^{de}	60.1^{bcd}	66.9^{b-f}	63.5^{cde}
I_2S_4	23.0^{abc}	24.4^{c-f}	23.7^{c-f}	36.8^{bc}	41.5^{a-d}	39.1^{b-e}	57.5^{cd}	55.6^{ef}	56.6^{de}	58.8^{cde}	65.7^{c-f}	62.3^{de}
I_2S_5	21.0^{c}	23.1^{ef}	22.0^{f}	34.8^{c}	40.3^{b-d}	37.6^{cde}	46.5^{e}	50.7^{f}	48.6^{f}	51.0^{de}	62.8^{def}	56.9^{ef}
S.Em.±	1.81	1.23	1.10	2.50	1.74	1.52	3.09	3.07	2.18	3.23	3.27	2.29
LSD (0.05)	5.23	3.60	3.12	7.29	5.06	4.32	9.02	8.97	6.20	9.42	9.54	6.53
C.V(%)	12.8	8.29	10.7	10.7	7.22	9.1	8.53	8.67	8.60	8.59	8.34	8.5

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form N, base figures indicate N substitution with inorganics only.
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 35. Number of secondary branches per hill bydagi chilli (*dabbi*) at 30, 60, 90 DAT and at final picking as influenced by intercropping, N substitution and graded levels of K

Treatments	30 DAT			60 DAT			90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping												
I_0: Sole chilli	2.5^{a}	3.2^{a}	2.9^{a}	6.0^{a}	5.9^{b}	6.0^{b}	8.2^{b}	8.7^{b}	8.5^{b}	9.2^{b}	9.5^{b}	9.4^{b}
I_1: Chilli+Garlic	2.2^{b}	2.5^{b}	2.3^{b}	6.1^{a}	6.9^{a}	6.5^{a}	9.7^{a}	10.0^{a}	9.8^{a}	10.2^{a}	11.1^{a}	10.7^{a}
I_2: Chilli+Coriander	1.7^{c}	2.0^{c}	1.9^{c}	5.7^{b}	5.9^{b}	5.8^{b}	7.6^{c}	7.4^{c}	7.5^{c}	8.2^{c}	9.4^{b}	8.8^{c}
S.Em.±	0.08	0.06	0.05	0.21	0.14	0.13	0.14	0.28	0.16	0.25	0.15	0.15
LSD (0.05)	0.23	0.17	0.14	0.62	0.41	0.36	0.40	0.82	0.44	0.74	0.44	0.42
N substitution and graded levels of K												
S_1: N_0:P_{50}:K_{100}	1.8^{c}	2.2^{c}	2.0^{c}	5.3^{c}	5.4^{d}	5.4^{c}	8.0^{c}	8.3^{b}	8.2^{b}	9.1^{b}	9.6^{c}	9.3^{c}
S_2: N_{25}:P_{50}:K_{75}	2.0^{bc}	2.4^{bc}	2.2^{b}	5.9^{abc}	5.9^{cd}	5.9^{b}	8.4^{abc}	8.6^{ab}	8.5^{b}	9.5^{ab}	10.4^{b}	9.9^{b}
S_3: N_{50}:P_{50}:K_{50}	2.5^{a}	2.9^{a}	2.7^{a}	6.6^{a}	6.9^{a}	6.8^{a}	8.9^{a}	9.6^{a}	9.2^{a}	10.2^{a}	11.1^{a}	10.7^{a}
S_4: N_{75}:P_{50}:K_{25}	2.1^{ab}	2.5^{b}	2.3^{b}	6.2^{ab}	6.7^{ab}	6.5^{a}	8.8^{ab}	8.7^{ab}	8.7^{ab}	9.3^{ab}	10.9^{ab}	9.7^{b}
S_5: N_{100}:P_{50}:K_0	2.4^{a}	2.8^{a}	2.6^{a}	5.4^{bc}	6.2^{bc}	5.8^{b}	8.3^{bc}	8.3^{b}	8.3^{b}	8.6^{b}	9.0^{d}	8.8^{c}
S.Em.±	0.11	0.07	0.06	0.27	0.18	0.16	0.18	0.36	0.20	0.33	0.19	0.19
LSD (0.05)	0.30	0.21	0.18	0.80	0.53	0.47	0.51	1.06	0.57	0.96	0.57	0.54
Interaction												
I_0S_1	2.0^{b-f}	2.9^{bc}	2.5^{bc}	5.3^{b}	4.8^{f}	5.1^{e}	7.8^{ef}	8.3^{bc}	8.1^{fgh}	8.6^{bcd}	9.3^{d-f}	9.0^{fgh}
I_0S_2	2.2^{b-e}	2.9^{bc}	2.5^{bc}	6.0^{ab}	5.5^{def}	5.8^{cde}	8.1^{def}	8.8^{abc}	8.5^{d-g}	9.2^{bc}	10.0^{cd}	9.6^{def}
I_0S_3	2.9^{a}	3.7^{a}	3.3^{a}	6.8^{ab}	6.8^{abc}	6.8^{ab}	8.3^{def}	9.4^{ab}	8.9^{c-e}	10.2^{ab}	10.5^{bc}	10.3^{bcd}
I_0S_4	2.4^{abc}	3.0^{b}	2.7^{b}	6.4^{ab}	6.5^{cde}	6.5^{bc}	8.7^{cde}	8.7^{abc}	8.7^{c-e}	9.1^{bcd}	9.7^{c-e}	9.4^{d-g}
I_0S_5	2.9^{a}	3.5^{a}	3.2^{a}	5.4^{b}	5.9^{cde}	5.7^{cde}	7.9^{ef}	8.4^{bc}	8.1^{fgh}	8.8^{bcd}	8.3^{f}	8.5^{gh}
I_1S_1	1.9^{c-f}	2.1^{fg}	2.0^{efg}	5.3^{b}	6.1^{bc}	5.7^{cde}	9.0^{bcd}	9.6^{ab}	9.3^{b-e}	9.8^{ab}	10.7^{bc}	10.3^{b-e}
I_1S_2	2.1^{b-e}	2.4^{d-f}	2.3^{cde}	6.0^{ab}	6.6^{a}	6.3^{bcd}	9.7^{ab}	9.8^{ab}	9.7^{abc}	10.5^{ab}	11.5^{ab}	11.0^{ab}
I_1S_3	2.5^{ab}	2.8^{bcd}	2.6^{b}	7.1^{a}	7.7^{ab}	7.4^{a}	10.2^{a}	10.8^{a}	10.5^{a}	11.4^{a}	12.0^{a}	11.7^{a}
I_1S_4	2.2^{b-e}	2.5^{c-e}	2.4^{bcd}	6.4^{ab}	7.4^{bc}	6.9^{ab}	10.1^{a}	10.1^{ab}	10.1^{ab}	10.3^{ab}	11.3^{ab}	10.8^{abc}
I_1S_5	2.4^{a-d}	2.6^{b-e}	2.48^{bc}	5.5^{ab}	6.7^{ef}	6.1^{bcd}	9.5^{abc}	9.5^{ab}	9.5^{a-d}	9.7^{ab}	10.0^{cd}	9.9^{c-f}
I_2S_1	1.4^{f}	1.6^{h}	1.5^{h}	5.3^{b}	5.4^{def}	5.4^{de}	7.3^{f}	7.1^{c}	7.2^{h}	7.3^{cd}	8.8^{ef}	8.1^{h}
I_2S_2	1.7^{ef}	1.9^{gh}	1.8^{gh}	5.6^{ab}	5.5^{def}	5.6^{cde}	7.5^{f}	7.3^{c}	7.4^{gh}	8.8^{bcd}	9.7^{c-e}	9.2^{efg}
I_2S_3	2.0^{b-f}	2.3^{efg}	2.1^{def}	6.0^{ab}	6.3^{cde}	6.1^{bcd}	8.1^{def}	8.5^{bc}	8.3^{e-h}	9.1^{bcd}	10.7^{bc}	9.9^{c-f}
I_2S_4	1.8^{def}	1.9^{gh}	1.9^{fg}	5.9^{ab}	6.2^{cde}	6.1^{bcd}	7.5^{f}	7.2^{c}	7.3^{h}	8.6^{bcd}	9.3^{d-f}	9.0^{fgh}
I_2S_5	1.8^{ef}	2.2^{efg}	2.0^{efg}	5.4^{b}	6.1^{cde}	5.7^{cde}	7.4^{f}	7.0^{c}	7.2^{h}	7.2^{d}	8.7^{ef}	8.0^{h}
S.Em.±	0.18	0.13	0.11	0.47	0.32	0.28	0.30	0.63	0.35	0.57	0.34	0.33
LSD (0.05)	0.52	0.37	0.31	1.38	0.92	0.81	0.88	1.84	1.00	1.66	0.98	0.94
C.V (%)	14.3	8.6	11.3	13.9	8.7	11.5	6.18	12.6	10.0	10.7	5.8	8.4

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

4.2.1.2 Number of secondary branches per hill

The variations in number of branches per hill as influenced by intercrops, substitution of N, graded levels of K and their interactions were significant at all the stages of plant growth (Table 35).

Under intercrops, the number of secondary branches per hill with garlic was significantly higher than the crop with coriander or without any intercrop at all the stages except at 30 DAT (6.5, 9.8 and 10.7 at 60 and 90 DAT and at final picking, respectively). While, chilli with coriander recorded lower number of branches than others particularly at the later stages of plant growth (7.5 and 8.8 g at 90 DAT and at final picking, respectively).

Among N substitution and graded levels of K, crop receiving equal substitution of nitrogen and 50 kg of potash recorded more number of branches than others at all the stages of plant growth (2.7, 6.8, 9.2 and 10.7 at 30, 60 and 90 DAT and at final picking, respectively). While, 100 per cent substitution of N through organics or no substitution of nitrogen recorded lower number of branches.

Among the treatment combinations chilli with garlic as an intercrop receiving equal doses of NPK with equal levels of organics (I_1S_3) recorded more number of branches at all stages of crop growth (7.4, 10.5 and 11.7 at 60 and 90 DAT and at final picking, respectively), while chilli intercropped with coriander irrespective of doses of nutrients in general recorded less number of secondary branches at all stages of observation.

4.2.1.3 Leaf area (cm^2 hill^{-1})

The leaf area of chilli crop varied significantly due intercrops, N substitution graded levels of K and their interactions at all the stages of plant growth (Table 36).

Among the intercrops evaluated, chilli + garlic intercropping system recorded significantly higher leaf area at 90 DAT and at final picking (915 and 1172 cm² hill^{-1}, respectively). But in the initial stage of plant growth, sole chilli recorded higher leaf area (70.4, 326.5 cm² hill^{-1} at 30 and 60 DAT, respectively) compared to the rest of the treatments.

Among the nutrient treatments, leaf area of chilli increased with increase in the inorganic nitrogen application upto 50 kg with equal substitution through organics and similar levels of inorganic P and K (S_3) at all the stages of plant growth (68.5, 318.2, 985.0 and 1222.0 cm² hill^{-1} at 30, 60 and 90 DAT and at final picking, respectively). While, no inorganic N or no K fertilizer ($N_0P_{50}K_{100}$ and $N_{100}P_{50}K_0$, respectively) recorded significantly lower leaf area than others at all the stages of crop growth except at 30 DAT.

Among the treatment combinations, sole chilli crop at the initial stage of plant growth (30 DAT) recorded significantly higher leaf area with 100 per cent inorganic source of nitrogen (I_0S_1, 89 cm² hill^{-1}). At 60 DAT sole chilli with equal doses of nutrients (I_0S_3) recorded significantly higher leaf area (365 cm² hill^{-1}), thereafter chilli + garlic intercropping system with equal doses of all the nutrients (I_1S_3) in the inorganic form ($N_{50}P_{50}$ and K_{50}) recorded significantly higher leaf area (1031 and 1430 cm² hill^{-1} at 90 DAT and at final picking, respectively), I_1S_2 having 75 per cent organic nitrogen was comparable with the former treatment combination at final picking, while chilli + coriander intercropping system with no inorganic nitrogen (I_2S_1) or zero potash (I_2S_5) application recorded lower leaf area at all the stages of plant growth. Influences due to other treatment combinations were rather overlapping.

4.2.1.4 Dry matter production (g plant^{-1})

The data revealed significant differences in the total dry matter production (TDMP) due to intercrops, N substitution, graded levels of K and their interaction (Table 37).

Dry matter production was significantly higher with garlic as intercrop at all the stages of crop growth except at 30 DAT (11.0 g, 43.9 g and 83.0 g at 60 and 90 DAT and at final picking, respectively). While, TDMP was the lowest with coriander intercrop (2.23 g, 7.70 g, 30.0 g and 59.1 g at 30, 60 and 90 DAT and at final picking, respectively).

Among the fertilizer treatments, the dry matter production increased with increase in the inorganic nitrogen recording the maximum with equal dose of all the inorganic nutrients

Table 36. Leaf area (cm² $hill^{-1}$) of bydagi chilli (*dabbi*) at 30, 60, 90 DAT and at final picking as influenced by intercropping,N substitution and graded levels of K

Treatments	30 DAT			60 DAT			90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping												
I_0: Sole chilli	64.9^{a}	75.8^{a}	70.4^{a}	300.0^{a}	353.0^{a}	326.5^{a}	824.0^{a}	697.0^{b}	752.0^{b}	826.0^{b}	1075.0^{b}	951.0^{b}
I_1: Chilli+Garlic	56.4^{b}	65.2^{b}	60.8^{b}	244.0^{b}	370.0^{a}	307.0^{b}	857.0^{a}	972.0^{a}	915.0^{a}	1114.0^{a}	1230.0^{a}	1172.0^{a}
I_2: Chilli+Coriander	48.0^{c}	54.6^{c}	51.3^{c}	205.0^{c}	194.0^{b}	199.3^{c}	708.0^{b}	797.0^{c}	752.0^{c}	841.0^{b}	870.0^{c}	856.0^{c}
S.Em.±	1.99	2.37	1.55	8.41	9.47	6.33	16.68	23.11	14.1	23.21	33.0	20.17
LSD (0.05)	5.80	6.93	4.40	24.53	27.63	18.00	46.90	67.47	40.0	67.73	96.3	57.35
N substitution and graded levels of K												
S_1: N_0:P_{50}:K_{100}	37.3^{d}	48.3^{c}	42.8^{c}	216.0^{c}	286.0^{bc}	251.0^{c}	711.0^{def}	721.0^{cd}	716.0^{d}	800.0^{cd}	931.0^{b}	866.0^{d}
S_2: N_{25}:P_{50}:K_{75}	47.3^{c}	58.7^{b}	53.0^{b}	268.0^{ab}	327.0^{ab}	297.5^{ab}	851.0^{b}	894.0^{b}	872.0^{b}	1032.0^{b}	1192.0^{a}	1112.0^{b}
S_3: N_{50}:P_{50}:K_{50}	61.3^{b}	75.7^{a}	68.5^{a}	289.0^{a}	347.0^{a}	318.2^{a}	947.0^{a}	1023.0^{a}	985.0^{a}	1190.0^{a}	1255.0^{a}	1222.0^{a}
S_4: N_{75}:P_{50}:K_{25}	65.6^{ab}	71.3^{a}	68.4^{a}	254.0^{b}	306.0^{ab}	280.3^{b}	772.0^{c}	791.0^{c}	781.0^{c}	881.0^{c}	1023.0^{b}	952.0^{c}
S_5: N_{100}:P_{50}:K_0	70.7^{a}	72.0^{a}	71.3^{a}	222.0^{c}	260.0^{c}	241.1^{c}	700.0^{d}	652.0^{d}	676.0^{d}	733.0^{d}	906.0^{b}	820.0^{d}
S.Em.±	2.57	3.07	2.00	10.85	14.96	8.17	20.75	29.84	18.2	29.96	42.6	26.04
LSD (0.05)	7.49	8.96	5.68	31.67	43.68	23.23	60.58	87.10	51.7	87.44	124.3	74.04
Interaction												
I_0S_1	40.0^{gh}	54.0^{ef}	47.0^{fgh}	263.0^{b-e}	345.0^{ab}	304.0^{bcd}	721.0^{def}	528.0^{hi}	626.0^{hi}	707.0^{g}	960.0^{d-g}	833.0^{fgh}
I_0S_2	52.0^{efg}	67.0^{cde}	59.5^{de}	320.0^{ab}	373.0^{a}	346.5^{ab}	914.0^{abc}	776.0^{d-g}	845.0^{cde}	930.0^{de}	1236.0^{bc}	1083.0^{bcd}
I_0S_3	74.0^{ab}	85.0^{ab}	79.5^{ab}	340.0^{a}	390.0^{a}	365.0^{a}	964.0^{a}	1031.0^{ab}	998.0^{ab}	1049.0^{bc}	1213.0^{bc}	1131.0^{bc}
I_0S_4	74.7^{ab}	80.0^{abc}	77.3^{b}	306.0^{abc}	360.0^{ab}	333.0^{ab}	818.0^{bcd}	636.0^{gh}	727.0^{fg}	756.0^{fg}	1073.0^{cde}	915.0^{efg}
I_0S_5	84.0^{a}	93.0^{a}	88.5^{a}	270.0^{bcd}	298.0^{bc}	284.0^{cde}	700.0^{defg}	428.0^{i}	564.0^{l}	689.0^{g}	893.0^{efg}	791.0^{gh}
I_1S_1	36.0^{h}	50.0^{ef}	43.0^{gh}	197.0^{fg}	342.0^{ab}	269.5^{de}	768.0^{de}	913.0^{a-d}	841.0^{cde}	950.0^{de}	1048.0^{c-f}	999.0^{cde}
I_1S_2	46.0^{fgh}	58.0^{def}	52.0^{efg}	276.0^{bcd}	398.0^{a}	337.0^{ab}	920.0^{ab}	1023.0^{ab}	971.0^{ab}	1267.0^{ab}	1397.0^{ab}	1332.0^{a}
I_1S_3	62.0^{b-e}	83.0^{abc}	72.5^{bc}	295.0^{abc}	403.0^{a}	349.0^{ab}	984.0^{a}	1078.0^{a}	1031.0^{a}	1384.0^{a}	1476.0^{a}	1430.0^{a}
I_1S_4	68.0^{bcd}	74.0^{bcd}	71.0^{bc}	257.0^{c-f}	373.0^{a}	315.0^{bc}	814.0^{bcd}	1002.0^{abc}	908.0^{bcd}	1136.0^{bc}	1185.0^{bcd}	1160.0^{b}
I_1S_5	70.0^{abc}	61.0^{de}	65.5^{cd}	196.0^{fg}	333.0^{ab}	264.7^{de}	798.0^{cde}	845.0^{c-f}	822.0^{de}	831.0^{efg}	1085.0^{cde}	958.0^{def}
I_2S_1	36.0^{h}	41.0^{f}	38.5^{h}	187.0^{g}	172.0^{e}	179.5^{g}	642.0^{fg}	723.0^{e-g}	683.0^{gh}	743.0^{fg}	785.0^{g}	764.0^{h}
I_2S_2	44.0^{fgh}	51.0^{ef}	47.5^{fgh}	208.0^{efg}	210.0^{de}	209.0^{fg}	718.0^{d-g}	884.0^{b-e}	801.0^{ef}	897.0^{def}	942.0^{d-g}	920.0^{efg}
I_2S_3	48.0^{e-h}	59.0^{de}	53.5^{efg}	231.0^{d-g}	250.0^{cd}	240.5^{ef}	894.0^{abc}	961.0^{a-c}	928.0^{bc}	1136.0^{b}	1075.0^{cde}	1105.0^{bc}
I_2S_4	54.0^{d-h}	60.0^{de}	57.0^{def}	200.0^{fg}	186.0^{de}	193.0^{g}	683.0^{efg}	735.0^{e-g}	709.0^{fgh}	752.0^{fg}	811.0^{fg}	782.0^{gh}
I_2S_5	58.0^{c-f}	62.0^{de}	60.0^{de}	199.0^{fg}	150.0^{e}	174.5^{g}	602.0^{g}	682.0^{f-h}	642.0^{ghi}	677.0^{g}	741.0^{g}	709.0^{h}
S.Em.±	4.44	5.32	3.46	18.80	21.16	14.15	35.95	51.69	31.5	51.89	73.8	45.1
LSD (0.05)	12.96	15.52	9.84	54.86	61.77	40.24	104.90	150.90	89.5	151.5	215.4	128.2
C.V. (%)	13.6	14.1	13.9	13.0	13.4	12.5	7.8	11.0	9.6	9.7	12.0	11.1

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 37. Dry matter production plant^{-1} (g) of bydagi chilli (*dabbi*) at 30, 60, 90 DAT and at final picking as influenced by intercropping, N substitution and graded levels of K

Treatments	30 DAT			60 DAT			90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping												
I_0: Sole chilli	3.8^{a}	3.7^{a}	3.75^{a}	10.1^{a}	12.1^{a}	11.2^{a}	33.8^{b}	35.4^{b}	34.6^{b}	75.4^{b}	76.1^{b}	75.7^{b}
I_1: Chilli+Garlic	2.7^{b}	3.0^{b}	2.82^{b}	9.8^{a}	12.2^{a}	11.0^{a}	43.3^{a}	44.6^{a}	43.9^{a}	82.2^{a}	83.7^{a}	83.0^{a}
I_2: Chilli+Coriander	2.2^{c}	2.3^{c}	2.23^{c}	8.1^{b}	7.3^{b}	7.7^{b}	29.4^{c}	30.5^{c}	30.0^{c}	60.5^{c}	57.6^{c}	59.1^{c}
S.Em.±	0.13	0.10	0.08	0.23	0.26	0.17	0.86	0.90	0.62	1.95	1.46	1.22
LSD (0.05)	0.37	0.28	0.22	0.68	0.76	0.50	2.50	2.62	1.76	5.68	4.27	3.46
N substitution and graded levels of K												
S_1: N_0:P_{50}:K_{100}	2.4^{c}	2.4^{c}	2.38^{c}	8.0^{c}	9.5^{c}	8.70^{c}	31.0^{c}	32.4^{c}	31.7^{c}	61.8^{c}	62.7^{c}	62.3^{d}
S_2: N_{25}:P_{50}:K_{75}	3.0^{b}	3.0^{b}	3.00^{b}	10.5^{a}	10.5^{bc}	10.5^{b}	39.3^{a}	39.9^{ab}	39.6^{a}	80.5^{ab}	77.8^{b}	79.2^{b}
S_3: N_{50}:P_{50}:K_{50}	3.8^{a}	3.8^{a}	3.80^{a}	11.1^{a}	12.2^{a}	11.6^{a}	41.2^{a}	42.4^{a}	41.8^{a}	87.5^{a}	88.8^{a}	88.2^{a}
S_4: N_{75}:P_{50}:K_{25}	2.8^{bc}	3.1^{b}	2.92^{b}	9.0^{b}	10.9^{b}	10.0^{b}	35.3^{b}	37.4^{b}	36.3^{b}	74.1^{b}	73.6^{b}	73.8^{c}
S_5: N_{100}:P_{50}:K_0	2.4^{c}	2.6^{c}	2.52^{c}	8.0^{c}	9.7^{c}	8.8^{c}	30.7^{c}	32.3^{c}	31.5^{c}	59.7^{c}	59.4^{c}	59.5^{d}
S.Em.±	0.16	0.12	0.10	0.30	0.34	0.22	1.11	1.16	0.80	2.51	1.89	1.57
LSD (0.05)	0.48	0.36	0.29	0.87	0.98	0.64	3.23	3.38	2.28	7.33	5.52	4.47
Interaction												
I_0S_1	2.8^{b-e}	2.8^{def}	2.80^{de}	8.4^{cde}	11.0^{c}	9.7^{e}	30.8^{e-h}	31.5^{gh}	31.2^{f}	63.2^{e}	64.2^{cd}	63.7^{fgh}
I_0S_2	3.7^{b}	3.6^{bc}	3.65^{b}	11.6^{a}	12.2^{bc}	11.9^{ab}	37.6^{cd}	38.4^{def}	38.0^{cd}	84.3^{abc}	82.4^{b}	83.4^{bc}
I_0S_3	5.7^{a}	5.4^{a}	5.55^{a}	12.2^{a}	13.5^{ab}	12.9^{a}	40.3^{bc}	42.3^{bcd}	41.3^{c}	89.8^{ab}	93.5^{a}	91.7^{a}
I_0S_4	3.6^{b}	3.7^{b}	3.65^{b}	9.4^{bcd}	12.7^{abc}	11.0^{bcd}	31.3^{efg}	34.1^{efg}	32.7^{f}	78.9^{bcd}	82.3^{b}	80.6^{cd}
I_0S_5	3.0^{bcd}	3.0^{cde}	3.00^{cd}	9.3^{bcd}	11.2^{c}	10.3^{cde}	29.0^{fgh}	30.8^{gh}	29.9^{fg}	60.8^{ef}	57.8^{def}	59.3^{h}
I_1S_1	2.4^{c-e}	2.4^{efg}	2.40^{efg}	8.7^{cd}	11.0^{c}	9.8^{de}	36.5^{cde}	38.9^{cd}	37.7^{cde}	73.9^{cde}	75.2^{b}	74.6^{def}
I_1S_2	2.8^{b-e}	3.0^{cde}	2.90^{cde}	10.6^{ab}	12.0^{bc}	11.3^{bc}	46.8^{a}	47.4^{ab}	47.1^{ab}	88.4^{ab}	92.1^{a}	90.2^{ab}
I_1S_3	3.2^{bc}	3.6^{bc}	3.38^{bc}	11.4^{a}	14.2^{a}	12.8^{a}	49.8^{a}	50.4^{a}	50.1^{a}	94.3^{a}	97.5^{a}	95.9^{a}
I_1S_4	2.6^{c-e}	3.2^{bcd}	2.92^{cde}	9.8^{bc}	12.6^{abc}	11.2^{bc}	45.4^{ab}	46.0^{abc}	45.7^{b}	83.2^{abc}	81.8^{b}	82.5^{bcd}
I_1S_5	2.4^{c-e}	2.6^{d-g}	2.50^{d-g}	8.4^{cde}	11.4^{c}	9.9^{de}	38.2^{cd}	40.2^{bcd}	39.2^{c}	71.4^{cde}	72.1^{bc}	71.6^{efg}
I_2S_1	1.9^{e}	2.0^{g}	1.95^{g}	6.9^{ef}	6.4^{e}	6.7^{h}i	25.7^{gh}	26.7^{h}	26.2^{gh}	48.4^{fg}	48.7^{ef}	48.5^{i}
I_2S_2	2.5^{c-e}	2.4^{efg}	2.45^{d-g}	9.5^{bcd}	7.2^{de}	8.3^{fg}	33.4^{def}	33.8^{efg}	33.6^{ef}	68.8^{de}	59.0^{de}	63.9^{gh}
I_2S_3	2.6^{c-e}	2.5^{efg}	2.53^{def}	9.7^{bcd}	8.8^{d}	9.3^{ef}	33.6^{def}	34.4^{efg}	34.0^{def}	78.4^{bcd}	75.5^{b}	77.0^{cde}
I_2S_4	2.1^{de}	2.3^{efg}	2.18^{fg}	8.0^{de}	7.6^{de}	7.8^{gh}	29.2^{fgh}	32.0^{fgh}	30.6^{f}	60.1^{efg}	56.7^{def}	58.4^{h}
I_2S_5	2.0^{e}	2.1^{fg}	2.05^{fg}	6.3^{f}	6.4^{e}	6.4^{i}	24.9^{h}	25.8^{h}	25.4^{h}	46.9^{g}	$48.^{if}$	47.5^{i}
S.Em.±	0.28	0.21	0.18	0.51	0.58	0.39	1.92	2.00	1.39	4.35	3.27	2.72
LSD (0.05)	0.83	0.62	0.50	1.51	1.70	1.11	5.59	5.85	3.94	12.70	9.56	7.74
C.V (%)	17.0	12.3	14.8	9.6	9.6	9.6	9.3	9.4	9.4	10.4	7.9	9.2

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

($N_{50}P_{50}$ and K_{50}) at all the stages of plant growth (3.8, 11.6, 41.8 and 88.2 g at 30, 60 and 90 DAT and at final picking, respectively). While, no inorganic nitrogen with 100 kg K_2O ha^{-1} ($N_0P_{50}K_{100}$) and zero dosage of potash with 100 kg inorganic nitrogen ($N_{100}P_{50}K_0$) recorded lower dry matter production (2.4, 8.7, 31.7 and 62.3 g with $N_0P_{50}K_{100}$ and 2.5, 8.80, 31.5 and 59.5 g with $N_{100}P_{50}K_0$ dosage of nutrients at 30,60 and 90 DAT, and at final picking, respectively).

Among the treatment combinations, chilli + garlic intercropping system with equal doses of all the inorganic nutrients (I_1S_3) recorded significantly higher dry matter production except at 30 DAT (12.80, 50.10 and 95.9 g at 60 and 90 DAT and at final picking, respectively), while it was on par with sole crop of chilli with similar doses of organics and fertilizers (I_0S_3) (12.9 and 91.7 g at 60 DAT and at final picking, respectively). At 30 DAT, sole chilli with equal doses of nutrients (I_0S_3) recorded significantly higher (5.55 g) dry matter production compared to the rest of the treatment combinations. At harvest, chilli + garlic intercrop with $N_{25}P_{50}$ and K_{75} (I_1S_2) nutrient combination recorded on par dry matter with I_1S_3 treatment combination (90.2 g). The lowest TDMP was recorded with chilli + coriander intercropping with no substitution of organics and without K application (I_2S_3). I_2S_1 treatment combination was on par with former treatment combination.

4.2.2 Yield components and yield

4.2.2.1 Number of matured fruits $hill^{-1}$

The number of matured fruits per hill differed significantly due to intercrops, N substitution, graded levels of K and their interactions (Table 38).

Among the intercropping systems chilli with garlic recorded significantly higher number of matured fruits (34.4) compared to the rest of the treatments. The lowest number of matured fruits was produced in the chilli + coriander intercropping system (24.9).

Among the graded levels of N and K applied to chilli crop, as the nitrogen substitution with inorganic fertilizer increased upto 50 kg per hectare along with similar levels of P and K (S_3) , the number of matured fruits increased recording the highest fruits (37.5) with the treatment. Thereafter, the matured fruits number decreased gradually with full substitution of N and withdrawal of potassium (S_5), $N_{100}P_{50}K_0$ recorded the lowest number of fruits per hill (21.6).

Significantly higher number of matured fruits was recorded with chilli + garlic intercropping system applied with equal doses of all the nutrients ($N_{50}P_{50}K_{50}$), while $N_{25}P_{50}K_{75}$ (I_1S_2) was on par with the former treatment (I_1S_3) (44.0 and 40.3 fruits $hill^{-1}$, respectively). The lowest number of matured fruits (18.4 fruits $hill^{-1}$) was observed with chilli + coriander intercropping system supplied with zero level of potassium (I_2S_5).

4.2.2.2 Fruit length (cm)

Data revealed significant differences in the fruit length due to intercrops, N substitution, graded level of K and their interactions (Table 38).

Among the intercrops, chilli under garlic intercropping system recorded the highest fruit length (10.9 cm). While, the lowest fruit length was observed with chilli + coriander intercropping system (9.5 cm).

Fruit length of chilli was significantly higher with S_2 (10.8 cm) and S_3 (11.3 cm), while significantly, lower fruit length was observed with S_1 (9.5 cm) and S_5 (9.2 cm), among the nutritional treatments.

Among the treatment combinations, garlic intercropped chilli receiving equal doses of all the three major nutrients (I_1S_3) recorded significantly higher fruit length (12.4 cm). Same intercrop system supplied with $N_{25}P_{50}K_{75}$ (I_1S_2) nutrient combination (11.8 cm) was on par with former treatment, while chilli + coriander intercropping system receiving zero potash (I_2S_5) ($N_{100}P_{50}K_0$) recorded the lowest fruit length (8.5 cm).

4.2.2.3 100-fruit weight (g)

100-fruit weight differed significant due to intercrops, levels and forms of nutrients supplied and their interactions (Table 38).

Table 38. Number of matured fruits $hill^{-1}$, fruit length (cm) and 100-fruit weight (g) of bydagi chilli (*dabbi*) as influenced by intercropping, N substitution and graded levels of K

Treatments	Number of matured fruits/hill			Fruit length (cm)			100-fruit weight (g)		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping									
I_0: Sole chilli	30.2^{b}	30.6^{b}	30.4^{b}	9.1^{b}	11.4^{ab}	10.2^{b}	107.9^{b}	115.8^{ab}	111.8^{b}
I_1: Chilli+Garlic	33.1^{a}	35.6^{a}	34.4^{a}	9.6^{a}	12.2^{a}	10.9^{a}	115.4^{a}	123.5^{a}	119.6^{a}
I_2: Chilli+Coriander	25.0^{c}	24.7^{c}	24.9^{c}	8.0^{c}	10.9^{b}	9.5^{c}	100.4^{c}	110.9^{b}	105.7^{b}
S.Em.±	0.97	1.17	0.76	0.11	0.29	0.15	2.02	2.97	1.80
LSD (0.05)	2.83	3.41	2.16	0.33	0.84	0.98	5.90	8.67	5.11
N substitution and graded levels of K									
S_1: N_0:P_{50}:K_{100}	25.0^{c}	25.9^{c}	25.5^{d}	8.3^{c}	10.8^{c}	9.5^{c}	100.7^{c}	109.0^{bc}	104.8^{c}
S_2: N_{25}:P_{50}:K_{75}	34.4^{a}	34.8^{ab}	34.6^{b}	9.5^{a}	12.1^{ab}	10.8^{a}	114.9^{ab}	124.3^{ab}	119.7^{ab}
S_3: N_{50}:P_{50}:K_{50}	37.4^{a}	37.5^{a}	37.5^{a}	9.9^{a}	12.7^{a}	11.3^{a}	122.2^{a}	129.6^{a}	125.9^{a}
S_4: N_{75}:P_{50}:K_{25}	29.6^{b}	30.8^{b}	30.2^{c}	8.9^{b}	11.5^{bc}	10.2^{b}	110.6^{b}	118.9^{ab}	114.8^{b}
S_5: N_{100}:P_{50}:K_0	20.8^{d}	22.4^{c}	21.6^{e}	7.9^{c}	10.4^{c}	9.2^{c}	91.2^{d}	102.0^{c}	96.6^{d}
S.Em.±	1.25	1.51	0.98	0.15	0.37	0.20	2.61	3.84	2.32
LSD (0.05)	3.66	4.41	2.79	0.43	1.08	0.56	7.62	11.19	6.60
Interaction									
I_0S_1	23.2^{def}	27.5^{def}	25.4^{fgh}	8.5^{e}	10.9^{cd}	9.7^{def}	98.4^{efg}	107.2^{cde}	102.8^{efg}
I_0S_2	36.4^{ab}	35.0^{bcd}	35.7^{bcd}	9.6^{cd}	11.6^{bcd}	10.6^{cd}	115.1^{a-d}	123.1^{a-d}	119.1^{bcd}
I_0S_3	38.0^{ab}	36.0^{bcd}	37.0^{bc}	10.2^{bc}	12.5^{abc}	11.3^{bc}	123.6^{ab}	130.6^{ab}	127.1^{ab}
I_0S_4	31.7^{bc}	31.0^{cde}	31.3^{de}	8.8^{de}	11.4^{bcd}	10.1^{de}	111.8^{b-e}	117.1^{a-e}	114.5^{b-e}
I_0S_5	21.8^{ef}	23.5^{efg}	22.7^{ghi}	8.1^{ef}	10.5^{cd}	9.3^{efg}	90.4^{fg}	101.1^{de}	95.8^{fg}
I_1S_1	29.0^{cd}	28.5^{c-f}	28.8^{ef}	8.9^{de}	11.2^{bcd}	10.1^{de}	113.4^{a-d}	113.5^{b-e}	113.5^{cde}
I_1S_2	38.4^{ab}	42.1^{ab}	40.3^{ab}	10.4^{ab}	13.2^{ab}	11.8^{ab}	121.4^{abc}	131.8^{ab}	127.0^{ab}
I_1S_3	42.0^{a}	46.0^{a}	44.0^{a}	11.0^{a}	13.8^{a}	12.4^{a}	128.2^{a}	136.3^{a}	132.3^{a}
I_1S_4	33.4^{bc}	36.5^{bc}	35.0^{cd}	9.5^{cd}	11.8^{a-d}	10.7^{cd}	116.4^{a-d}	127.6^{abc}	122.0^{abc}
I_1S_5	22.7^{def}	24.9^{efg}	23.8^{fgh}	8.4^{e}	10.9^{cd}	9.7^{def}	98.4^{efg}	108.1^{cde}	103.3^{efg}
I_2S_1	22.9^{def}	21.7^{fg}	22.3^{hi}	7.4^{fg}	10.2^{d}	8.8^{fg}	90.2^{fg}	106.2^{cde}	98.2^{fg}
I_2S_2	28.4^{cde}	27.4^{def}	27.9^{efg}	8.4^{e}	11.5^{bcd}	10.0^{de}	108.4^{cde}	117.9^{a-e}	113.2^{cde}
I_2S_3	32.1^{bc}	30.6^{cde}	31.4^{de}	8.6^{e}	11.7^{bcd}	10.2^{de}	114.8^{a-d}	121.8^{a-d}	118.3^{bcd}
I_2S_4	23.8^{def}	24.9^{efg}	24.4^{fgh}	8.3^{e}	11.4^{bcd}	9.9^{def}	103.7^{def}	112.2^{b-e}	107.9^{def}
I_2S_5	18.0^{f}	18.7^{g}	18.4^{i}	7.2^{g}	9.8^{d}	8.5^{g}	84.9^{g}	96.7^{e}	90.8^{g}
S.Em.±	2.17	2.62	1.70	0.25	0.64	0.34	4.52	6.64	4.02
LSD (0.05)	6.33	7.63	4.83	0.74	1.87	0.98	13.20	19.40	11.42
C.V. (%)	12.8	14.9	13.9	4.95	9.63	8.27	7.3	9.8	8.8

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among the intercropping systems, chilli intercropped with garlic recorded significantly higher fruit weight of chilli (119.6 g) compared to sole chilli (111.8 g) and chilli + coriander intercropping system (105.7 g). The latter two treatments were on par with each other.

Among the nutrient treatments, the crop receiving organic and inorganic N and inorganic P and K in equal doses (S_3) recorded maximum 100-fruit weight (125.9 g), and S_2 with $N_{25}P_{50}K_{75}$ was on par with it (119.7 g). While, S_5 with entire inorganic nitrogen and no potassium recorded the minimum 100-fruit weight (96.6 g).

Among the treatment combinations, chilli + garlic intercropping system with equal doses of major nutrients (I_1S_3) recorded significantly higher 100-fruit weight (132.3 g) followed by similar intercropping system with S_2 or S_1 levels of fertilizers and sole chilli with S_3 level of fertilizers. Significantly lower fruit weight (90.8 g) was recorded with chilli + coriander intercropping system with 100 per cent inorganic N without potassium nutrition (I_2S_5).

4.2.2.4 1000-seed weight (g)

Variations in 1000-seed weight as influenced by intercrops, N substitution, graded levels of K and their interactions were significant (Table 39).

Among the chilli based cropping systems, chilli intercropped with garlic recorded significantly higher 1000-seed weight (7.3 g) compared to others.

Among the nutrient treatments, the seed weight of chilli increased with increase in the nitrogen nutrition, and recorded maximum seed weight with equal doses of all the nutrients (S_3-$N_{50}P_{50}K_{50}$) (7.8 g), while S_2 with $N_{25}P_{50}K_{75}$ was on par with the former (S_3) treatment. Treatment receiving no inorganic N or no K fertilizers recorded lower seed weight (6.0 g and 6.3 g with S_5 and S_1, respectively).

The treatment combinations revealed significantly higher 1000-seed weight (8.9 g) with chilli intercropped with garlic fertilized with $N_{50}P_{50}K_{50}$ (I_1S_3) nutrition compared to the rest of the treatment combinations except above intercrop system fertilized with $N_{25}P_{50}K_{75}$ (I_1S_2) nutrition (8.4 g). While, the lowest seed weight (5.8 g) was recorded with chilli + coriander intercropping system without the application of potassium fertilizer (I_2xS_5).

4.2.2.5 Seed to pod ratio

Seed to pod ratio was significantly influenced due to intercrops, N substitution graded level of K and their interaction (Table 39).

Under different intercrops tried with chilli, chilli intercropped with garlic recorded significantly higher seed to pod ratio (36.5) and was significantly superior to chilli with coriander (29.1). Seed to pod ratio with the former treatment (I_1) was comparable or statistically on par with sole chilli.

Among the graded levels of N and K, equal dosage of all the nutrients $N_{50}P_{50}K_{50}$ (S_3) recorded significantly higher seed to pod ratio (37.8). S_2 with $N_{25}P_{50}K_{75}$ was next in the order and was on par with former treatment. While, significantly lower seed to pod ratio was recorded with the treatment receiving no potassium application ($N_{100}P_{50}K_0$) (29.9) and the treatment receiving no inorganic nitrogen (S_1) (30.6).

Among the treatment combinations, chilli + garlic intercropping system nutritioned with equal dosage of all the major nutrients through inorganics (I_1S_3) recorded significantly higher seed to pod ratio (42.7), while it was on par with the same intercropping system fertilized with $N_{25}P_{50}K_{75}$ (I_1S_2 with 38.6) and sole crop of chilli nutritioned with $N_{50}P_{50}K_{50}$ (I_0S_3) fertilizer application (31.9). While, significantly lower (27.3) seed to pod ratio was recorded with chilli + coriander intercropping system receiving entire N in the inorganic form and no potassium (I_2S_5).

4.2.2.6 Dry fruit yield (kg ha^{-1})

Differences in chilli yield due to intercrops, N substitution, graded levels of K and their interactions were significant (Table 40).

Chilli + garlic intercropping system recorded significantly higher chilli yield (890 kg ha^{-1}), while the lowest chilli yield was observed with chilli + coriander intercropping system (701 kg ha^{-1}).

Table 39. 1000-seed weight (g) and seed to pod ratio of bydagi chilli (*dabbi*) as influenced by intercropping, N substitution and graded levels of K

Treatments	1000-seed weight (g)			Seed to pod ratio		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping						
I_0: Sole chilli	5.8^{b}	7.6^{ab}	6.7^{b}	34.1^{a}	34.8^{a}	34.5^{a}
I_1: Chilli+Garlic	6.4^{a}	8.3^{a}	7.3^{a}	36.4^{a}	36.6^{a}	36.5^{a}
I_2: Chilli+Coriander	5.6^{b}	7.3^{b}	6.4^{b}	27.3^{b}	30.9^{b}	29.1^{b}
S.Em.±	0.15	0.28	0.16	1.29	1.00	0.81
LSD (0.05)	0.44	0.80	0.45	3.76	2.92	2.32
N substitution and graded levels of K						
S_1: N_0:P_{50}:K_{100}	5.4^{cd}	7.1^{c}	6.3^{bc}	30.5^{b}	30.7^{c}	30.6^{cd}
S_2: N_{25}:P_{50}:K_{75}	6.3^{ab}	8.3^{ab}	7.3^{a}	34.5^{ab}	35.6^{b}	35.0^{ab}
S_3: N_{50}:P_{50}:K_{50}	6.8^{a}	8.9^{a}	7.8^{a}	36.1^{a}	39.4^{a}	37.8^{a}
S_4: N_{75}:P_{50}:K_{25}	5.9^{bc}	7.4^{bc}	6.7^{b}	33.2^{ab}	33.7^{bc}	33.5^{bc}
S_5: N_{100}:P_{50}:K_0	5.1^{d}	6.9^{c}	6.0^{c}	29.8^{b}	30.0^{c}	29.9^{d}
S.Em.±	0.20	0.36	0.20	1.66	1.29	1.05
LSD (0.05)	0.57	1.04	0.58	4.85	3.77	2.99
Interaction						
I_0S_1	5.4^{cde}	7.1^{cd}	6.3^{de}	32.4^{a-d}	31.4^{cde}	31.9^{cde}
I_0S_2	6.0^{cde}	7.8^{bcd}	7.0^{cd}	36.7^{abc}	34.2^{bcd}	35.5^{bcd}
I_0S_3	6.5^{bc}	8.9^{abc}	7.7^{bc}	38.2^{ab}	40.6^{ab}	39.4^{ab}
I_0S_4	5.8^{cde}	7.3^{cd}	6.6^{de}	34.8^{a-d}	32.9^{cde}	33.9^{bcd}
I_0S_5	5.2^{de}	6.8^{cd}	6.0^{de}	31.8^{a-d}	31.5^{cde}	31.7^{cde}
I_1S_1	5.4^{cde}	7.3^{cd}	6.4^{de}	33.1^{a-d}	34.5^{bcd}	33.8^{bcd}
I_1S_2	7.2^{ab}	9.5^{ab}	8.4^{ab}	38.4^{ab}	38.8^{bc}	38.6^{ab}
I_1S_3	7.8^{a}	9.9^{a}	8.9^{a}	40.8^{abc}	44.6^{a}	42.7^{a}
I_1S_4	6.3^{bcd}	7.4^{cd}	6.9^{cd}	37.3^{a-d}	36.2^{bcd}	36.8^{bc}
I_1S_5	5.2^{de}	7.1^{cd}	6.2^{de}	32.6^{d}	29.1^{de}	30.8^{cde}
I_2S_1	5.3^{de}	7.0^{cd}	6.2^{de}	25.9^{d}	26.2^{e}	26.1^{e}
I_2S_2	5.8^{cde}	7.4^{cd}	6.6^{cde}	28.3^{cd}	33.8^{bcd}	31.1^{cde}
I_2S_3	6.2^{bcd}	7.9^{bcd}	7.1^{cd}	29.4^{bcd}	32.9^{cde}	31.2^{cde}
I_2S_4	5.7^{cde}	7.3^{cd}	6.5^{de}	27.6^{cd}	32.0^{cde}	29.8^{de}
I_2S_5	4.9^{e}	6.7^{d}	5.8^{e}	25.1^{d}	29.5^{cde}	27.3^{e}
S.Em.±	0.34	0.62	0.35	2.88	2.24	1.82
LSD (0.05)	0.99	1.80	1.00	8.40	6.53	5.18
C.V.	9.93	13.81	12.63	15.2	11.5	13.5

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 40. Yield and equivalent yield (kg ha^{-1}) of bydagi chilli (*dabbi*) as influenced by intercropping, N substitution and graded levels of K

Treatments	Yield (kg ha^{-1})			Chilli equivalent yield (kg ha^{-1})		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping						
I_0: Sole chilli	741^{a}	861^{b}	801^{b}	742^{b}	861^{b}	801^{b}
I_1: Chilli+Garlic	809^{a}	971^{a}	890^{a}	1178^{a}	1342^{a}	1260^{a}
I_2: Chilli+Coriander	634^{b}	768^{c}	701^{c}	779^{b}	922^{b}	850^{b}
S.Em.±	30.0	29.1	20.9	29.6	32.1	21.8
LSD (0.05)	87.4	84.9	59.4	86.3	93.6	62.1
N substitution and graded levels of K						
S_1: N_0:P_{50}:K_{100}	633^{cd}	779^{cd}	706^{c}	791^{cd}	952^{cd}	872^{c}
S_2: N_{25}:P_{50}:K_{75}	815^{ab}	940^{ab}	878^{ab}	996^{ab}	1131^{ab}	1063^{a}
S_3: N_{50}:P_{50}:K_{50}	873^{a}	1020^{a}	947^{a}	1061^{a}	1215^{a}	1137^{a}
S_4: N_{75}:P_{50}:K_{25}	744^{bc}	872^{bc}	808^{b}	896^{bc}	1036^{bc}	966^{b}
S_5: N_{100}:P_{50}:K_0	577^{d}	723^{d}	650^{c}	752^{d}	875^{d}	814^{c}
S.Em.±	38.7	37.5	27.0	38.2	41.4	28.2
LSD (0.05)	112.8	109.6	76.6	111.4	120.8	80.4
Interaction						
I_0S_1	632^{de}	811^{c-f}	722^{e-i}	632^{g}	811^{fg}	722^{ghi}
I_0S_2	818^{abcd}	919^{b-e}	869^{b-e}	818^{defg}	919^{d-g}	869^{e-g}
I_0S_3	862^{abc}	953^{bc}	908^{bc}	862^{def}	953^{d-g}	908^{ef}
I_0S_4	794^{bcd}	898^{b-e}	846^{b-f}	794^{efg}	898^{d-g}	846^{e-h}
I_0S_5	602^{de}	725^{def}	664^{ghi}	602^{g}	725^{g}	664^{i}
I_1S_1	662^{cde}	826^{c-f}	744^{d-h}	999^{cde}	1192^{bc}	1096^{bc}
I_1S_2	907^{ab}	1094^{ab}	1001^{ab}	1292^{ab}	1494^{a}	1393^{a}
I_1S_3	1028^{a}	1221^{a}	1125^{a}	1422^{a}	1628^{a}	1525^{a}
I_1S_4	820^{abcd}	931^{bcd}	875^{bcd}	1146^{bc}	1280^{b}	1213^{b}
I_1S_5	628^{de}	787^{c-f}	708^{f-i}	1030^{cd}	1117^{bcd}	1073^{bcd}
I_2S_1	604^{de}	701^{ef}	653^{hi}	742^{fg}	852^{efg}	797^{fghi}
I_2S_2	720^{bcde}	808^{c-f}	764^{c-h}	880^{def}	981^{c-f}	930^{def}
I_2S_3	729^{bcd}	887^{b-e}	808^{c-g}	898^{def}	1063^{b-e}	981^{cde}
I_2S_4	618^{de}	786^{c-f}	702^{f-i}	749^{fg}	929^{d-g}	839^{e-h}
I_2S_5	502^{e}	657^{f}	580^{i}	624^{g}	783^{fg}	704^{hi}
S.Em.±	67.0	65.0	46.7	66.1	71.7	48.9
LSD (0.05)	195.4	189.8	132.7	192.9	209.3	138.9
C.V. (%)	16.0	13.0	14.4	12.7	11.9	12.4

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among the fertilizer treatments, chilli yield increased with nitrogen application and the maximum yield (947 kg ha^{-1}) (S_3) was obtained with equal doses of all the nutrients. Thereafter, the yield decreased with decreasing potassium nutrition or increasing inorganic N substitution. While, no inorganic nitrogen (S_1) and no potassium treatments (S_5) recorded lower chilli yield (706 and 650 kg ha^{-1}, respectively).

The treatment combinations revealed higher dry pod yield (1125 kg ha^{-1}) of *Byadgi* chilli with chilli + garlic intercropping system supplied with equal doses of all the nutrients in the inorganic form (I_1S_3) and the above cropping system supplied with $N_{25}P_{50}K_{75}$ (I_1S_2) was on par (1001 kg ha^{-1}) (Fig. 8). While, significantly lower chilli yield (580 kg ha^{-1}) was recorded with chilli + coriander intercropping system receiving $N_{100}P_{50}K_0$ (I_2S_5) nutrient combination.

4.2.2.7 Yield of intercrops (kg ha^{-1})

Among the two intercrops tried yield of garlic bulbs averaged over fertilizer levels was higher (450 kg ha^{-1}) than the seed yield of coriander under similar conditions (246 kg ha^{-1}) (Table 41).

Among the treatment combinations garlic crop with equal doses of nutrients applied to base crop (I_1S_3) recorded significantly higher bulb yield (500 kg ha^{-1}) compared to the rest of the treatment combinations except the crop receiving $N_{25}P_{50}K_{75}$ (I_1S_2) (481 kg ha^{-1}). While, it was the lowest with coriander treatments receiving different fertilizer levels. Among them yield was again significantly higher (289 kg ha^{-1}) with equal levels of NPK in the inorganic form (I_2S_3). While, S_2 and S_1 levels were comparable and next in the order, while significantly lower yield (207 kg ha^{-1}) was recorded with highest level of inorganic nitrogen coupled with no potassium (S_5).

4.2.2.8 Chilli equivalent yield (kg ha^{-1})

Data revealed significant differences in chilli equivalent yield with various intercrops, N substitution, graded levels of K and their interaction (Table 40).

Among the intercropping system chilli + garlic recorded significantly higher chilli equivalent yield (1260 kg ha^{-1}) compared to sole crop of chilli (801 kg ha^{-1}) and chilli + coriander intercropping system (850 kg ha^{-1}).

Among the nutrient treatment, S_3 and S_2 with inorganic nitrogen 25 kg or more and potassium nutrient 50 kg or more recorded higher chilli equivalent yield than other levels (1137 and 1063 kg ha^{-1}, respectively) and the yield was lowest with no substitution of recommended nitrogen through organic (S_5) or no supply of inorganic nitrogen (S_1) or in other words only with inorganic K or no K treatments (872 and 814 kg ha^{-1}, respectively).

Among the treatment combinations, intercropping system of chilli + garlic with equal dosage of all the nutrients in the inorganic from (I_1S_3) and $N_{25}P_{50}K_{75}$ (I_1S_2) nutrient combinations recorded significantly higher chilli equivalent yields (1525 and 1393 kg ha^{-1}, respectively). The lowest chilli equivalent yield (664 kg ha^{-1}) was recorded with sole crop of chilli receiving no potassium (I_0S_5) followed by I_2S_5, I_0S_1 and I_1S_1.

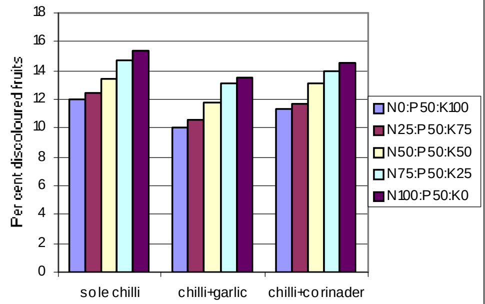
4.2.3 Entomological observations

4.2.3.1 Thrips population (no $leaf^{-1}$)

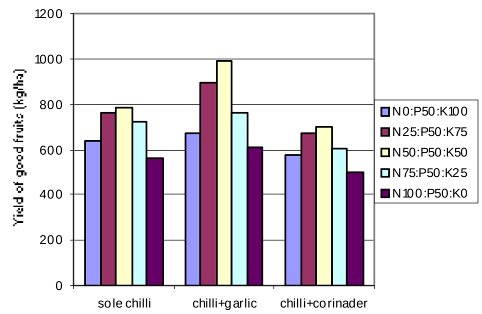
The variations in thrips population as influenced by intercropping, N substitution, graded levels of K and their interaction were significant at all the stages of observation. In general, thrips population over the growing season was maximum during 60 DAT (Table 42).

Intercropped chilli irrespective of component crop recorded significantly lower thrips population at all the stages of crop growth compared to sole chilli (0.54, 0.82, 0.34 and 0.20 with garlic intercrop and 0.61, 0.84, 0.40 and 0.28 with coriander intercrop at 30, 60 and 90 DAT and at final picking, respectively). Both the intercrops were at par.

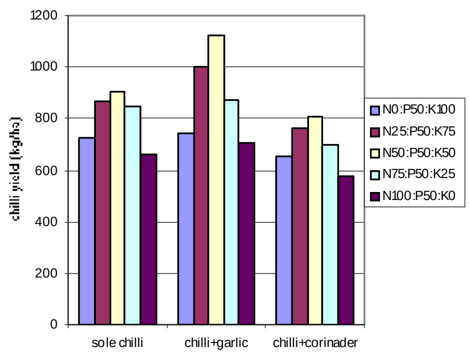
Among the nutrient treatments, the population of thrips increased with increase in the inorganic nitrogen level at all the stages and the highest population was observed with the treatment S_5 receiving 100 per cent inorganic N coupled with zero potassium (1.02, 1.26, 0.63 and 0.41 at 30, 60 and 90 DAT and at final picking, respectively). Thrips populations upto 50 kg of inorganic nitrogen (S_3) were significantly lower and S_1, S_2 and S_3 were statistically at par at all the stages of observation.



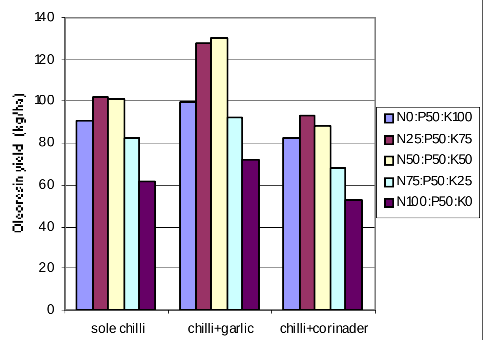
Per cent discoloured fruits as influenced by intercropping, N substitution and graded levels of K



Yield of good quality fruits as influenced by intercropping, N substitution and graded levels of K



Chilli yield as influenced by intercropping, N substitution and graded levels of K



Oleoresin yield as influenced by intercropping, N substitution and graded levels of K

Fig.8.: Percent Discolored fruits, fruit yield and yield of good fruits and oleoresin yield as influenced by chilli based intercropping systems

Table 41. Yield (kg ha^{-1}) of intercrops as influenced by intercropping, N substitution and graded levels of K

Treatments (Main / Sub)	2005-06		2006-07		Pooled	
	Garlic	Coriander	Garlic	Coriander	Garlic	Coriander
S_1: N_0:P_{50}:K_{100}	422 ^{bc}	230 ^{de}	458 ^{ab}	252 ^{c}	440 ^{bc}	241 ^{def}
S_2: N_{25}:P_{50}:K_{75}	468 ^{ab}	256 ^{de}	494 ^{ab}	278 ^{c}	481 ^{ab}	267 ^{de}
S_3: N_{50}:P_{50}:K_{50}	492 ^{a}	282 ^{d}	508 ^{a}	294 ^{c}	500 ^{a}	289 ^{d}
S_4: N_{75}:P_{50}:K_{25}	408 ^{c}	215 ^{e}	437 ^{ab}	238 ^{c}	423 ^{c}	227 ^{ef}
S_5: N_{100}:P_{50}:K_0	396 ^{c}	204 ^{e}	412 ^{b}	210 ^{d}	404 ^{c}	207 ^{f}
Mean	437 ^{a}	237 ^{b}	462 ^{a}	254 ^{b}	450 ^{a}	246 ^{b}
Main						
S.Em.±	8.09		12.0		7.2	
CD (0.05)	24.3		36.0		20.9	
Sub						
S.Em.±	18.1		26.9		16.2	
CD (0.05)	54.2		80.5		46.6	
C.V. (%)	9.3		13.0		11.4	

Note: In case of garlic bulbs, and in coriander capsules represent the yield.
Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among the treatment combinations, chilli + garlic intercropping system with entire N in the organic form coupled with highest K level (I_1S_1) recorded significantly lower thrips population at all the stages of crop growth (0.40, 0.56, 0.20 and 0.14 at 30, 60 and 90 DAT and at final picking, respectively) (Fig. 9). Treatment combinations having part of the recommended N in the organic form and potassium equal or more than 50 kg irrespective of the system performed more or less similar and were statistically often on par with former treatment. While, significantly higher population of thrips was recorded with chilli receiving entire N in the organic form and zero potassium (I_0S_5) at all the stages of crop growth (1.34, 1.54, 0.78 and 0.54 at 30, 60 and 90 DAT and at final picking, respectively) followed by sole chilli with next higher doses of inorganic nitrogen fertilizer, differences at final picking, however, were rather overlapping.

4.2.3.2 Mites population (no. $leaf^{-1}$)

The mites population per leaf due to intercrops, N substitution, graded levels of K and their interactions were significant at all the stages of plant growth. In general, mites population picked up from 60 DAT onwards upto harvest (Table 43).

Among the intercrop treatments, chilli with garlic recorded significantly lower mites population at all the stages of plant growth (0.50, 0.68 and 0.66 at 60 and 90 DAT and at final picking, respectively) followed by coriander intercrop and both were at par and chilli with garlic proved superior to sole chilli in reducing mites.

Table 42. Population of thrips leaf^{-1} of bydagi chilli (*dabbi*) at 30, 60, 90 DAT and at final picking as influenced by intercropping, N substitution and graded levels of K

Treatments	30 DAT			60 DAT			90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping												
I_0: Sole chilli	0.89 (1.38)^{a}	0.67 (1.29)^{a}	0.80 (1.34)^{a}	1.12 (1.45)^{a}	0.92 (1.39)^{a}	1.02 (1.42)^{a}	0.62 (1.27)^{a}	0.46 (1.20)^{a}	0.53 (1.23)^{a}	0.32 (1.15)^{a}	0.32 (1.15)^{a}	0.32 (1.15)^{a}
I_1: Chilli+Garlic	0.62 (1.27)^{b}	0.49 (1.22)^{b}	0.54 (1.24)^{b}	0.91 (1.38)^{b}	0.73 (1.32)^{b}	0.82 (1.35)^{b}	0.46 (1.20)^{b}	0.22 (1.11)^{b}	0.34 (1.16)^{b}	0.23 (1.11)^{b}	0.16 (1.08)^{b}	0.20 (1.10)^{b}
I_2: Chilli+Coriander	0.66 (1.29)^{b}	0.53 (1.23)^{b}	0.61 (1.27)^{b}	0.95 (1.39)^{b}	0.73 (1.32)^{b}	0.84 (1.36)^{b}	0.55 (1.24)^{ab}	0.22 (1.11)^{b}	0.40 (1.18)^{b}	0.27 (1.13)^{ab}	0.28 (1.13)^{a}	0.28 (1.13)^{b}
S.Em.±	0.03	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01
LSD (0.05)	0.08	0.06	0.05	0.06	0.03	0.03	0.05	0.07	0.04	0.03	0.05	0.03
N substitution and graded levels of K												
S_1: N_0:P_{50}:K_{100}	0.52 (1.23)^{c}	0.37 (1.17)^{b}	0.44 (1.20)^{c}	0.60 (1.26)^{c}	0.55 (1.25)^{d}	0.58 (1.26)^{d}	0.38 (1.17)^{c}	0.16 (1.08)^{c}	0.27 (1.13)^{c}	0.19 (1.10)^{b}	0.10 (1.05)^{c}	0.16 (1.08)^{d}
S_2: N_{25}:P_{50}:K_{75}	0.62 (1.27)^{bc}	0.41 (1.19)^{b}	0.51 (1.23)^{c}	0.81 (1.34)^{b}	0.70 (1.30)^{c}	0.74 (1.32)^{c}	0.46 (1.20)^{bc}	0.20 (1.10)^{bc}	0.33 (1.15)^{c}	0.20 (1.10)^{b}	0.20 (1.10)^{bc}	0.2 (1.10)^{cd}
S_3: N_{50}:P_{50}:K_{50}	0.56 (1.25)^{c}	0.49 (1.22)^{b}	0.52 (1.23)^{c}	0.86 (1.36)^{b}	0.73 (1.32)^{c}	0.80 (1.34)^{c}	0.46 (1.21)^{bc}	0.25 (1.12)^{bc}	0.36 (1.17)^{bc}	0.27 (1.13)^{b}	0.20 (1.10)^{bc}	0.25 (1.12)^{bc}
S_4: N_{75}:P_{50}:K_{25}	0.84 (1.36)^{ab}	0.70 (1.30)^{a}	0.78 (1.33)^{b}	1.27 (1.50)^{a}	0.95 (1.40)^{b}	1.11 (1.45)^{b}	0.58 (1.26)^{ab}	0.40 (1.18)^{ab}	0.49 (1.22)^{b}	0.31 (1.14)^{a}	0.32 (1.15)^{ab}	0.32 (1.15)^{b}
S_5: N_{100}:P_{50}:K_0	1.15 (1.47)^{a}	0.88 (1.37)^{a}	1.02 (1.42)^{a}	1.44 (1.56)^{a}	1.09 (1.45)^{a}	1.26 (1.50)^{a}	0.74 (1.32)^{a}	0.52 (1.23)^{a}	0.63 (1.28)^{a}	0.37 (1.18)^{a}	0.44 (1.20)^{a}	0.41 (1.19)^{a}
S.Em.±	0.04	0.03	0.02	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.01
LSD (0.05)	0.10	0.08	0.06	0.08	0.04	0.04	0.07	0.09	0.05	0.04	0.06	0.04
Interaction												
I_0S_1	0.56 (1.25)^{c}	0.42 (1.19)^{de}	0.48 (1.22)^{ef}	0.66 (1.26)^{g}	0.60 (1.27)^{ef}	0.62 (1.27)^{gh}	0.46 (1.20)^{bcd}	0.30 (1.14)^{abc}	0.38 (1.17)$^{b-e}$	0.27 (1.13)^{bc}	0.15 (1.07)^{c}	0.21 (1.10)^{cd}
I_0S_2	0.70 (1.30)^{bc}	0.48 (1.22)^{bcde}	0.58 (1.26)^{def}	0.90 (1.38)$^{d-g}$	0.70 (1.31)^{def}	0.81 (1.35)^{efg}	0.50 (1.23)$^{a-d}$	0.32 (1.15)^{abc}	0.41 (1.19)$^{b-e}$	0.25 (1.12)^{bc}	0.25 (1.12)^{bc}	0.25 (1.12)^{bcd}
I_0S_3	0.66 (1.29)^{bc}	0.56 (1.25)$^{b-e}$	0.61 (1.27)$^{c-f}$	0.95 (1.39)$^{c-g}$	0.80 (1.34)^{cde}	0.88 (1.37)^{def}	0.55 (1.25)$^{a-d}$	0.38 (1.17)^{abc}	0.47 (1.21)^{bcd}	0.30 (1.14)^{abc}	0.25 (1.12)^{bc}	0.28 (1.13)^{bcd}
I_0S_4	1.14 (1.46)^{ab}	0.85 (1.36)^{ab}	1.00 (1.41)^{b}	1.40 (1.54)^{ab}	1.20 (1.48)^{ab}	1.30 (1.51)^{b}	0.64 (1.28)^{abc}	0.54 (1.24)^{ab}	0.59 (1.26)^{ab}	0.32 (1.15)^{abc}	0.44 (1.20)^{ab}	0.38 (1.18)^{ab}
I_0S_5	1.63 (1.62)^{a}	1.08 (1.44)^{a}	1.34 (1.53)^{a}	1.71 (1.65)^{a}	1.36 (1.54)^{a}	1.54 (1.59)^{a}	0.85 (1.36)^{a}	0.70 (1.30)^{a}	0.78 (1.33)^{a}	0.48 (1.22)^{a}	0.60 (1.26)^{a}	0.54 (1.24)^{a}
I_1S_1	0.46 (1.21)^{c}	0.32 (1.15)^{e}	0.40 (1.18)^{f}	0.56 (1.25)^{g}	0.55 (1.25)^{f}	0.56 (1.25)^{h}	0.29 (1.13)^{d}	0.11 (1.05)^{c}	0.20 (1.09)^{e}	0.18 (1.08)^{c}	0.10 (1.05)^{c}	0.14 (1.06)^{d}
I_1S_2	0.54 (1.24)^{c}	0.36 (1.17)^{e}	0.44 (1.20)^{ef}	0.74 (1.32)^{g}	0.68 (1.30)^{def}	0.71 (1.31)^{fgh}	0.37 (1.17)^{cd}	0.15 (1.07)^{bc}	0.26 (1.12)^{de}	0.19 (1.09)^{bc}	0.15 (1.07)^{c}	0.17 (1.08)^{cd}
I_1S_3	0.48 (1.22)^{c}	0.43 (1.19)^{de}	0.46 (1.21)^{ef}	0.81 (1.34)^{fg}	0.71 (1.31)^{def}	0.76 (1.33)^{fgh}	0.37 (1.18)^{cd}	0.20 (1.10)^{bc}	0.29 (1.14)^{cde}	0.23 (1.11)^{bc}	0.15 (1.07)^{c}	0.19 (1.09)^{cd}
I_1S_4	0.64 (1.28)^{bc}	0.54 (1.24)$^{b-e}$	0.58 (1.26)^{def}	1.17 (1.47)$^{b-f}$	0.82 (1.35)^{cde}	1.00 (1.41)^{cde}	0.55 (1.24)$^{a-d}$	0.30 (1.14)^{abc}	0.43 (1.19)$^{b-e}$	0.27 (1.13)^{bc}	0.20 (1.10)^{bc}	0.25 (1.12)^{bcd}
I_1S_5	0.90 (1.38)^{bc}	0.78 (1.33)^{abcd}	0.85 (1.36)^{bcd}	1.28 (1.51)$^{a-d}$	1.00 (1.41)^{bc}	1.14 (1.46)^{bc}	0.66 (1.29)^{abc}	0.44 (1.20)^{abc}	0.55 (1.24)^{abc}	0.35 (1.16)^{abc}	0.30 (1.14)^{bc}	0.32 (1.15)^{bc}
I_2S_1	0.51 (1.23)^{c}	0.36 (1.16)^{e}	0.44 (1.20)^{ef}	0.58 (1.26)^{g}	0.55 (1.25)^{f}	0.56 (1.25)^{h}	0.40 (1.18)^{cd}	0.11 (1.05)^{c}	0.26 (1.12)^{de}	0.19 (1.09)^{bc}	0.10 (1.05)^{c}	0.15 (1.07)^{d}
I_2S_2	0.58 (1.26)^{bc}	0.38 (1.17)^{e}	0.48 (1.22)^{ef}	0.78 (1.33)^{fg}	0.64 (1.28)^{ef}	0.71 (1.31)^{fgh}	0.46 (1.21)^{bcd}	0.15 (1.07)^{bc}	0.31 (1.14)^{cde}	0.26 (1.12)^{bc}	0.28 (1.13)^{bc}	0.27 (1.12)^{bcd}
I_2S_3	0.53 (1.24)^{c}	0.48 (1.21)^{cde}	0.51 (1.23)^{ef}	0.83 (1.35)^{efg}	0.71 (1.31)^{def}	0.77 (1.33)^{fgh}	0.48 (1.22)^{bcd}	0.20 (1.10)^{bc}	0.34 (1.16)$^{b-e}$	0.27 (1.13)^{bc}	0.27 (1.13)^{bc}	0.27 (1.13)^{bcd}
I_2S_4	0.78 (1.33)^{bc}	0.68 (1.30)$^{a-e}$	0.74 (1.32)$^{b-e}$	1.24 (1.49)$^{b-e}$	0.88 (1.37)^{cd}	1.06 (1.43)^{cd}	0.62 (1.27)^{abc}	0.32 (1.15)^{abc}	0.47 (1.21)^{bcd}	0.31 (1.14)^{abc}	0.32 (1.15)^{abc}	0.32 (1.15)^{bc}
I_2S_5	1.00 (1.41)^{bc}	0.73 (1.32)^{abc}	0.90 (1.38)^{bc}	1.34 (1.53)^{abc}	0.95 (1.40)^{c}	1.14 (1.46)^{bc}	0.74 (1.32)^{ab}	0.44 (1.20)^{abc}	059 (1.26)^{ab}	0.37 (1.17)^{ab}	0.46 (1.21)^{ab}	0.42 (1.19)^{ab}
S.Em.±	0.06	0.05	0.04	0.04	0.03	0.03	0.04	0.05	0.03	0.03	0.04	0.02
LSD (0.05)	0.18	0.13	0.10	0.13	0.08	0.07	0.12	0.15	0.09	0.08	0.11	0.06
C.V. (%)	7.9	6.3	7.2	5.6	3.3	4.6	5.8	7.7	6.7	4.2	5.9	5.1

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

Among the fertilizer treatments, lower mites population was recorded with zero inorganic nitrogen coupled with highest level of potassium (S_1-0.38, 0.53 and 0.51 at 60 and 90 DAT and at final picking, respectively) closely followed by S_3 (0.56, 0.73 and 0.69 at 60 and 90 DAT and at final picking, respectively). The mites population increased with increasing levels of inorganic N and corresponding decrease in potassium. The highest mites population was observed with S_5 receiving entire N in the inorganic form and no potassium (0.92, 1.07 and 1.03 with 60 and 90 DAT and at final picking, respectively).

Among the treatment combinations, the highest mites population was recorded with the treatment combination consisting of sole chilli nutritioned with 100 per cent inorganic N coupled with no potassium application (I_0S_5) at all the stages of plant growth (1.37, 1.22 and 1.17 at 60 and 90 DAT and at final picking, respectively) (Fig.9). On the other hand, the lowest mites population was recorded with the treatment combination consisting of garlic intercropped with chilli nutritioned with highest level of potassium and zero inorganic N application (I_1S_1) at all stages of crop growth (0.32, 0.47 and 0.46 mites per leaf at 60 and 90 DAT and at final picking, respectively). It was on par with the treatment combination consisting of sole chilli and both the intercrops nutritioned with higher level of potassium coupled with lower level of inorganic N application at all the stages of plant growth, in general.

4.2.3.3 Population of predators in chilli

4.2.3.3.1 Coccinellid population (No.plant^{-1})

The data revealed significant differences in the coccinellid population per plant due to intercrops, substitution of N, graded levels of K and their interaction. Coccinellid population was higher during 60 DAT and it decreased with further advancement in the age of the crop (Table 44).

Among the intercrops, sole chilli and chilli + coriander intercropping system recorded significantly higher coccinellid population per plant (1.08 and 0.71 at 60 and 90 DAT with sole chilli and 1.02 and 0.65 with chilli + coriander intercropping, respectively). However, at final picking only sole chilli recorded higher population of coccinellids (0.63 plant^{-1}). On the other hand, the lowest coccinellid population was recorded with chilli + garlic intercropping system at all the stages of plant growth (0.81, 0.50 and 0.46 coccinellids per plant at 60 and 90 DAT and at final picking, respectively).

Among the nutrient treatments, coccinellid population registered higher values with maximum dosage of inorganic nitrogen coupled with lowest level of potassium fertilizer ($N_{100}P_{50}K_0$) at all the stages of plant growth (1.17, 0.88 and 0.77 at 60 and 90 DAT and at final picking, respectively). Next higher dose of inorganic nitrogen was next in the order with regard to coccinellid beetle population, and the population decreased with increase in the organic source of nitrogen and potash fertilizer. Significantly lower population of the beetles was observed with the treatments receiving no inorganic form of nitrogen and highest level of potassium fertilizer (S_1).

Among the treatment combinations, sole chilli nutritioned with 100 per cent inorganic fertilizer coupled with zero level of potassium application (I_0S_5) recorded significantly higher coccinellid population at all the stages of plant growth (1.29, 0.97 and 0.92 at 60 and 90 DAT and at final picking, respectively) (Fig. 10). On the other hand, significantly lower coccinellid population was observed in the treatment combination consisted I_1xS_1 at all the stages of plant growth (0.66, 0.29 and 0.23 at 60 and 90 DAT and at final picking, respectively). In general, coccinellid population followed nutrition pattern and effect of the intercropping were rather overlapping.

4.2.3.3.2 Spider population (no. plant^{-1})

The significant differences in spider population were achieved due to intercropping, substitution of N, graded levels of K and their interactions (Table 45). Spider population picked up from 60 DAT onwards and was higher during 90 DAT and then onwards it decreased at final picking (Table 45).

Among the cropping systems, the trend remained same as that of coccinellid population. The sole chilli registered significantly higher spider population than intercropped crop at all the stages of observation (0.21, 0.25 and 0.23 at 60 and 90 DAT and at final picking, respectively).

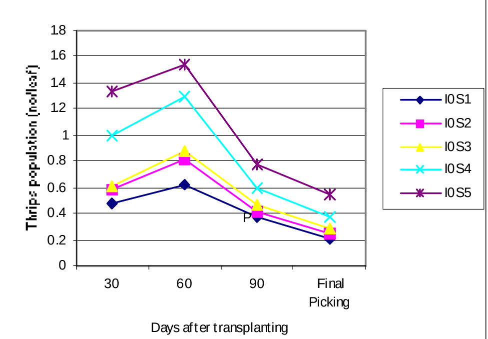
Table 43. Population of mites leaf^{-1} of bydagi chilli (*dabbi*) at 60, 90 DAT and at final picking as influenced by intercropping, N substitution and graded levels of K

Treatments	60 DAT			90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping									
I_0: Sole chilli	1.02 (1.42)^{a}	0.46 (1.21)^{a}	0.74 (1.32)^{a}	1.12 (1.46)^{a}	0.62 (1.27)^{a}	0.87 (1.36)^{a}	0.90 (1.38)^{a}	0.76 (1.33)^{a}	0.84 (1.36)^{a}
I_1: Chilli+Garlic	0.72 (1.31)^{b}	0.27 (1.13)^{b}	0.50 (1.23)^{b}	0.93 (1.39)^{b}	0.45 (1.20)^{b}	0.68 (1.29)^{b}	0.72 (1.31)^{b}	0.60 (1.27)^{b}	0.66 (1.29)^{b}
I_2: Chilli+Coriander	0.74 (1.32)^{b}	0.32 (1.15)^{b}	0.53 (1.23)^{b}	0.93 (1.39)^{b}	0.56 (1.25)^{ab}	0.76 (1.32)^{ab}	0.76 (1.33)^{b}	0.72 (1.31)^{ab}	0.74 (1.32)^{ab}
S.Em.±	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02
LSD (0.05)	0.06	0.05	0.04	0.06	0.06	0.04	0.05	0.05	0.04
N substitution and graded levels of K									
S_1: N_0:P_{50}:K_{100}	0.55 (1.24)^{c}	0.21 (1.10)^{c}	0.38 (1.17)^{d}	0.70 (1.30)^{d}	0.35 (1.16)^{c}	0.53 (1.23)^{d}	0.53 (1.24)^{b}	0.50 (1.23)^{d}	0.51 (1.23)^{d}
S_2: N_{25}:P_{50}:K_{75}	0.67 (1.29)^{cd}	0.25 (1.12)^{c}	0.46 (1.21)^{cd}	0.80 (1.34)^{cd}	0.46 (1.21)^{c}	0.63 (1.28)^{cd}	0.67 (1.29)^{b}	0.58 (1.25)^{cd}	0.63 (1.28)^{cd}
S_3: N_{50}:P_{50}:K_{50}	0.80 (1.34)^{bc}	0.32 (1.15)^{bc}	0.56 (1.24)^{c}	0.97 (1.40)^{bc}	0.48 (1.22)^{bc}	0.73 (1.31)^{c}	0.70 (1.30)^{b}	0.68 (1.30)^{bc}	0.69 (1.30)^{c}
S_4: N_{75}:P_{50}:K_{25}	0.96 (1.40)^{b}	0.42 (1.19)^{b}	0.69 (1.29)^{b}	1.13 (1.46)^{b}	0.63 (1.28)^{ab}	0.88 (1.37)^{b}	1.02 (1.42)^{a}	0.81 (1.35)^{ab}	0.90 (1.37)^{b}
S_5: N_{100}:P_{50}:K_0	1.25 (1.50)^{a}	0.58 (1.26)^{a}	0.92 (1.38)^{a}	1.40 (1.55)^{a}	0.74 (1.32)^{a}	1.07 (1.43)^{a}	1.09 (1.45)^{a}	0.97 (1.40)^{a}	1.03 (1.43)^{a}
S.Em.±	0.03	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02
LSD (0.05)	0.08	0.06	0.05	0.08	0.08	0.06	0.06	0.06	0.06
Interaction									
I_0S_1	0.57 (1.25)^{de}	0.25 (1.12)^{cd}	0.41 (1.18)^{fg}	0.78 (1.33)^{d}	0.36 (1.17)^{bc}	0.57 (1.25)^{efg}	0.61 (1.27)^{cd}	0.54 (1.25)^{cde}	0.58 (1.25)^{efg}
I_0S_2	0.67 (1.29)^{cde}	0.27 (1.13)^{bcd}	0.47 (1.21)$^{d-g}$	0.93 (1.39)^{bcd}	0.54 (1.24)^{abc}	0.73 (1.31)$^{c-g}$	0.72 (1.31)^{bcd}	0.62 (1.27)$^{b-e}$	0.67 (1.29)$^{d-g}$
I_0S_3	0.93 (1.39)^{bcd}	0.42 (1.19)^{bcd}	0.68 (1.29)$^{b-e}$	1.07 (1.44)^{bcd}	0.54 (1.24)^{abc}	0.80 (1.34)$^{b-e}$	0.73 (1.32)^{bcd}	0.73 (1.32)$^{a-d}$	0.73 (1.32)$^{c-g}$
I_0S_4	1.23 (1.49)^{b}	0.56 (1.25)^{ab}	0.90 (1.37)^{b}	1.28 (1.51)^{ab}	0.78 (1.33)^{ab}	1.03 (1.42)^{abc}	1.16 (1.47)^{ab}	0.92 (1.39)^{ab}	1.04 (1.42)^{abc}
I_0S_5	1.90 (1.70)^{a}	0.83 (1.35)^{a}	1.37 (1.53)^{a}	1.63 (1.62)^{a}	0.83 (1.35)^{a}	1.22 (1.48)^{a}	1.28 (1.50)^{a}	1.06 (1.43)^{a}	1.17 (1.48)^{a}
I_1S_1	0.47 (1.21)^{e}	0.17 (1.08)^{d}	0.32 (1.15)^{g}	0.63 (1.28)^{d}	0.32 (1.15)^{c}	0.47 (1.21)^{g}	0.48 (1.21)^{d}	0.43 (1.19)^{e}	0.46 (1.21)^{g}
I_1S_2	0.70 (1.30)^{cde}	0.20 (1.09)^{cd}	0.45 (1.20)^{efg}	0.80 (1.34)^{cd}	0.36 (1.17)^{bc}	0.58 (1.26)^{efg}	0.63 (1.27)^{cd}	0.51 (1.22)^{ef}	0.58 (1.26)^{efg}
I_1S_3	0.73 (1.32)^{cde}	0.27 (1.13)^{bcd}	0.50 (1.22)$^{c-g}$	0.87 (1.37)^{bcd}	0.42 (1.19)^{abc}	0.65 (1.28)$^{d-g}$	0.67 (1.29)^{bcd}	0.58 (1.26)$^{b-f}$	0.63 (1.28)$^{d-g}$
I_1S_4	0.87 (1.37)^{bcd}	0.30 (1.14)^{bcd}	0.58 (1.25)$^{c-f}$	1.07 (1.44)^{bcd}	0.52 (1.23)^{abc}	0.79 (1.33)$^{c-f}$	0.92 (1.39)^{bcd}	0.71 (1.31)$^{a-e}$	0.81 (1.33)$^{c-f}$
I_1S_5	1.00 (1.41)^{bc}	0.47 (1.21)^{bc}	0.74 (1.31)^{bc}	1.25 (1.50)^{abc}	0.60 (1.27)^{abc}	0.92 (1.39)$^{a-d}$	1.00 (1.41)^{abc}	0.87 (1.37)^{abc}	0.93 (1.39)$^{a-d}$
I_2S_1	0.60 (1.26)^{cde}	0.20 (1.09)^{cd}	0.40 (1.18)^{fg}	0.63 (1.28)^{d}	0.36 (1.17)^{bc}	0.49 (1.22)^{fg}	0.48 (1.22)^{d}	0.48 (1.22)^{de}	0.48 (1.22)^{fg}
I_2S_2	0.67 (1.29)^{cde}	0.25 (1.12)^{bcd}	0.46 (1.21)$^{d-g}$	0.70 (1.30)^{d}	0.48 (1.22)^{abc}	0.58 (1.26)^{efg}	0.67 (1.29)^{d}	0.58 (1.26)^{cde}	0.62 (1.27)^{efg}
I_2S_3	0.70 (1.30)^{cde}	0.30 (1.14)^{bcd}	0.50 (1.22)$^{c-g}$	0.97 (1.40)^{bcd}	0.54 (1.24)^{abc}	0.75 (1.32)$^{c-g}$	0.68 (1.30)^{bcd}	0.72 (1.31)$^{a-e}$	0.71 (1.31)$^{c-g}$
I_2S_4	0.80 (1.34)^{cde}	0.38 (1.17)^{bcd}	0.59 (1.26)$^{c-f}$	1.03 (1.42)^{bcd}	0.63 (1.28)^{abc}	0.83 (1.35)$^{b-e}$	1.00 (1.41)^{bcd}	0.80 (1.34)$^{a-d}$	0.90 (1.37)$^{b-e}$
I_2S_5	0.93 (1.39)^{bcd}	0.47 (1.21)^{bc}	0.70 (1.30)^{bcd}	1.35 (1.53)^{ab}	0.80 (1.34)^{a}	1.08 (1.44)^{ab}	1.07 (1.44)^{ab}	0.97 (1.40)^{a}	1.03 (1.43)^{ab}
S.Em.±	0.05	0.04	0.03	0.05	0.05	0.03	0.04	0.04	0.03
LSD (0.05)	0.13	0.11	0.08	0.14	0.14	0.10	0.11	0.11	0.10
C.V. (%)	5.7	5.5	5.6	5.7	7.1	6.4	4.7	5.1	6.4

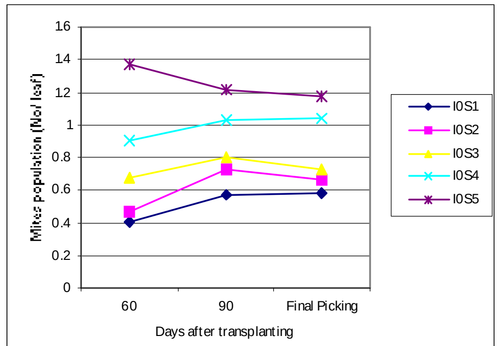
Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

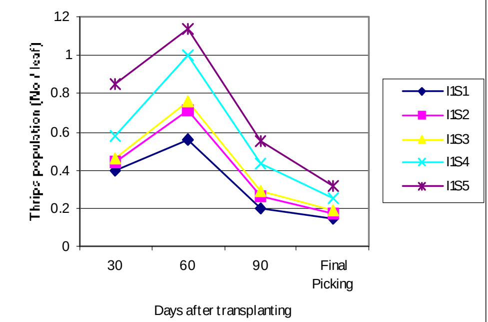
Figures in parenthesis indicate $\sqrt{x+1}$ transformation values



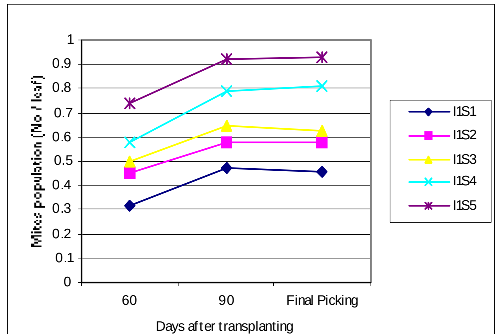
Population of thrips on sole chilli as influenced by N substitution and graded levels



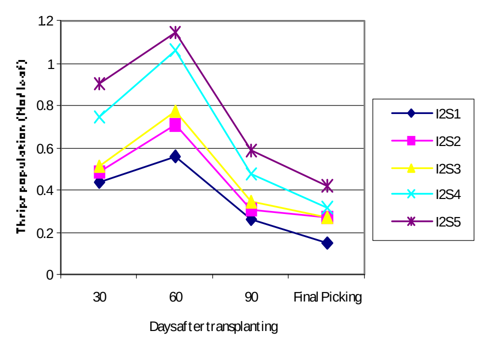
Population of mites in sole chill as influenced by N substitution and graded levels of K



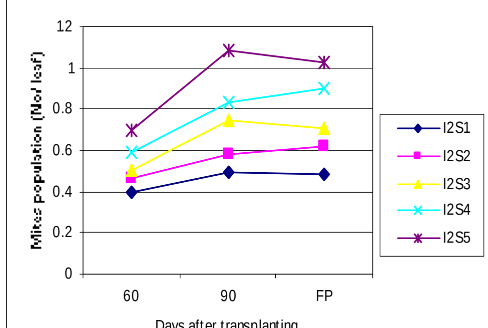
Population of thrips in chilli+garlic intercropping as influenced by N substitution and graded levels of K



Population of mites in chill+garlic intercropping as influenced by N substitution and graded levels of K



Population of thrips in chill+coriander intercropping as influenced by N substitution and graded levels of K



Population of mites in chill+coriander intercropping as influenced by N substitution and graded levels of K

LEGEND: S1-$N_0P_{50}K_{100}$, S2-$N_{25}P_{50}K_{75}$, S3-$N_{50}P_{50}K_{50}$, S4-$N_{75}P_{50}K_{25}$,S5-$N_{100}P_{50}K_0$

Fig.9: Population of thrips and mites asinfluenced by N substitution and graded levels of K under different cropping systems

Table 44. Coccinellid beetles plant^{-1} of bydagi chilli (*dabbi*) at 60 and 90 DAT and at final picking as influenced by intercropping, N substitution and graded levels of K

Treatments	60 DAT			90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping									
I_0: Sole chilli	1.25 (1.50)^{a}	0.90 (1.38)^{a}	1.08 (1.44)^{a}	0.80 (1.34)^{a}	0.62 (1.27)^{a}	0.71 (1.30)^{a}	0.70 (1.30)^{a}	0.55 (1.24)^{a}	0.63 (1.27)^{a}
I_1: Chilli+Garlic	0.90 (1.38)^{b}	0.72 (1.31)^{b}	0.81 (1.34)^{b}	0.62 (1.27)^{b}	0.37 (1.17)^{b}	0.50 (1.22)^{b}	0.52 (1.23)^{b}	0.40 (1.18)^{b}	0.46 (1.20)^{b}
I_2: Chilli+Coriander	1.21 (1.49)^{a}	0.83 (1.35)^{ab}	1.02 (1.43)^{a}	0.74 (1.32)^{a}	0.55 (1.25)^{a}	0.65 (1.28)^{a}	0.53 (1.24)^{b}	0.45 (1.20)^{ab}	0.49 (1.22)^{b}
S.Em.±	0.01	0.02	0.01	0.02	0.03	0.02	0.02	0.02	0.01
LSD (0.05)	0.04	0.06	0.04	0.05	0.08	0.04	0.05	0.05	0.03
N substitution and graded levels of K									
S_1: N_0:P_{50}:K_{100}	1.02 (1.42)^{c}	0.55 (1.25)^{b}	0.79 (1.34)^{c}	0.43 (1.20)^{c}	0.25 (1.12)^{c}	0.34 (1.16)^{c}	0.40 (1.18)^{c}	0.25 (1.11)^{c}	0.33 (1.15)^{d}
S_2: N_{25}:P_{50}:K_{75}	1.06 (1.44)^{bc}	0.64 (1.28)^{b}	0.85 (1.36)^{c}	0.52 (1.23)^{c}	0.35 (1.16)^{bc}	0.43 (1.19)^{c}	0.47 (1.21)^{c}	0.35 (1.16)^{b}	0.41 (1.19)^{cd}
S_3: N_{50}:P_{50}:K_{50}	1.14 (1.46)^{abc}	0.90 (1.38)^{a}	1.02 (1.42)^{b}	0.80 (1.34)^{b}	0.55 (1.25)^{ab}	0.68 (1.30)^{b}	0.52 (1.23)^{bc}	0.50 (1.22)^{b}	0.51 (1.22)^{bc}
S_4: N_{75}:P_{50}:K_{25}	1.19 (1.48)^{ab}	0.94 (1.39)^{a}	1.07 (1.43)^{ab}	0.82 (1.35)^{b}	0.62 (1.27)^{a}	0.72 (1.31)^{b}	0.68 (1.29)^{b}	0.52 (1.23)^{ab}	0.60 (1.26)^{b}
S_5: N_{100}:P_{50}:K_0	1.27 (1.51)^{a}	1.06 (1.44)^{a}	1.17 (1.47)^{a}	1.02 (1.42)^{c}	0.73 (1.32)^{a}	0.88 (1.37)^{a}	0.87 (1.37)^{a}	0.67 (1.29)^{a}	0.77 (1.33)^{a}
S.Em.±	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.02
LSD (0.05)	0.05	0.08	0.05	0.06	0.10	0.06	0.06	0.06	0.04
Interaction									
I_0S_1	1.14 (1.46)$^{a-e}$	0.64 (1.28)^{cde}	0.89 (1.37)$^{c-f}$	0.46 (1.21)^{cd}	0.33 (1.15)^{bcd}	0.40 (1.18)^{d}	0.52 (1.23)$^{c-e}$	0.30 (1.14)$^{c-f}$	0.41 (1.19)$^{d-g}$
I_0S_2	1.19 (1.48)$^{a-d}$	0.70 (1.30)$^{b-e}$	0.95 (1.39)$^{b-e}$	0.54 (1.24)^{cd}	0.44 (1.20)$^{a-d}$	0.49 (1.22)^{cd}	0.52 (1.23)$^{c-e}$	0.50 (1.22)$^{b-e}$	0.51 (1.23)^{cde}
I_0S_3	1.25 (1.50)$^{a-d}$	1.00 (1.41)$^{a-d}$	1.12 (1.46)^{abc}	0.93 (1.39)^{ab}	0.71 (1.30)^{ab}	0.82 (1.35)^{a}	0.60 (1.26)$^{b-d}$	0.57 (1.25)$^{a-d}$	0.58 (1.26)^{bcd}
I_0S_4	1.27 (1.51)^{abc}	1.02 (1.42)^{abc}	1.15 (1.47)^{ab}	0.97 (1.40)^{ab}	0.74 (1.32)^{ab}	0.86 (1.36)^{a}	0.80 (1.34)^{abc}	0.58 (1.26)^{abc}	0.69 (1.30)^{bc}
I_0S_5	1.40 (1.55)^{ab}	1.19 (1.48)^{a}	1.29 (1.51)^{a}	1.08 (1.44)^{a}	0.85 (1.36)^{a}	0.97 (1.40)^{a}	1.00 (1.41)^{a}	0.83 (1.35)^{a}	0.92 (1.38)^{a}
I_1S_1	0.83 (1.35)^{f}	0.49 (1.22)^{e}	0.66 (1.29)^{f}	0.40 (1.18)^{d}	0.17 (1.08)^{d}	0.29 (1.13)^{d}	0.27 (1.13)^{e}	0.18 (1.09)^{f}	0.23 (1.11)^{g}
I_1S_2	0.83 (1.35)^{f}	0.59 (1.26)^{de}	0.71 (1.30)^{ef}	0.48 (1.22)^{cd}	0.21 (1.10)^{cd}	0.35 (1.16)^{d}	0.47 (1.21)^{de}	0.27 (1.13)^{def}	0.37 (1.17)^{efg}
I_1S_3	0.88 (1.37)^{ef}	0.83 (1.35)$^{a-e}$	0.86 (1.36)^{def}	0.67 (1.29)^{bcd}	0.40 (1.18)$^{a-d}$	0.55 (1.24)^{bcd}	0.47 (1.21)^{de}	0.42 (1.19)$^{b-f}$	0.44 (1.20)^{def}
I_1S_4	0.96 (1.40)$^{d-f}$	0.83 (1.35)$^{a-e}$	0.90 (1.37)$^{c-f}$	0.67 (1.29)^{bcd}	0.42 (1.19)$^{a-d}$	0.55 (1.24)^{bcd}	0.58 (1.26)$^{b-d}$	0.47 (1.21)$^{b-f}$	0.52 (1.23)^{cde}
I_1S_5	1.02 (1.42)$^{c-f}$	0.90 (1.38)$^{a-d}$	0.96 (1.40)^{bcd}	0.93 (1.39)^{ab}	0.65 (1.28)^{abc}	0.79 (1.34)^{ab}	0.80 (1.34)^{abc}	0.60 (1.26)^{abc}	0.70 (1.30)^{bc}
I_2S_1	1.10 (1.45)$^{b-f}$	0.59 (1.26)^{de}	0.85 (1.36)^{def}	0.47 (1.21)^{cd}	0.31 (1.14)^{bcd}	0.39 (1.18)^{d}	0.40 (1.18)^{de}	0.20 (1.10)^{ef}	0.30 (1.14)^{fg}
I_2S_2	1.19 (1.48)$^{a-d}$	0.64 (1.28)^{cde}	0.92 (1.38)$^{b-f}$	0.51 (1.23)^{cd}	0.39 (1.18)$^{a-d}$	0.46 (1.21)^{cd}	0.40 (1.18)^{de}	0.40 (1.18)$^{b-f}$	0.40 (1.18)$^{d-g}$
I_2S_3	1.25 (1.50)$^{a-d}$	0.91 (1.38)$^{a-d}$	1.08 (1.44)$^{a-d}$	0.82 (1.33)^{abc}	0.64 (1.28)^{abc}	0.73 (1.31)^{abc}	0.47 (1.21)^{de}	0.47 (1.21)$^{b-f}$	0.47 (1.21)^{def}
I_2S_4	1.30 (1.52)^{abc}	0.96 (1.40)$^{a-d}$	1.13 (1.46)^{abc}	0.88 (1.37)^{ab}	0.69 (1.30)^{ab}	0.79 (1.34)^{ab}	0.62 (1.27)$^{b-d}$	0.52 (1.23)^{bcd}	0.57 (1.25)$^{b-e}$
I_2S_5	1.42 (1.56)^{a}	1.11 (1.45)^{ab}	1.27 (1.51)^{a}	1.05 (1.43)^{a}	0.78 (1.33)^{ab}	0.92 (1.38)^{a}	0.85 (1.36)^{ab}	0.60 (1.27)^{ab}	0.73 (1.32)^{ab}
S.Em.±	0.03	0.05	0.03	0.04	0.06	0.03	0.04	0.04	0.03
LSD (0.05)	0.09	0.13	0.08	0.11	0.17	0.10	0.11	0.11	0.07
C.V. (%)	3.9	5.9	4.9	4.7	8.2	6.6	4.7	5.2	5.0

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form N base figures indicate N substitution with inorganics only.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

Among the cropping systems, the trend remained same as that of coccinellid population. The sole chilli registered significantly higher spider population than intercropped crop at all the stages of observation (0.21, 0.25 and 0.23 at 60 and 90 DAT and at final picking, respectively).

Among the fertilizer treatments, sole chilli nutritioned with 100 per cent inorganic N fertilizer coupled with zero level of potassium application (I_0S_5) recorded significantly higher spider population at all the stages of crop growth (0.34, 0.38 and 0.40 and 60 and 90 DAT and at final picking, respectively) (Fig. 10). On the other hand, significantly lower spider population was observed in the treatment combination I_1xS_1 at all the stages of plant growth (0.04, 0.08 and 0.05 at 60 and 90 DAT and at final picking, respectively). In general, spider population followed coccinellid population pattern and varied according to the nutrition supplied to the crop and effects of the intercrops were overlapping.

4.2.3.4 Population of predators in intercrops (no. plant^{-1})

4.2.3.4.1 Population of coccinellids

Coccinellid population varied significantly due to intercrops, substitution of N, graded levels of K and their interactions (Table 46).

Among intercrops, coriander registered significantly higher coccinellid population (1.36) compared to garlic intercrop (1.07). Among the fertilizer treatments lower level of N coupled with higher dosage of potassium ($N_0P_{50}K_{100}$) recorded lowest coccinellid population (0.88), while treatment, consisting of 100 per cent nitrogen fertilized without K ($N_{100}P_{50}K_0$) recorded significantly higher coccinellid population (1.48). It was on par with $N_{75}P_{50}K_{25}$ nutritioned treatment (1.38).

Among the treatment combinations, garlic intercropped with chilli nutritioned with highest level of potassium (100 kg) and without N fertilizer (I_1S_1) recorded significantly lower coccinellid population (0.76) compared to rest of the treatment combinations except I_1S_2 (0.92). On the other hand, significantly higher population of beetles (1.60) was recorded with coriander fertilized with 100 per cent N and zero level of K (I_2S_5). Other treatments were intermediate in their influence.

4.2.3.4.2 Population of spider

Data on spider population did not differ significantly between two intercrops (Table 46). It ranged from 0.90 to 0.82 plant^{-1}.

Among the fertilizer treatments, zero or minimum inorganic nitrogen coupled with higher potassium supply ($N_0P_{50}K_{100}$) recorded significantly lower spider population in the intercrops (0.68 and 0.78 with S_1 and S_2, respectively), while highest spider population (1.08) was recorded in the treatment consisted of highest level of inorganic N+ zero potassium ($N_{100}P_{50}K_0$).

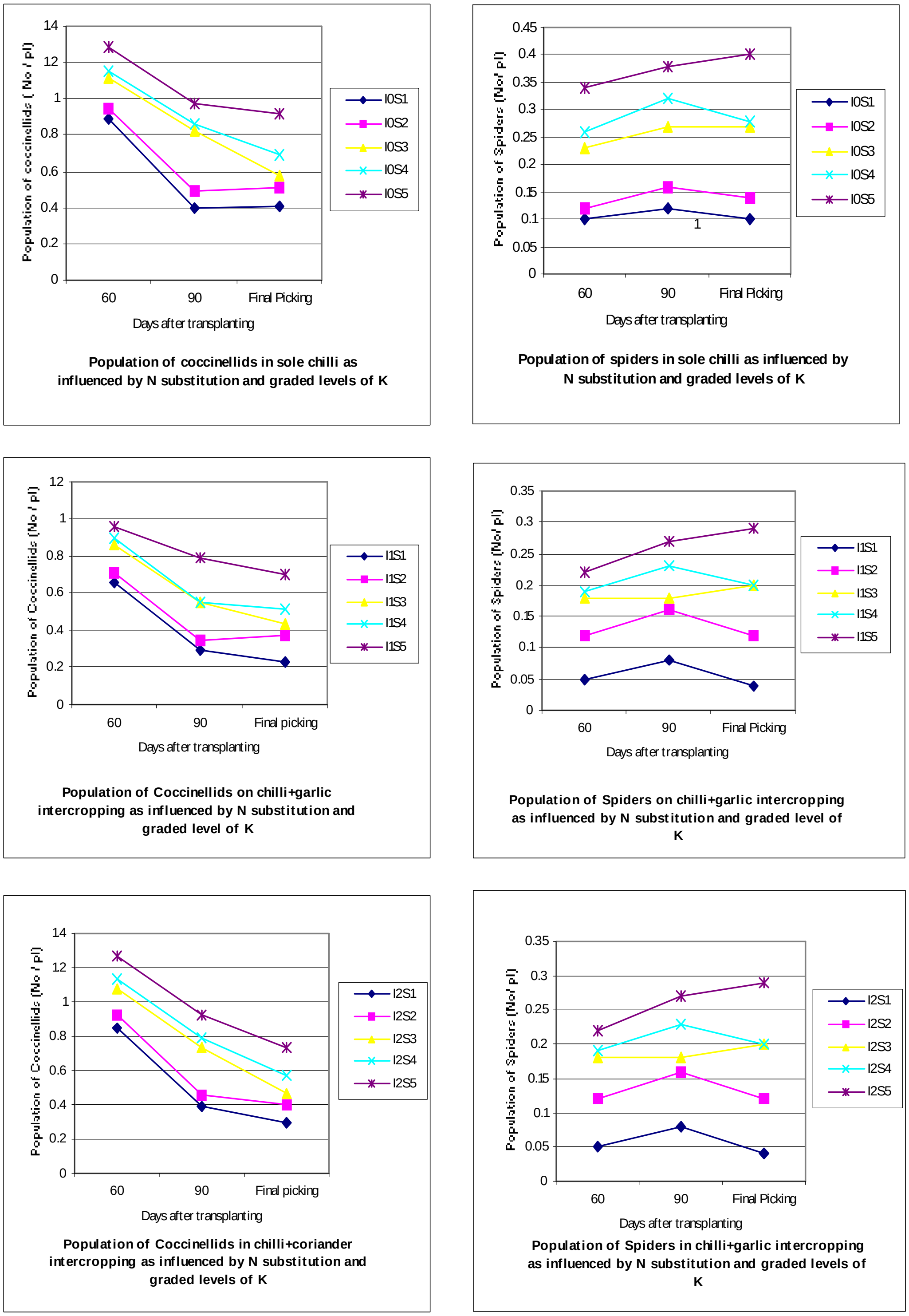
Irrespective of the intercrops used, the spider population was lower with the supply of lower quantity of inorganic nitrogen and higher quantity of potassium and the trend reversed with change in the nutrient levels. Significantly higher spider population (1.12) was observed with garlic intercrop receiving entire N in the inorganic form and zero K fertilization (I_1S_5) followed by coriander receiving same levels of fertilizer (I_2S_5 ,1.02) and garlic receiving $N_{75}P_{50}K_{25}$ nutrition ((I_1S_4 ,0.88).

4.2.3.4.3 Population of *Chrysoperla carnea*

Between the two intercrops C*hrysoperla* population did not differ significantly. It ranged from 0.74 to 0.70 with garlic and coriander intercrops, respectively (Table 46).

Among the nutrient treatments zero or minimum inorganic nitrogen coupled with high potassium supply ($N_0P_{50}K_{100}$) recorded significantly lower C*hrysoperla* population in the intercrops (0.46 with S_1 treatment). While, the lowest *Chrysoperla* population (1.04) was recorded in the treatment supplied with highest level of inorganic N + zero potassium ($N_{100}P_{50}K_0$).

Among the treatment combinations, irrespective of intercrop used, the *Chrysoperla* population was lower with the supply of higher quantity of potassium with lower quantity of inorganic nitrogen and the trend changed with change in the nutrient levels. Significantly



Population of coccinellids in sole chilli as influenced by N substitution and graded levels of K

Population of spiders in sole chilli as influenced by N substitution and graded levels of K

Population of Coccinellids on chilli+garlic intercropping as influenced by N substitution and graded level of K

Population of Spiders on chilli+garlic intercropping as influenced by N substitution and graded level of K

Population of Coccinellids in chilli+coriander intercropping as influenced by N substitution and graded levels of K

Population of Spiders in chilli+garlic intercropping as influenced by N substitution and graded levels of K

LEGEND: S1-$N_0P_{50}K_{100}$, S2-$N_{25}P_{50}K_{75}$, S3-$N_{50}P_{50}K_{50}$, S4-$N_{75}P_{50}K_{25}$, S5-$N_{100}P_{50}K_0$

Fig.10: Population of coccinellids and spiders as influenced by N substitution and graded levels of K under different cropping systems

Table 45. Spider population/plant of bydagi chilli (*dabbi*) at 60, 90 DAT and at final picking as influenced by intercropping, N substitution and graded levels of K

Treatments	60 DAT			90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping									
I_0: Sole chilli	0.25 (1.12)^{a}	0.16 (1.08)^{a}	0.21 (1.10)^{a}	0.27 (1.13)^{a}	0.20 (1.10)^{a}	0.25 (1.12)^{a}	0.25 (1.12)^{a}	0.20 (1.10)^{a}	0.23 (1.11)^{a}
I_1: Chilli+Garlic	0.20 (1.10)^{ab}	0.10 (1.05)^{ab}	0.15 (1.07)^{b}	0.18 (1.09)^{ab}	0.18 (1.09)^{ab}	0.18 (1.09)^{b}	0.16 (1.08)^{b}	0.18 (1.08)^{ab}	0.17 (1.08)^{b}
I_2: Chilli+Coriander	0.16 (1.08)^{b}	0.07 (1.03)^{b}	0.12 (1.05)^{b}	0.15 (1.07)^{b}	0.11 (1.05)^{b}	0.14 (1.07)^{b}	0.14 (1.07)^{b}	0.10 (1.05)^{b}	0.12 (1.06)^{b}
S.Em.±	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01
LSD (0.05)	0.03	0.04	0.02	0.05	0.03	0.03	0.03	0.05	0.03
N substitution and graded levels of K									
S_1: N_0:P_{50}:K_{100}	0.10 (1.05)^{c}	0.01 (1.01)^{c}	0.06 (1.03)^{c}	0.08 (1.04)^{c}	0.10 (1.05)^{c}	0.10 (1.05)^{c}	0.08 (1.04)^{c}	0.05 (1.02)^{c}	0.07 (1.03)^{c}
S_2: N_{25}:P_{50}:K_{75}	0.14 (1.07)^{bc}	0.07 (1.03)^{bc}	0.11 (1.05)^{c}	0.14 (1.07)^{bc}	0.14 (1.07)^{bc}	0.14 (1.07)^{bc}	0.14 (1.06)^{bc}	0.14 (1.06)^{bc}	0.14 (1.06)^{c}
S_3: N_{50}:P_{50}:K_{50}	0.24 (1.11)^{ab}	0.14 (1.07)^{ab}	0.19 (1.09)^{b}	0.20 (1.10)^{abc}	0.18 (1.09)^{bc}	0.19 (1.10)^{ab}	0.20 (1.10)^{ab}	0.20 (1.10)^{ab}	0.20 (1.10)^{b}
S_4: N_{75}:P_{50}:K_{25}	0.25 (1.12)^{a}	0.14 (1.07)^{ab}	0.20 (1.09)^{b}	0.25 (1.12)^{ab}	0.20 (1.10)^{ab}	0.23 (1.11)^{a}	0.25 (1.12)^{a}	0.20 (1.10)^{ab}	0.23 (1.11)^{ab}
S_5: N_{100}:P_{50}:K_0	0.32 (1.15)^{a}	0.18 (1.09)^{a}	0.25 (1.12)^{a}	0.32 (1.15)^{a}	0.23 (1.11)^{a}	0.27 (1.13)^{a}	0.30 (1.14)^{a}	0.28 (1.13)^{a}	0.29 (1.14)^{a}
S.Em.±	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.01
LSD (0.05)	0.04	0.05	0.03	0.06	0.04	0.04	0.04	0.05	0.04
Interaction									
I_0S_1	0.12 (1.06)$^{c-e}$	0.07 (1.03)^{bc}	0.10 (1.05)^{cde}	0.14 (1.07)^{bc}	0.10 (1.05)^{bc}	0.12 (1.06)^{cde}	0.14 (1.07)^{bc}	0.06 (1.03)^{bc}	0.10 (1.05)^{cd}
I_0S_2	0.16 (1.08)$^{b-e}$	0.07 (1.03)^{bc}	0.12 (1.06)^{cde}	0.18 (1.09)^{bc}	0.14 (1.07)$^{a-c}$	0.16 (1.08)$^{b-e}$	0.14 (1.07)^{bc}	0.14 (1.07)^{abc}	0.14 (1.07)^{bcd}
I_0S_3	0.27 (1.13)$^{a-d}$	0.20 (1.10)^{ab}	0.23 (1.11)^{abc}	0.30 (1.14)^{abc}	0.23 (1.11)$^{a-c}$	0.27 (1.13)^{abc}	0.27 (1.13)^{ab}	0.27 (1.13)^{ab}	0.27 (1.13)^{ab}
I_0S_4	0.32 (1.15)^{ab}	0.20 (1.10)^{ab}	0.26 (1.13)^{ab}	0.37 (1.17)^{ab}	0.27 (1.13)^{ab}	0.32 (1.15)^{ab}	0.30 (1.14)^{ab}	0.27 (1.13)^{ab}	0.28 (1.13)^{ab}
I_0S_5	0.41 (1.19)^{a}	0.27 (1.13)^{a}	0.34 (1.16)^{a}	0.47 (1.21)^{a}	0.30 (1.14)^{a}	0.38 (1.17)^{a}	0.40 (1.18)^{a}	0.40 (1.18)^{a}	0.40 (1.08)^{a}
I_1S_1	0.10 (1.05)^{de}	0.00 (1.00)^{c}	0.05 (1.02)^{e}	0.07 (1.03)^{c}	0.10 (1.05)^{bc}	0.08 (1.04)^{de}	0.07 (1.03)^{c}	0.00 (1.00)^{bc}	0.04 (1.02)^{cd}
I_1S_2	0.14 (1.07)$^{b-e}$	0.10 (1.05)^{abc}	0.12 (1.06)^{cde}	0.14 (1.07)^{bc}	0.18 (1.09)$^{a-c}$	0.16 (1.08)$^{b-e}$	0.07 (1.03)^{c}	0.18 (1.09)^{abc}	0.12 (1.06)^{bcd}
I_1S_3	0.20 (1.10)$^{b-e}$	0.14 (1.07)^{abc}	0.18 (1.09)^{bcd}	0.18 (1.09)^{bc}	0.18 (1.09)$^{a-c}$	0.18 (1.09)$^{b-e}$	0.18 (1.09)^{bc}	0.20 (1.10)^{abc}	0.20 (1.10)^{ab}
I_1S_4	0.24 (1.11)$^{a-c}$	0.13 (1.06)^{abc}	0.19 (1.09)^{bcd}	0.23 (1.11)^{abc}	0.20 (1.10)$^{a-c}$	0.23 (1.11)$^{a-d}$	0.22 (1.11)^{abc}	0.18 (1.09)^{abc}	0.20 (1.10)^{ab}
I_1S_5	0.30 (1.14)$^{a-c}$	0.14 (1.07)^{abc}	0.22 (1.10)^{bc}	0.30 (1.14)^{abc}	0.23 (1.11)$^{a-c}$	0.27 (1.13)^{abc}	0.30 (1.14)^{ab}	0.28 (1.13)^{ab}	0.29 (1.13)^{ab}
I_2S_1	0.07 (1.03)^{e}	0.00 (1.00)^{c}	0.04 (1.02)^{e}	0.06 (1.03)^{c}	0.07 (1.03)^{c}	0.07 (1.03)^{e}	0.07 (1.03)^{c}	0.06 (1.03)^{bc}	0.07 (1.03)^{cd}
I_2S_2	0.14 (1.07)$^{b-e}$	0.00 (1.00)^{c}	0.07 (1.03)^{de}	0.14 (1.07)^{bc}	0.10 (1.05)^{bc}	0.12 (1.06)^{cde}	0.14 (1.07)^{bc}	0.06 (1.03)^{bc}	0.10 (1.05)^{cd}
I_2S_3	0.18 (1.09)$^{b-e}$	0.07 (1.03)^{bc}	0.13 (1.06)^{cde}	0.14 (1.07)^{bc}	0.14 (1.07)$^{a-c}$	0.14 (1.07)^{cde}	0.14 (1.07)^{bc}	0.13 (1.06)$^{a-c}$	0.14 (1.07)^{bcd}
I_2S_4	0.18 (1.09)$^{b-e}$	0.07 (1.03)^{bc}	0.13 (1.06)^{cde}	0.18 (1.09)^{bc}	0.17 (1.08)$^{b-c}$	0.18 (1.09)$^{b-e}$	0.20 (1.10)^{abc}	0.13 (1.06)$^{a-c}$	0.16 (1.08)^{bcd}
I_2S_5	0.25 (1.12)$^{a-d}$	0.14 (1.07)^{abc}	0.20 (1.09)^{bcd}	0.20 (1.10)^{abc}	0.19 (1.09)$^{a-c}$	0.20 (1.10)$^{a-e}$	0.20 (1.10)^{abc}	0.18 (1.10)$^{a-c}$	0.20 (1.10)^{ab}
S.Em.±	0.03	0.03	0.02	0.04	0.03	0.02	0.03	0.03	0.02
LSD (0.05)	0.08	0.08	0.05	0.11	0.08	0.06	0.08	0.08	0.06
C.V. (%)	4.1	4.6	4.3	5.9	4.8	5.4	4.5	4.8	5.1

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

Table 46. Population of coccinellids plant^{-1}, spiders plant-^{1} and *Chrysoperla carnea* plant^{-1} in the intercrops of bydagi chilli (*dabbi*) as influenced by intercropping, N substitution and graded levels of K

Treatments	Coccinellids			Spiders			*Chrysoperla carnea*		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping									
I_1: Chilli+Garlic	1.20 (1.48)^{b}	0.92 (1.39)^{b}	1.07 (1.44)^{b}	1.27 (1.50)^{a}	0.56 (1.25)^{a}	0.90 (1.38)^{a}	1.04 (1.43)^{a}	0.46 (1.21)^{a}	0.74 (1.32)^{a}
I_2: Chilli+Coriander	1.42 (1.56)^{a}	1.30 (1.52)^{a}	1.36 (1.54)^{a}	1.14 (1.46)^{a}	0.52 (1.23)^{a}	0.82 (1.35)^{a}	1.02 (1.42)^{a}	0.42 (1.19)^{a}	0.68 (1.30)^{a}
S.Em.±	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.02	0.01
LSD (0.05)	0.07	0.06	0.04	NS	NS	NS	NS	NS	NS
N substitution and graded levels of K									
S_1: N_0:P_{50}:K_{100}	1.15 (1.47)^{b}	0.58 (1.26)^{c}	0.88 (1.37)^{d}	1.01 (1.42)^{b}	0.36 (1.17)^{b}	0.68 (1.30)^{c}	0.76 (1.33)^{b}	0.18 (1.09)^{d}	0.46 (1.20)^{d}
S_2: N_{25}:P_{50}:K_{75}	1.23 (1.49)^{ab}	1.00 (1.41)^{b}	1.10 (1.45)^{c}	1.14 (1.46)^{ab}	0.44 (1.20)^{b}	0.78 (1.33)^{bc}	0.96 (1.40)^{c}	0.26 (1.12)^{cd}	0.58 (1.26)^{c}
S_3: N_{50}:P_{50}:K_{50}	1.30 (1.52)^{ab}	1.23 (1.49)^{ab}	1.28 (1.51)^{b}	1.16 (1.47)^{ab}	0.54 (1.24)^{b}	0.84 (1.36)^{b}	1.04 (1.43)^{bc}	0.40 (1.18)^{c}	0.70 (1.30)^{c}
S_4: N_{75}:P_{50}:K_{25}	1.38 (1.54)^{ab}	1.33 (1.53)^{a}	1.36 (1.54)^{ab}	118 (1.48)^{ab}	0.56 (1.25)^{b}	0.86 (1.37)^{b}	1.15 (1.47)^{ab}	0.58 (1.26)^{b}	0.86 (1.36)^{b}
S_5: N_{100}:P_{50}:K_0	1.47 (1.57)^{a}	1.48 (1.58)^{a}	1.48 (1.58)^{a}	1.33 (1.53)^{a}	0.84 (1.36)^{a}	1.08 (1.44)^{a}	1.25 (1.50)^{a}	0.86 (1.36)^{a}	1.04 (1.43)^{a}
S.Em.±	0.03	0.03	0.02	0.02	0.03	0.02	0.02	0.03	0.02
LSD (0.05)	0.08	0.09	0.06	0.07	0.08	0.05	0.07	0.08	0.04
Interaction									
I_1S_1	1.08 (1.44)^{b}	0.45 (1.20)^{d}	0.76 (1.32)^{e}	1.08 (1.44)^{b}	0.36 (1.17)^{c}	0.72 (1.31)^{cd}	0.80 (1.34)^{cd}	0.14 (1.07)^{f}	0.46 (1.21)^{e}
I_1S_2	1.12 (1.46)^{b}	0.75 (1.32)^{cd}	0.92 (1.39)^{de}	1.20 (1.48)^{ab}	0.40 (1.18)^{c}	0.80 (1.34)^{bcd}	1.00 (1.41)^{bc}	0.29 (1.13)^{def}	0.64 (1.28)^{cde}
I_1S_3	1.20 (1.48)^{ab}	0.97 (1.40)^{bc}	1.08 (1.44)^{cd}	1.20 (1.48)^{ab}	0.53 (1.24)^{bc}	0.86 (1.37)^{bcd}	1.10 (1.45)^{abc}	0.44 (1.20)^{cde}	0.74 (1.32)^{bcd}
I_1S_4	1.25 (1.50)^{ab}	1.25 (1.50)^{ab}	1.25 (1.50)^{bc}	1.20 (1.48)^{ab}	0.56 (1.25)^{bc}	0.88 (1.39)^{abc}	1.16 (1.47)^{ab}	0.64 (1.28)^{abc}	0.90 (1.38)^{ab}
I_1S_5	1.35 (1.53)^{ab}	1.40 (1.55)^{a}	1.38 (1.54)^{ab}	1.40 (1.55)^{a}	0.90 (1.38)^{a}	1.12 (1.46)^{a}	1.20 (1.48)^{ab}	0.88 (1.37)^{a}	1.04 (1.43)^{a}
I_2S_1	1.23 (1.49)^{ab}	0.74 (1.32)^{cd}	1.00 (1.41)^{d}	1.08 (1.44)^{b}	0.32 (1.15)^{c}	0.68 (1.30)^{d}	0.70 (1.30)^{d}	0.20 (1.10)^{ef}	0.44 (1.20)^{e}
I_2S_2	1.35 (1.53)^{ab}	1.27 (1.50)^{ab}	1.30 (1.52)^{abc}	1.08 (1.44)^{b}	0.44 (1.20)^{c}	0.74 (1.32)^{cd}	0.90 (1.38)^{bcd}	0.20 (1.10)^{ef}	0.54 (1.24)^{de}
I_2S_3	1.47 (1.57)^{ab}	1.53 (1.59)^{a}	1.50 (1.58)^{ab}	1.16 (1.47)^{ab}	0.52 (1.23)^{bc}	0.82 (1.35)^{bcd}	1.00 (1.41)^{bc}	0.33 (1.15)^{def}	0.65 (1.28)^{cde}
I_2S_4	1.50 (1.58)^{ab}	1.47 (1.57)^{a}	1.49 (1.57)^{ab}	1.15 (1.47)^{ab}	0.52 (1.23)^{bc}	0.82 (1.35)^{bcd}	1.17 (1.47)^{ab}	0.52 (1.23)^{bcd}	0.84 (1.35)^{abc}
I_2S_5	1.60 (1.61)^{a}	1.60 (1.61)^{a}	1.60 (1.61)^{a}	1.26 (1.50)^{ab}	0.80 (1.34)^{ab}	1.02 (1.42)^{ab}	1.30 (1.52)^{a}	0.79 (1.34)^{ab}	1.04 (1.43)^{a}
S.Em.±	0.04	0.05	0.03	0.03	0.04	0.03	0.03	0.04	0.03
LSD (0.05)	0.12	0.13	0.08	0.09	0.11	0.07	0.10	0.11	0.07
C.V.(%)	4.7	5.3	5.0	3.9	5.0	4.4	4.1	5.1	4.5

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Figures in parenthesis indicate $\sqrt{x+1}$ transformation values

higher (1.04).*Chrysoperla* population was observed with garlic and coriander intercrops receiving entire N in the inorganic form with zero K fertilization (1.04 in each) followed by garlic and coriander receiving $N_{75}P_{50}K_{25}$ nutrition (0.90 and 0.84, respectively).

4.2.3.5 Leaf curl index

The variations in leaf curl index (LCI) as influenced by intercrops, substitution of N, graded levels of K and their interaction were significant at all the stages of observation (Table 47).

Among the intercrops, LCI was the lowest in the chilli intercropped with garlic at all the stages of plant growth (0.63, 0.55 and 0.39 at 60 and 90 DAT and at final picking, respectively). Coriander crop was next in the order. While, the highest LCI was recorded in the sole crop of chilli (0.78, 0.79 and 0.52 at 60 and 90 DAT and at final picking, respectively).

Among all the nutrient treatments, LCI was the lowest with the treatment receiving entire N in the organic form (S_1) coupled with maximum level of potassium at all the stage of crop growth (0.51, 0.45 and 0.33 at 60 and 90 DAT and at final picking, respectively). As the quantity of inorganic nitrogen supplied increased with corresponding decrease in the potassium, LCI increased and reached the highest values with S_5 having entire N in the inorganic form and no potassium (1.04, 0.92 and 0.63 at 60 and 90 DAT at final picking, respectively).

Among the treatment combinations, LCI was the lowest with chilli + garlic intercropping system receiving full dose of nitrogen through organic source coupled with highest potassium level (I_1S_1) at all the stages of plant growth (0.43, 0.42 and 0.27 LCI at 60 and 90 DAT and at final picking, respectively) (Fig. 11). However, it was on par with I_0S_1, I_1S_2 and I_1S_3 and I_2S_1 treatment combinations. While, significantly higher LCI was recorded with sole chilli nutritioned with 100 per cent inorganic N without potassium application (I_0S_5) at all the stages of crop growth (1.17, 1.08 and 0.68 at 60 and 90 DAT and at final picking, respectively).

4.2.4 Chemical analysis of the plant and soil

4.2.4.1 Nitrogen uptake by chilli (mg hill^{-1})

The variations in the nitrogen uptake due to graded levels of N and K and their interactions were significant (Table 49).

Intercropping system did not differ in the uptake of nitrogen by chilli crop. Among the fertilizer treatments, maximum uptake of nitrogen (19.9 kg ha^{-1}) was recorded with 100 kg ha^{-1}of inorganic N application with zero level of K_2O application (S_5). While, it was on par with rest of the fertilizer treatments except zero level of inorganic fertilizer applied treatment with 100kg K_2O application (N_0 P_{50} K_{100}) (15.4 kg ha^{-1}).

Among the treatment combinations, sole chilli nutritioned with equal quantities of all the three major nutrients (I_0S_3) recorded significantly higher N uptake (20.87 kg ha^{-1}). While, it was on par with the rest of the treatment combinations except I_0S_1, I_1S_1, I_1S_2, I_2S_1 and I_2S_2 treatment combinations. On the other hand, significantly lower N uptake was recorded with garlic and coriander intercropped with chilli supplied with zero level of inorganic N nutrition coupled with 100 kg K_2O ha^{-1} (I_1S_1 and I_2S_1).

4.2.4.2 Uptake of potassium by chilli (mg 100 g^{-1})

The data revealed significant differences in potassium uptake due to intercrops, N substitution, graded levels of K and their interaction (Table 49).

Among the intercrops, garlic intercropped with chilli recorded significantly higher K uptake (49.65 kg ha^{-1}), while the lowest K uptake was recorded with chilli + coriander intercropped system (31.69 kg ha^{-1}).

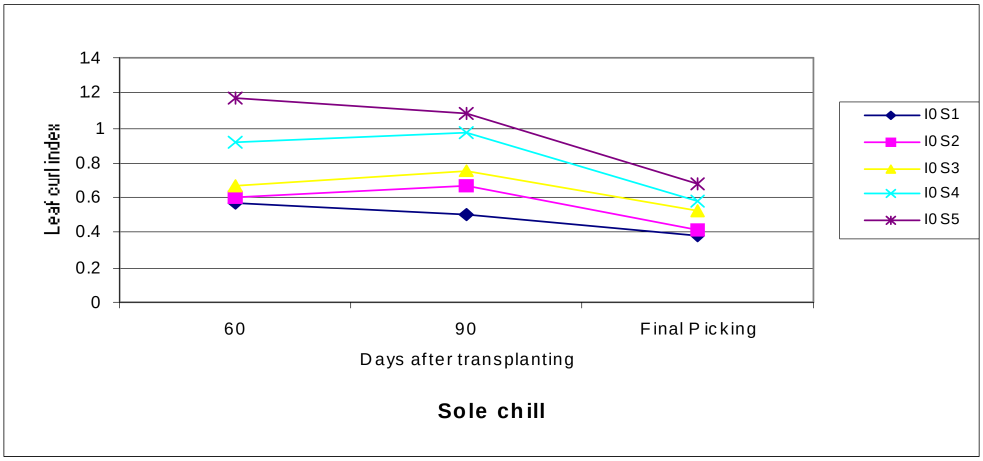
Among the fertilizer treatments, the potassium uptake increased with increase in potassium application, recording maximum uptake (47.87 kg ha^{-1}) with 75 kg of potassium ($N_{25}P_{50}K_{75}$), while it was on par with equal doses of all the nutrients $N_{50}P_{50}K_{50}$ (43.96 kg ha^{-1}), while the lowest K uptake (27.25 kg ha^{-1}) was observed with lowest (zero) level of potassium application ($N_{100}P_{50}K_0$).

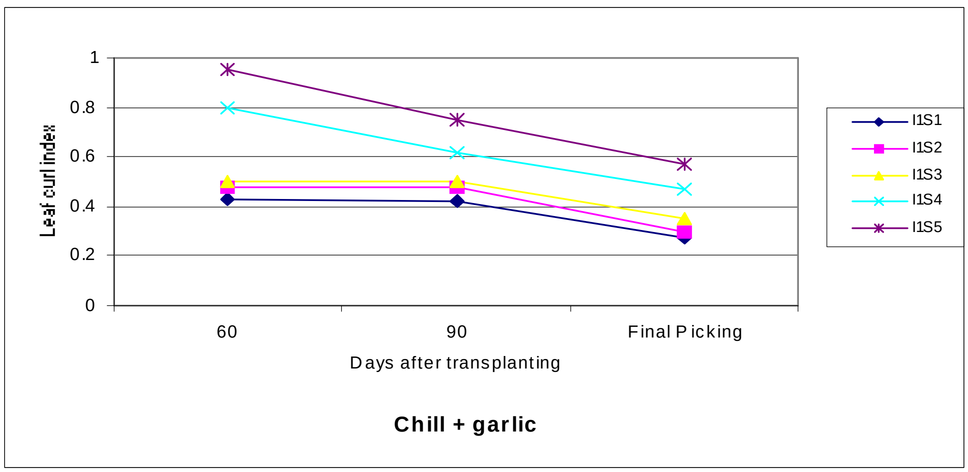
Table 47. Leaf curl index of bydagi chilli (*dabbi*) at 60, 90 DAT and at final picking as influenced by intercropping, N substitution and graded levels of K

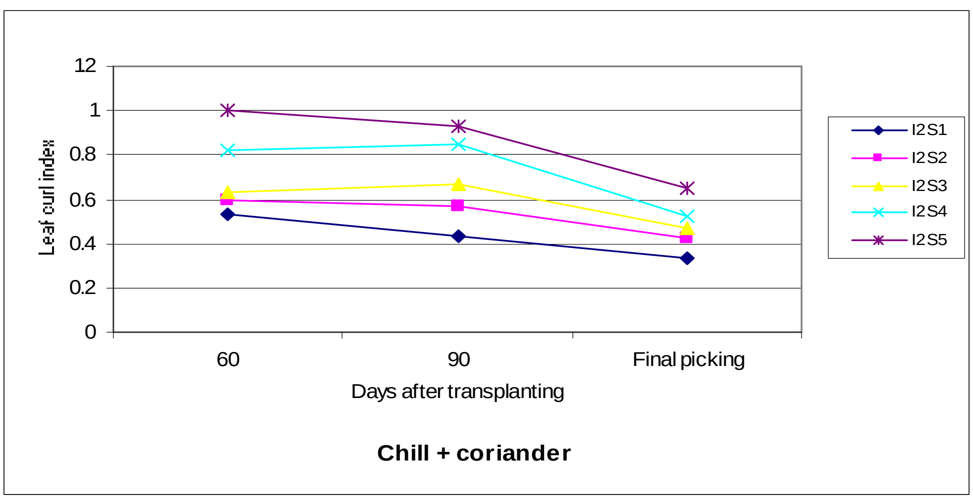
Treatments	60 DAT			90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping									
I_0: Sole chilli	0.99^{a}	0.57^{a}	0.78^{a}	0.97^{a}	0.62^{a}	0.79^{a}	0.52^{a}	0.51^{a}	0.52^{a}
I_1: Chilli+Garlic	0.81^{b}	0.45^{b}	0.63^{c}	0.67^{c}	0.44^{b}	0.55^{c}	0.40^{b}	0.38^{c}	0.39^{c}
I_2: Chilli+Coriander	0.92^{a}	0.52^{a}	0.72^{b}	0.82^{b}	0.56^{a}	0.69^{b}	0.50^{a}	0.45^{b}	0.48^{b}
S.Em.±	0.04	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.01
LSD (0.05)	0.10	0.06	0.06	0.09	0.06	0.05	0.04	0.05	0.03
N substitution and graded levels of K									
S_1: N_0:P_{50}:K_{100}	0.64^{d}	0.38^{c}	0.51^{d}	0.54^{d}	0.36^{c}	0.45^{d}	0.33^{d}	0.32^{d}	0.33^{e}
S_2: N_{25}:P_{50}:K_{75}	0.71^{cd}	0.41^{c}	0.56^{cd}	0.73^{c}	0.41^{c}	0.57^{c}	0.40^{c}	0.36^{d}	0.38^{d}
S_3: N_{50}:P_{50}:K_{50}	0.80^{c}	0.40^{c}	0.60^{c}	0.77^{c}	0.51^{b}	0.64^{c}	0.44^{c}	0.44^{c}	0.44^{c}
S_4: N_{75}:P_{50}:K_{25}	1.04^{b}	0.64^{b}	0.84^{b}	0.94^{b}	0.68^{a}	0.81^{b}	0.52^{b}	0.52^{b}	0.52^{b}
S_5: N_{100}:P_{50}:K_0	1.33^{a}	0.74^{a}	1.04^{a}	1.10^{a}	0.74^{a}	0.92^{a}	0.63^{a}	0.63^{a}	0.63^{a}
S.Em.±	0.05	0.03	0.03	0.04	0.03	0.02	0.02	0.02	0.02
LSD (0.05)	0.13	0.08	0.73	0.12	0.08	0.07	0.05	0.06	0.04
Interaction									
I_0S_1	0.73^{fgh}	0.40^{de}	0.57^{e-h}	0.60^{fg}	0.40^{ef}	0.50^{fgh}	0.40^{de}	0.37^{f-i}	0.38^{fg}
I_0S_2	0.80^{efg}	0.40^{de}	0.60^{efg}	0.90^{cde}	0.43^{ef}	0.67^{de}	0.43^{cd}	0.40^{e-h}	0.42^{ef}
I_0S_3	0.87^{def}	0.47^{cd}	0.67^{e}	0.90^{cde}	0.60^{cd}	0.75^{cd}	0.50^{bcd}	0.53^{bcd}	0.52^{cd}
I_0S_4	1.10^{bcd}	0.73^{ab}	0.92^{bcd}	1.13^{ab}	0.80^{ab}	0.97^{ab}	0.57^{b}	0.60^{abc}	0.58^{bc}
I_0S_5	1.47^{a}	0.87^{a}	1.17^{a}	1.30^{a}	0.87^{a}	1.08^{a}	0.70^{a}	0.67^{a}	0.68^{a}
I_1S_1	0.53^{h}	0.33^{de}	0.43^{h}	0.53^{g}	0.30^{f}	0.42^{h}	0.27^{f}	0.27^{l}	0.27^{i}
I_1S_2	0.60^{gh}	0.37^{de}	0.48^{gh}	0.60^{fg}	0.37^{ef}	0.48^{gh}	0.30^{ef}	0.30^{hi}	0.30^{hi}
I_1S_3	0.74^{fgh}	0.27^{e}	0.50^{fgh}	0.60^{fg}	0.40^{ef}	0.50^{fgh}	0.33^{ef}	0.37^{f-l}	0.35^{fgh}
I_1S_4	1.00^{cde}	0.60^{bc}	0.80^{d}	0.70^{efg}	0.53^{de}	0.62^{de}	0.47^{bcd}	0.47^{def}	0.47^{de}
I_1S_5	1.20^{bc}	0.70^{b}	0.95^{bc}	0.90^{cde}	0.60^{cd}	0.75^{cd}	0.53^{bc}	0.60^{abc}	0.57^{c}
I_2S_1	0.67^{fgh}	0.40^{de}	0.53^{e-h}	0.50^{g}	0.37^{ef}	0.43^{h}	0.33^{ef}	0.33^{ghi}	0.33^{ghi}
I_2S_2	0.73^{fgh}	0.47^{cd}	0.60^{efg}	0.70^{efg}	0.43^{ef}	0.57^{efg}	0.47^{bcd}	0.37^{f-l}	0.42^{ef}
I_2S_3	0.80^{efg}	0.47^{cd}	0.63^{ef}	0.80^{def}	0.53^{de}	0.67^{de}	0.50^{bcd}	0.43^{d-g}	0.47^{de}
I_2S_4	1.03^{cde}	0.60^{bc}	0.82^{cd}	1.00^{bcd}	0.70^{bc}	0.85^{bc}	0.53^{bc}	0.50^{cde}	0.52^{cd}
I_2S_5	1.33^{ab}	0.67^{b}	1.00^{b}	1.10^{abc}	0.77^{ab}	0.93^{b}	0.67^{a}	0.63^{ab}	0.65^{ab}
S.Em.±	0.08	0.05	0.04	0.07	0.05	0.04	0.03	0.04	0.03
LSD (0.05)	0.23	0.14	0.13	0.21	0.14	0.12	0.09	0..11	0.07
C.V. (%)	14.9	15.9	15.7	15.1	15.0	15.4	11.3	14.7	13.1

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form, N base figures indicate N substitution with inorganics only.
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among the treatment combinations, garlic intercropped with chilli nutritioned with higher levels of potassium ($\geq$50 kg ha^{-1}) application recorded significantly higher potassium uptake (53.84 to 60.58 kg ha^{-1} with I_1S_1 and I_1S_2, respectively). However, the lowest uptake of potassium (21.60 kg ha^{-1}) was recorded with chilli + coriander intercropping system nutritioned with lowest (zero) level of potassium (I_2S_5) and sole chilli with similar fertilizer level (I_0S_5, 25.89 kg ha^{-1}).







LEGEND: S1-$N_0P_{50}K_{100}$, S2-$N_{25}P_{50}K_{75}$, S3-$N_{50}P_{50}K_{50}$, S4-$N_{75}P_{50}K_{25}$, S5-$N_{100}P_{50}K_0$

Fig.11. Leaf curl index (LCI) as influenced by N substitution and graded levels of K under different cropping systems

4.2.4.3 Available nitrogen (kg ha^{-1}) in the soil after harvest

The data on available N in the soil after harvest as influenced due to intercropping, N substitution and graded levels of K and the interaction between intercrops and graded levels of N and K are presented in Table 48.

Cropping system did not differ significantly in the available nitrogen after harvest. Among the fertilizer treatments, available N was significantly higher (316 kg ha^{-1}) with maximum dosage of inorganic N with lowest level of potassium fertilizer ($N_{100}P_{50}K_0$). While, it was on par with rest of the treatments except zero level of inorganic nitrogen coupled with 100 kg potassium ($N_0P_{50}K_{100}$) application (276 kg ha^{-1}).

Among the treatment combinations, chilli + coriander cropping system nutritioned with 75 kg inorganic N application with 25 kg K_2O (I_2S_4) recorded significantly higher available N in the soil (320 kg ha^{-1}). While, it was on par with rest of the treatment combinations except all the cropping systems nutritioned with zero level of inorganic N application (I_0S_1, $I_1S_1$and I_2S_2 treatment combinations).

4.2.4.4 Available potassium in the soil after harvest (kg ha^{-1})

Intercropping systems did not differ in the available potash after harvest. Nevertheless, available potassium varied significantly due to substitution of N, graded level of K, and their interaction. It ranged from 356 kg ha^{-1} with sole chilli system to 357 kg ha^{-1} with chilli + coriander intercropping system (Table 48).

Among the fertilizer treatments, the available potassium was significantly higher with higher level of applied potassium. Treatment receiving 100 kg ha^{-1} of potassium recorded significantly higher available potassium than the treatment receiving 25kg ha^{-1}or no potassium at all. The latter treatment recorded lowest available K status in the soil(316kg ha^{-1}).

Among the treatment combinations, chilli + garlic intercropping system nutritioned with highest level of potassium coupled with zero level of inorganic N (I_1S_1) recorded significantly higher available K_2O in the soil (401 kg ha^{-1}), while the treatment receiving no potassium fertilizer under sole cropping (I_0S_5) recorded significantly lower available K_2O status in the soil (312 kg ha^{-1}). Other treatment combinations were intermediate and varied in accordance with K fertilization.

4.2.5 Quality parameters

4.2.5.1 Ascorbic acid (mg 100 g^{-1})

The ascorbic acid content of green chilli fruit did not differ significantly due to intercrop (it ranged from 224 to 226.9 mg 100 g^{-1}), however, it varied significantly due to N substitution, graded levels of K and the interaction effects (Table 50).

Among the fertilizer treatments, with increase the inorganic nitrogen application, the ascorbic acid content decreased and recorded significantly lower value (185.5 mg 100 g^{-1})

with 100 per cent inorganic N coupled with lowest potassium application ($N_{100}P_{50}K_0$). While, the highest ascorbic acid content (266.8 mg 100 g^{-1}) was observed with 100 per cent organic N (zero inorganic N) coupled with highest potassium nutrition ($N_0P_{50}K_{100}$).

Significantly higher (272.7 mg 100 g^{-1}) ascorbic acid content was observed with chilli + garlic intercropping system nutritioned with zero level of inorganic N (100% organic N) coupled with highest dosage of potassium nutrition (I_1S_1), while it was on par with the treatment combination consisted of all the chilli based cropping systems fertilized with lower level of inorganic N coupled with higher level of potassium application (I_0S_1, I_0S_2, I_1S_2, I_2S_1 and I_2S_2). While, the lowest ascorbic acid content (183.4 mg 100 g^{-1}) was observed with chilli + coriander intercropping system fertilized with 100 per cent inorganic N coupled with zero level of potassium (I_2S_5). In general, ascorbic acid content decreased with increase in the inorganic N application in the chilli based cropping systems evaluated.

4.2.5.2 Capsaicin content (%)

Among the intercrops, capsaicin content of chilli fruits did not differ significantly (it ranged from 0.15% to 0.13%). While, significant variations were observed with N substitution, graded levels of K fertilization and due to interaction (Table 50).

Table 48. Available N and available K_2O (kg ha^{-1}) of bydagi chilli (*dabbi*) after crop harvest as influenced by intercropping, N substitution and graded levels of K

Treatments	Available N (kg ha^{-1})			Available K_2O (kg ha^{-1})		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping						
I_0: Sole chilli	296^{a}	314^{a}	305^{a}	345^{a}	367^{a}	356^{a}
I_1: Chilli+Garlic	289^{a}	311^{a}	300^{a}	356^{a}	375^{a}	366^{a}
I_2: Chilli+Coriander	291^{a}	313^{a}	302^{a}	343^{a}	372^{a}	357^{a}
S.Em.±	5.3	3.5	2.8	5.7	12.5	6.9
LSD (0.05)	NS	NS	NS	NS	NS	NS
N substitution and graded levels of K						
S_1: N_0:P_{50}:K_{100}	267.2	284.2^{b}	276^{b}	374^{a}	404^{a}	389^{a}
S_2: N_{25}:P_{50}:K_{75}	289.9	316.2^{a}	303^{ab}	364^{a}	402^{a}	383^{a}
S_3: N_{50}:P_{50}:K_{50}	295.7	318.7^{a}	307^{ab}	357^{a}	377^{ab}	367^{ab}
S_4: N_{75}:P_{50}:K_{25}	304.1	321.5^{a}	313^{ab}	334^{b}	351^{bc}	342^{b}
S_5: N_{100}:P_{50}:K_0	305.8	326.4^{a}	316^{a}	312^{c}	319^{c}	316^{c}
S.Em.±	6.4	6.5	4.6	7.3	16.2	8.9
LSD (0.05)	18.8	19.2	13.2	21.4	47.2	25.3
Interaction						
I_0S_1	274.7^{abc}	286.0^{cd}	278^{b}	367^{abc}	397^{ab}	382^{abc}
I_0S_2	296.1^{abc}	317.2^{a-d}	304^{a}	358^{abc}	403^{ab}	380^{abc}
I_0S_3	302.8^{ab}	319.8^{a-d}	311^{a}	354^{a-d}	374^{ab}	364^{a-e}
I_0S_4	306.4^{a}	322.5^{abc}	315^{a}	334^{cde}	347^{ab}	340^{c-f}
I_0S_5	307.6^{a}	329.4^{a}	319^{a}	311^{e}	313^{b}	312^{f}
I_1S_1	263.0^{bc}	282.0^{d}	273^{b}	388^{a}	413^{a}	401^{a}
I_1S_2	281.2^{abc}	313.4^{a-d}	303^{a}	378^{ab}	406^{ab}	392^{ab}
I_1S_3	297.1^{abc}	316.8^{a-d}	307^{a}	364^{abc}	374^{ab}	369^{a-d}
I_1S_4	300.1^{abc}	320.1^{a-d}	310^{a}	336^{b-e}	358^{ab}	347^{b-f}
I_1S_5	304.2^{ab}	324.5^{ab}	314^{a}	315^{de}	323^{ab}	319^{def}
I_2S_1	267.2^{bc}	284.5^{cd}	276^{b}	368^{abc}	403^{ab}	386^{abc}
I_2S_2	292.6^{abc}	317.8^{a-d}	302^{a}	357^{a-d}	396^{ab}	377^{abc}
I_2S_3	287.2^{abc}	319.4^{a-d}	303^{a}	353^{a-d}	384^{ab}	368^{a-d}
I_2S_4	305.7^{a}	322.1^{a-d}	320^{a}	331^{cde}	347^{ab}	339^{c-f}
I_2S_5	305.6^{a}	326.4^{a}	316^{a}	310^{e}	320^{ab}	315^{ef}
S.Em.±	11.2	11.4	6.2	12.8	28.0	15.4
LSD (0.05)	32.7	33.3	17.7	36.9	81.8	43.7
C.V. (%)	7.8	6.5	7.1	6.3	13.1	10.5

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form N base figures indicate N substitution with inorganics.
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 49. Nitrogen uptake (kg ha^{-1}) and potassium uptake (kg ha^{-1}) of bydagi chilli (*dabbi*) as influenced by intercropping, N substitution and graded levels of K

Treatments	Nitrogen uptake (kg ha^{-1})			Potassium uptake (kg ha^{-1})		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping						
I_0: Sole chilli	17.73^{a}	20.52^{a}	19.12^{a}	34.96^{b}	37.84^{b}	36.4^{b}
I_1: Chilli+Garlic	16.86^{a}	19.39^{a}	18.12^{a}	44.66^{a}	54.64^{a}	49.65^{a}
I_2: Chilli+Coriander	17.25^{a}	19.99^{a}	18.62^{a}	30.26^{c}	33.13^{b}	31.69^{c}
S.Em.±	0.58	0.40	0.35	0.98	2.02	1.12
LSD (0.05)	NS	NS	NS	2.87	5.89	3.19
N substitution and graded levels of K						
S_1: N_0:P_{50}:K_{100}	14.78^{b}	16.02^{b}	15.4^{C}	38.02^{b}	44.92^{ab}	41.47^{b}
S_2: N_{25}:P_{50}:K_{75}	16.75^{ab}	20.00^{ab}	18.38^{a}	43.47^{a}	52.27^{a}	47.87^{a}
S_3: N_{50}:P_{50}:K_{50}	17.89^{a}	21.21^{a}	19.55^{ab}	41.41^{ab}	46.5^{a}	43.96^{ab}
S_4: N_{75}:P_{50}:K_{25}	18.64^{a}	21.12^{a}	19.88^{a}	33.46^{c}	37.91^{b}	35.68^{c}
S_5: N_{100}:P_{50}:K_0	18.34^{a}	21.47^{a}	19.90^{a}	26.77^{d}	27.74^{c}	27.25^{d}
S.Em.±	0.74	0.51	0.45	1.27	2.60	1.45
LSD (0.05)	2.17	1.49	1.28	3.70	7.60	4.12
Interaction						
I_0S_1	14.79^{bc}	15.97^{d}	15.18^{e}	35.52^{cde}	38.36^{de}	36.94^{cde}
I_0S_2	17.32^{abc}	20.96^{ab}	19.14^{abc}	42.44^{bc}	49.24^{bcd}	45.84^{b}
I_0S_3	18.67^{abc}	23.09^{a}	20.87^{a}	39.7^{cd}	36.84^{de}	38.27^{cd}
I_0S_4	18.84^{abc}	21.62^{ab}	20.23^{abc}	33.71^{de}	36.40^{de}	35.06^{cde}
I_0S_5	19.04^{ab}	21.34^{ab}	20.19^{abc}	23.43^{f}	28.35^{ef}	25.89^{fg}
I_1S_1	14.95^{abc}	17.4^{cd}	16.17^{de}	48.12^{ab}	59.55^{abc}	53.84^{a}
I_1S_2	16.8^{abc}	19.45^{bc}	18.15^{bcd}	53.59^{a}	67.57^{a}	60.58^{a}
I_1S_3	17.46^{abc}	20.23^{abc}	18.85^{abc}	50.93^{a}	62.96^{ab}	56.95^{a}
I_1S_4	17.79^{abc}	19.45^{bc}	18.62^{abc}	36.69^{cde}	48.57^{cd}	42.63^{bc}
I_1S_5	17.27^{abc}	20.37^{ab}	18.82^{abc}	33.95^{de}	34.56^{def}	34.26^{de}
I_2S_1	14.61^{c}	15.10^{d}	14.86^{e}	30.42^{e}	36.85^{de}	33.64^{de}
I_2S_2	16.14^{abc}	19.54^{bc}	17.84^{cd}	34.28^{de}	39.99^{de}	37.19^{cde}
I_2S_3	17.54^{abc}	20.33^{ab}	18.93^{abc}	33.60^{de}	39.71^{de}	36.66^{cde}
I_2S_4	19.28^{a}	22.28^{ab}	20.78^{a}	29.98^{e}	28.76^{ef}	29.37^{ef}
I_2S_5	18.70^{abc}	22.71^{a}	20.70^{ab}	22.92^{f}	20.31^{f}	21.61^{g}
S.Em.±	1.29	0.89	0.78	2.2	4.51	2.51
LSD (0.05)	3.75	2.58	2.22	6.42	13.16	7.13
C.V. (%)	12.9	7.7	10.2	10.4	17.3	15.6

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form N base figures indicate N substitution with inorganics only in case of nitrogen
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among the fertilizer treatments, capsaicin content of the chilli fruits increased significantly with decrease in the inorganic N fertilization recording significantly higher value (0.18%) with lowest (zero) level of inorganic N application coupled with highest level of potassium nutrition ($N_0P_{50}K_{100}$). While, it was on par with $N_{25}P_{50}K_{75}$ nutrient application (0.16%). The lower capsaicin content (0.10%) was recorded with highest level of inorganic N application coupled with zero potassium application ($N_{100}P_{50}K_0$) and S_4 was at par.

Among the treatment combinations, chilli + garlic intercropping system nutritioned with lowest level of inorganic N (100% organic N source) with higher potassium application (I_1S_1) recorded significantly higher capsaicin (0.19%). While, it was on par with the treatment combinations consisted of all the chilli based cropping system fertilized with lower level of inorganic N with higher level of potassium (I_0S_1, I_0S_2, I_1S_2, I_2S_1 and I_2S_2 treatment combinations). The lowest capsaicin content (0.09%) was recorded with sole chilli fertilized with highest level of inorganic N coupled with zero potassium application (I_0F_5).

4.2.5.3 Scovielle heat units (SHU)

The SHU differed significantly due to intercrops, N substitution, graded levels of K and due to interaction (Table 50).

Among the intercrops, chilli+garlic intercropping system recorded highest SHU, while sole chilli and chilli+coriander were at par with each other.

As for the graded levels of N and K, highest SHU (26080) were recorded with the treatment receiving entire nitrogen in organic form and 100 kg ha^{-1} K_2O. On the other hand, treatment receiving 75 kg ha^{-1} or more of inorganic nitrogen and $\leq$ 25 kg K_2O recorded significantly lower scovielle heat units (S_4 and S_5).

Among the treatment combinations, chilli intercropped with garlic receiving only organic form of nitrogen and highest level of K (I_1S_1) recorded significantly higher SHU (28500). I_1S_2, I_1S_3 and I_2S_1 were at par with the former treatment, while, $N_{100}P_{50}K_0$ and $N_{75}P_{50}K_{25}$ recorded lower SHU irrespective of the cropping system.

4.2.5.4 Discoloured fruits (%)

Per cent discoloured fruits were significantly lower in chilli intercropped with garlic (11.78%) than in other systems (Table 51).

Among the graded fertilizer treatments, percentage discoloured fruits were significantly lower when the fertilizer N applied was minimum or zero and potassium equalled or exceeded 75 kg ha^{-1} (11.10 and 11.56 with $N_0P_{50}K_{100}$ and $N_{25}P_{50}K_{75}$, respectively). On the other hand, when the inorganic form of nitrogen was 75 kg or more with corresponding variation in potassium from 25 to 0, the per cent discoloured fruits increased, the maximum 13.93 and 14.45 per cent were recorded with S_4 and S_5, respectively.

Among the treatment combinations, per cent discoloured fruits was the highest (15.38%) with sole chilli receiving highest level of inorganic nitrogen (I_0S_5) (Fig. 8). However, same fertilizer combination under chilli + garlic recorded significantly lower percentage of discoloured fruits, while it was not to the same extent in chilli + coriander. Both the intercropping systems receiving lower level of inorganic nitrogen and higher levels of potassium fertilizers recorded lower percentage of discoloured fruits.

4.2.5.5 Yield of good quality fruits (kg ha^{-1})

The influences due to the intercropping system, substitution of N, graded nutrition and their interaction were significant with respect to good quality fruits (Table 51).

Chilli + garlic recorded highest yield of good quality fruits (786 kg ha^{-1}), while chilli with coriander recorded the lowest yield of quality fruits (612 kg ha^{-1}).

Among fertilizer levels S_2 and S_3 receiving 25 to 50 kg N and 50 to 75 kg K_2O, respectively recorded significantly higher yield of good quality fruits (776 and 827 kg ha^{-1}, respectively). Further increase in inorganic N and decrease in K fertilization reduced the yield of quality fruits and the lowest yield (557 kg ha^{-1}) of quality fruit was obtained with $N_{100}P_{50}K_0$.

Table 50. Ascorbic acid content (mg 100 g^{-1}), capsaicin content (%) and scovillie heat units of bydagi chilli (*dabbi*) as influenced by intercropping, N substitution and graded levels of K

Treatments	Ascorbic acid content (mg 100 g^{-1})			Capsaicin content (%)			Scovillie heat units		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping									
I_0: Sole chilli	219.7^{a}	228.2^{a}	224.0^{a}	0.11^{b}	0.14^{a}	0.13^{a}	16600^{b}	21300^{b}	18950^{b}
I_1: Chilli+Garlic	224.9^{a}	239.2^{a}	232.0^{a}	0.14^{a}	0.16^{a}	0.15^{a}	20900^{a}	24400^{a}	22650^{a}
I_2: Chilli+Coriander	220.4^{a}	233.3^{a}	226.9^{a}	0.12^{ab}	0.16^{a}	0.14^{a}	17400^{b}	24100^{ab}	20750^{b}
S.Em.±	6.90	4.50	4.1	0.01	0.01	0.01	907	978	667
LSD (0.05)	NS	NS	NS	0.02	NS	NS	2650	2855	1897
N substitution and graded levels of K									
S_1: N_0:P_{50}:K_{100}	257.1^{a}	276.5^{a}	266.8^{a}	0.16^{a}	0.19^{a}	0.18^{a}	23670^{a}	28500^{a}	26080^{a}
S_2: N_{25}:P_{50}:K_{75}	243.0^{a}	258.3^{b}	250.6^{b}	0.14^{a}	0.17^{a}	0.16^{ab}	21500^{ab}	25500^{a}	23500^{b}
S_3: N_{50}:P_{50}:K_{50}	231.0^{a}	241.8^{b}	236.4^{b}	0.13^{a}	0.17^{a}	0.15^{b}	19333^{b}	24670^{a}	22000^{b}
S_4: N_{75}:P_{50}:K_{25}	195.2^{b}	202.4^{c}	198.8^{c}	0.10^{bc}	0.13^{b}	0.11^{c}	14500^{c}	19670^{b}	17080^{c}
S_5: N_{100}:P_{50}:K_0	182.1^{b}	188.8^{c}	185.5^{c}	0.08^{c}	0.12^{b}	0.10^{c}	12500^{c}	18000^{b}	15250^{c}
S.Em.±	9.0	5.80	5.3	0.01	0.01	0.01	1172	1263	861
LSD (0.05)	26.1	16.9	15.2	0.03	0.03	0.02	3421	3686	2449
Interaction									
I_0S_1	254.0^{ab}	264.0^{ab}	259.0^{ab}	0.15^{abc}	0.17^{ab}	0.16^{a-d}	21500^{a-d}	25500^{ab}	23500^{bc}
I_0S_2	246.0^{ab}	252.0^{ab}	249.0^{ab}	0.13^{a-d}	0.16^{abc}	0.15^{a-e}	19500^{b-e}	24000^{abc}	21750^{bcd}
I_0S_3	230.0^{a-e}	239.0^{bc}	234.5^{b}	0.12^{a-d}	0.16^{abc}	0.14^{b-f}	18000^{c-f}	24000^{abc}	21000^{cde}
I_0S_4	188.4^{cde}	196.4^{d}	192.4^{c}	0.08^{d}	0.12^{bc}	0.10^{fg}	12000^{f}	18000^{cd}	15000^{f}
I_0S_5	180.1^{e}	189.6^{d}	184.9^{c}	0.08^{d}	0.10^{c}	0.09^{g}	12000^{f}	15000^{d}	13500^{f}
I_1S_1	260.6^{a}	284.8^{a}	272.7^{a}	0.18^{a}	0.20^{a}	0.19^{a}	27000^{a}	30000^{a}	28500^{a}
I_1S_2	244.7^{ab}	266.4^{ab}	255.6^{ab}	0.17^{ab}	0.18^{ab}	0.18^{ab}	25500^{ab}	27000^{ab}	26250^{ab}
I_1S_3	228.4^{a-e}	244.1^{b}	236.3^{b}	0.15^{abc}	0.18^{ab}	0.17^{abc}	22000^{abc}	27000^{ab}	24500^{abc}
I_1S_4	204.8^{b-e}	210.2^{cd}	207.5^{c}	0.11^{bcd}	0.14^{abc}	0.13^{c-g}	16500^{c-f}	20000^{bcd}	18250^{def}
I_1S_5	186.0^{de}	190.4^{d}	188.2^{c}	0.09^{cd}	0.12^{bc}	0.11^{efg}	13500^{ef}	18000^{cd}	15750^{f}
I_2S_1	256.6^{ab}	280.7^{a}	268.7^{a}	0.15^{abc}	0.20^{a}	0.18^{ab}	22500^{abc}	30000^{a}	26250^{ab}
I_2S_2	238.2^{abc}	256.4^{ab}	247.3^{ab}	0.13^{a-d}	0.17^{ab}	0.15^{a-e}	19500^{b-e}	25500^{ab}	22500^{bcd}
I_2S_3	234.6^{a-d}	242.4^{b}	238.5^{b}	0.12^{a-d}	0.16^{abc}	0.14^{f}	18000^{c-f}	23000^{abc}	20500^{cde}
I_2S_4	192.4^{cde}	200.6^{d}	196.5^{c}	0.09^{cd}	0.14^{abc}	0.12^{d-g}	15000^{def}	21000^{bcd}	18000^{def}
I_2S_5	180.3^{e}	186.5^{d}	183.4^{c}	0.08^{d}	0.14^{abc}	0.11^{efg}	12000^{f}	21000^{bcd}	16500^{ef}
S.Em.±	15.5	10.0	9.2	0.02	0.02	0.01	2030	2187	1492
LSD (0.05)	45.3	29.3	26.3	0.05	0.05	0.04	5925	6384	4292
C.V. (%)	12.1	7.4	9.9	18.7	16.9	17.8	19.2	16.3	17.5

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form N base figures indicate N substitution with inorganics.
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Chilli + garlic supplied with equal quantities of major nutrients in the inorganic form with 50 per cent N through organic form (I_1S_3) recorded significantly higher yield of good quality fruits (993 kg ha^{-1}) followed by similar system receiving $N_{25}P_{50}K_{25}$ (I_1S_2) nutrient combination (893 kg ha^{-1}) (Fig. 8). On the other hand, chilli intercropped with coriander supplied with $N_{100}P_{50}K_0$ (I_2S_5) recorded significantly lower yield of good quality fruit yield (496 kg ha^{-1}).

Table 51. Discoloured fruits (%) and yield of good fruits (kg ha^{-1}) of bydagi chilli (*dabbi*) as influenced by intercropping N substitution and graded levels of K

Treatments	Discoloured fruits (%)			Yield of good fruits (kg ha^{-1})		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping						
I_0: Sole chilli	13.99^{a}	13.20^{a}	13.60^{a}	638^{a}	748^{b}	693^{b}
I_1: Chilli+Garlic	12.10^{b}	11.46^{b}	11.78^{b}	712^{a}	860^{a}	786^{a}
I_2: Chilli+Coriander	13.32^{a}	12.52^{a}	12.92^{a}	551^{b}	672^{b}	612^{c}
S.Em.±	0.36	0.34	0.25	27.1	26.03	18.78
LSD (0.05)	1.04	0.98	0.70	79.1	75.98	53.41
N substitution and graded levels of K						
S_1: N_0:P_{50}:K_{100}	11.39^{d}	10.80^{d}	11.10^{c}	561^{cd}	695^{cd}	628^{b}
S_2: N_{25}:P_{50}:K_{75}	11.97^{cd}	11.15^{cd}	11.56^{c}	718^{ab}	835^{ab}	776^{a}
S_3: N_{50}:P_{50}:K_{50}	13.13^{bc}	12.36^{bc}	12.75^{b}	760^{a}	894^{a}	827^{a}
S_4: N_{75}:P_{50}:K_{25}	14.30^{ab}	13.56^{ab}	13.93^{a}	638^{bc}	753^{bc}	696^{b}
S_5: N_{100}:P_{50}:K_0	14.90^{a}	14.00^{a}	14.45^{a}	492^{d}	623^{d}	557^{c}
S.Em.±	0.46	0.43	0.32	34.97	33.61	24.25
LSD (0.05)	1.34	1.27	0.90	102.1	98.09	68.96
Interaction						
I_0S_1	12.1^{c-e}	11.82^{bcd}	11.96^{def}	555^{cde}	715^{cde}	635^{d-g}
I_0S_2	12.80^{b-e}	12.06^{bcd}	12.43^{cde}	713^{bcd}	808^{bcd}	761^{cd}
I_0S_3	13.77^{abc}	13.15^{abc}	13.46^{bcd}	744^{abc}	827^{bc}	786^{bc}
I_0S_4	15.40^{ab}	14.10^{ab}	14.75^{ab}	671^{bcd}	771^{cd}	721^{cde}
I_0S_5	15.90^{a}	14.86^{a}	15.38^{a}	507^{de}	619^{de}	563^{gh}
I_1S_1	10.27^{e}	9.86^{d}	10.06^{g}	594^{cde}	746^{cde}	670^{c-g}
I_1S_2	11.00^{de}	10.12^{d}	10.56^{fg}	808^{ab}	978^{ab}	893^{ab}
I_1S_3	11.85^{cde}	11.64^{bcd}	11.75^{d-g}	908^{a}	1078^{a}	993^{a}
I_1S_4	13.40^{a-d}	12.70^{abc}	13.05^{b-e}	712^{bcd}	812^{bcd}	762^{cd}
I_1S_5	14.00^{abc}	12.96^{abc}	13.48^{bcd}	540^{cde}	686^{cde}	613^{e-h}
I_2S_1	11.80^{cde}	10.98^{cd}	11.39^{efg}	534^{de}	624^{de}	579^{fgh}
I_2S_2	12.10^{c-e}	11.27^{cd}	11.68^{d-g}	633^{b-e}	719^{cde}	676^{c-g}
I_2S_3	13.80^{abc}	12.30^{bcd}	13.05^{b-e}	629^{b-e}	777^{cd}	703^{c-f}
I_2S_4	14.1^{abc}	13.87^{ab}	13.98^{abc}	532^{de}	677^{cde}	604^{e-h}
I_2S_5	14.80^{ab}	14.18^{ab}	14.49^{ab}	429^{e}	563^{e}	496^{h}
S.Em.±	0.80	0.75	0.55	60.57	58.21	42.0
LSD (0.05)	2.33	2.20	1.56	176.8	169.9	119.4
C.V. (%)	10.5	10.4	10.5	16.5	13.3	14.8

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form N base figures indicate N substitution with inorganics only.
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

4.2.5.6 Oleoresin content (%)

Oleoresin per cent was the highest with chilli + garlic (13.16%) cropping system and other systems were next in the order (Table 52).

Oleoresin per cent with entire nitrogen through organics + 100 kg K_2O per hectare (S_1) was the highest (14.48%) and the values decreased with increase is inorganic N and decrease in potassium, reaching the lowest value with S_4 and S_5 (11.54% and 10.98%, respectively).

Similar to good quality fruits oleoresin per cent was the highest (14.88%) with chilli intercropped with garlic receiving no inorganic nitrogen and highest level of K (I_1S_1). The same system receiving $N_{25}P_{50}K_{75}$ (I_1S_2) and chilli intercropped with coriander under similar fertilization (I_2S_2) and sole chilli (I_0S_0) with no inorganic nitrogen were statistically at par. On the other hand, chilli intercropped with coriander receiving entire N in the inorganic form and no K recorded significantly lower oleoresin per cent. Other treatment combinations were in between.

Table 52. Oleoresin content (%) and oleoresin yield (kg ha^{-1}) of bydagi chilli (*dabbi*) as influenced by intercropping, N substitution and graded levels of K

Treatments	Oleoresin content (%)			Oleoresin yield (kg ha^{-1})		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping						
I_0: Sole chilli	12.18^{a}	12.95^{ab}	12.56^{b}	77.85^{b}	97.05^{b}	87.5^{b}
I_1: Chilli+Garlic	12.49^{a}	13.83^{a}	13.16^{a}	89.00^{a}	119.67^{a}	104.3^{a}
I_2: Chilli+Coriander	11.85^{a}	13.07^{b}	12.43^{b}	65.86^{c}	87.96^{b}	76.9^{c}
S.Em.±	0.24	0.27	0.19	3.20	3.85	2.50
LSD (0.05)	NS	0.82	0.53	9.34	11.23	7.12
N substitution and graded levels of K						
S_1: N_0:P_{50}:K_{100}	13.84^{a}	15.11^{a}	14.48^{a}	77.24^{b}	104.6^{ab}	90.9^{b}
S_2: N_{25}:P_{50}:K_{75}	13.27^{a}	14.28^{ab}	13.78^{b}	95.39^{a}	119.64^{a}	107.5^{a}
S_3: N_{50}:P_{50}:K_{50}	12.31^{b}	13.33^{b}	12.82^{c}	93.48^{a}	119.57^{a}	106.5^{a}
S_4: N_{75}:P_{50}:K_{25}	10.81^{c}	12.27^{c}	11.54^{d}	69.27^{b}	92.54^{b}	80.9^{c}
S_5: N_{100}:P_{50}:K_0	10.65^{c}	11.31^{c}	10.98^{d}	52.47^{c}	71.44^{c}	61.9^{d}
S.Em.±	0.31	0.36	0.24	4.13	4.97	3.20
LSD (0.05)	0.92	1.05	0.68	12.06	14.5	9.20
Interaction						
I_0S_1	13.68^{a}	14.84^{ab}	14.26^{ab}	75.5^{bcd}	105.43^{bcd}	90.5^{bc}
I_0S_2	13.12^{ab}	13.77^{abc}	13.44^{bc}	93.31^{ab}	111.23^{bc}	102.3^{b}
I_0S_3	12.64^{a-d}	13.04^{bcd}	12.84^{cd}	94.30^{ab}	107.50^{bcd}	100.9^{b}
I_0S_4	10.80^{ef}	12.05^{cde}	11.43^{efg}	72.48^{bcd}	92.50^{b-e}	82.5^{cde}
I_0S_5	10.60^{f}	11.03^{de}	10.84^{fg}	53.65^{de}	68.56^{ef}	61.1^{fg}
I_1S_1	14.1^{a}	15.65^{a}	14.88^{a}	83.64^{b}	116.03^{b}	99.8^{bc}
I_1S_2	13.64^{ab}	14.82^{ab}	14.23^{ab}	110.50^{a}	144.67^{a}	127.6^{a}
I_1S_3	12.42^{a-e}	13.85^{abc}	13.14^{bcd}	111.50^{a}	149.27^{a}	130.4^{a}
I_1S_4	11.30^{c-f}	12.80^{b-e}	12.05^{def}	80.09^{bc}	104.09^{bcd}	92.1^{bc}
I_1S_5	11.00^{def}	12.05^{cde}	11.53^{efg}	59.25^{cde}	84.29^{c-f}	71.7^{def}
I_2S_1	13.74^{a}	14.85^{ab}	14.30^{ab}	72.59^{bcd}	92.34^{b-e}	82.5^{cde}
I_2S_2	13.04^{abc}	14.27^{ab}	13.65^{abc}	82.35^{bc}	103.01^{bcd}	92.7^{bc}
I_2S_3	11.86^{b-f}	13.11^{bc}	12.48^{cde}	74.64^{bcd}	101.93^{bcd}	88.3^{bcd}
I_2S_4	10.32^{f}	11.95^{cde}	11.14^{fg}	55.24^{de}	81.04^{def}	68.1^{efg}
I_2S_5	10.30^{f}	10.86^{e}	10.58^{g}	44.50^{e}	61.47^{f}	52.9^{g}
S.Em.±	0.97	0.63	0.41	7.16	8.60	5.60
LSD (0.05)	2.82	1.83	1.18	20.89	25.11	15.90
C.V. (%)	7.8	8.2	8.00	16.0	14.7	15.3

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form N base figures indicate N substitution with inorganics.
In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

4.2.5.7 Oleoresin yield (kg ha^{-1})

Oleoresin yield was the highest with garlic intercrop (104 kg ha^{-1}) while, it was the lowest under coriander intercrop (Table 52).

Among the graded levels of fertilizers oleoresin yield was higher and comparable with S_2 and S_3. While, $N_{100}P_{50}K_0$ recorded the lowest oleoresin yield (61.9 kg ha^{-1}).

Chilli intercropped with garlic receiving equal to more than 25 kg N and equal to more than 50 kg K_2O recorded the highest oleoresin yield among all the treatment combinations (127.6 and 130.4 kg ha^{-1} with I_1S_2 and I_1S_3, respectively) (Fig. 8). On the other hand, under coriander intercrop oleoresin yield of B*ydagi* chilli supplied with $N_{100}P_{50}K_0$ was significantly lower (52.9 kg ha^{-1}). While I_2S_4 and I_0S_5 were at par with the former treatment combination (I_2S_2).

4.2.6 Economic analysis

4.2.6.1 Gross return (Rs. ha^{-1})

The variations due to cropping system, crop nutrition and their interaction were significant with respect to gross return (Table 53).

Table 53. Gross returns and net returns (Rs. ha^{-1}) and B:C ratio of bydagi chilli (*dabbi*) as influenced by intercropping,N substitution and graded levels of K

Treatments	Gross returns (Rs. ha^{-1})			Net returns (Rs. ha^{-1})			B:C ratio		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Intercropping									
I_0: Sole chilli	37080^{b}	43060^{b}	40070^{b}	21700^{b}	27630^{b}	24660^{b}	2.41^{b}	2.80^{b}	2.60^{b}
I_1: Chilli+Garlic	58890^{a}	67100^{a}	63000^{a}	38440^{a}	46660^{a}	42550^{a}	2.88^{a}	3.28^{a}	3.08^{a}
I_2: Chilli+Coriander	39140^{b}	46080^{b}	42610^{b}	21830^{b}	28870^{b}	25350^{b}	2.26^{b}	2.67^{b}	2.46^{b}
S.Em.±	1486	1604	1093	1480	1590	1086	0.08	0.09	0.06
LSD (0.05)	4339	4681	3109	4321	4641	3089	0.23	0.26	0.17
N substitution and graded levels of K									
S_1: N_0:P_{50}:K_{100}	39560^{cd}	45590^{c}	43580^{c}	21550^{c}	29580^{cd}	25570^{c}	2.20^{c}	2.63^{cd}	2.42^{c}
S_2: N_{25}:P_{50}:K_{75}	50160^{ab}	56580^{ab}	53360^{a}	32170^{ab}	38580^{ab}	35380^{a}	2.74^{ab}	3.10^{ab}	2.92^{b}
S_3: N_{50}:P_{50}:K_{50}	53030^{a}	60730^{a}	56880^{a}	35230^{a}	43020^{a}	39130^{a}	2.94^{a}	3.37^{a}	3.16^{a}
S_4: N_{75}:P_{50}:K_{25}	44820^{bc}	51770^{b}	48300^{b}	27310^{b}	34260^{b}	30780^{b}	2.54^{b}	2.94^{bc}	2.74^{b}
S_5: N_{100}:P_{50}:K_0	37610^{d}	43740^{c}	40680^{c}	20340^{c}	26480^{c}	23410^{c}	2.15^{c}	2.52^{d}	2.33^{c}
S.Em.±	1919	2070	1411	1911	2053	1402	0.10	0.11	0.08
LSD (0.05)	5601	6043	4013	5578	5992	3987	0.30	0.33	0.22
Interaction									
I_0S_1	31600^{g}	40550^{fg}	36080^{ghi}	15770^{f}	24720^{ef}	20250^{fg}	2.00^{ef}	2.56^{cdef}	2.28^{ef}
I_0S_2	40900^{defg}	45950^{d-g}	43430^{efg}	25270^{def}	30330^{def}	27800^{cdef}	2.62^{bcd}	2.94^{c-f}	2.78^{cd}
I_0S_3	43100^{def}	47650^{d-g}	45380^{ef}	27710^{cde}	32050^{def}	29880^{cde}	2.80^{bc}	3.09^{bcd}	2.95^{c}
I_0S_4	39700^{efg}	44900^{d-g}	42300^{e-h}	24520^{def}	29720^{def}	27120^{cdef}	2.62^{bcd}	2.96^{b-f}	2.79^{cd}
I_0S_5	30100^{g}	36250^{g}	33180^{i}	15200^{f}	21350^{f}	18270^{g}	2.02^{ef}	2.43^{def}	2.23^{f}
I_1S_1	49970^{cde}	59620^{bc}	54790^{bc}	29500^{cde}	39150^{cd}	34320^{bc}	2.44^{cde}	2.91^{c-f}	2.68^{cde}
I_1S_2	64580^{ab}	74700^{a}	69640^{a}	43780^{ab}	53900^{ab}	48840^{a}	3.10^{ab}	3.59^{ab}	3.35^{ab}
I_1S_3	71080^{a}	81380^{a}	76230^{a}	50510^{a}	60810^{a}	55660^{a}	3.46^{a}	3.96^{a}	3.71^{a}
I_1S_4	57320^{bc}	63980^{b}	60650^{b}	36990^{bc}	43680^{bc}	40330^{b}	2.82^{bc}	3.15^{bc}	2.99^{bc}
I_1S_5	51500^{cd}	55830^{bcd}	53670^{bcd}	31420^{cd}	35750^{cde}	33580^{bc}	2.56^{bcde}	2.78^{c-f}	2.67^{cde}
I_2S_1	37120^{fg}	42620^{efg}	39870^{fghi}	19390^{ef}	24890^{ef}	22140^{efg}	2.17^{def}	2.41^{ef}	2.29^{ef}
I_2S_2	44980^{def}	49030^{cdef}	47010^{def}	27460^{cde}	31510^{def}	29490^{cde}	2.50^{cde}	2.80^{c-f}	2.65^{c-e}
I_2S_3	44920^{def}	53170^{b-e}	49040^{cde}	27480^{cde}	36210^{cde}	31840^{cd}	2.57^{bcde}	3.07^{b-e}	2.82^{cd}
I_2S_4	37450^{fg}	46430^{d-g}	41940^{efgh}	20420^{def}	29390^{def}	24900^{defg}	2.20^{def}	2.72^{c-f}	2.46^{def}
I_2S_5	31220^{g}	39150^{fg}	35180^{hi}	14410^{f}	22350^{f}	18380^{g}	1.86^{f}	2.33^{f}	2.10^{f}
S.Em.±	3324	3586	2445	3310	3556	2429	0.18	0.20	0.13
LSD (0.05)	9701	10470	6951	9661	10380	6907	0.54	0.57	0.37
C.V. (%)	12.8	11.9	12.3	20.9	17.9	19	12.7	11.7	11.9

Note: Crop was supplied with 100 kg N ha^{-1} in inorganic and/or organic form N base figures indicate N substitution with inorganics.

In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

On the whole, chilli + garlic recorded the highest gross return (Rs.63, 000 ha^{-1}) among the systems and $N_{50}P_{50}K_{50}$ and $N_{25}P_{50}K_{75}$ recorded significantly higher gross returns among the fertilizer level (Rs.56880 and Rs.53360 ha^{-1}, respectively).

Among the interaction treatments, chilli + garlic supplied either with $N_{50}P_{50}K_{50}$ or $N_{25}P_{50}K_{75}$ recorded higher gross returns (Rs.76230 and Rs.69640 ha^{-1}, respectively). On the other hand, sole chilli with entire N in the inorganic form and no potassium fertilizer (I_0S_5) recorded significantly lower gross return (Rs.33180 ha^{-1}) closely followed by chilli + coriander with similar nutrition (I_2S_5) and chilli + coriander and sole chilli receiving no inorganic nitrogen ($I_2S_1$and I_0S_1).

4.2.6.2 Net return (Rs. ha^{-1})

Net return were also highest with chilli + garlic system (Rs. 42550 ha^{-1}), while sole chilli and chilli + coriander were at par with each other (Table 53).

Net return as influenced by graded fertilizers indicated similar variation as that of gross returns. S_3 levels were significantly superior over other levels of fertilizers (Rs. 39130 ha^{-1}), while no (S_1) or entire N (S_5) in the inorganic form recorded significantly lower net return (Rs. 23410 and Rs. 25570 ha^{-1}, respectively).

Again, chilli + garlic with $N_{50}P_{50}K_{50}$ followed by $N_{25}P_{50}K_{75}$ recorded significantly higher net returns (Rs. 55660 and 48840/- ha^{-1}, respectively) among all the treatment combinations. While, the net return with sole chilli receiving only inorganic form of nitrogen (I_0S_5) was significantly lower, closely followed by chilli + coriander with similar fertilizer dose (I_2S_5).

4.2.6.3 B: C ratio

B: C ratio was also significantly influenced due to intercropping, fertilization and their interaction (Table 53).

B: C ratio was the highest (3.08) with chilli + garlic while chilli + coriander and sole chilli were at par with each other. Highest B: C ratio of 3.16 was observed with fertilizer dosage of $N_{50}P_{50}K_{50}$ (S_3) among all the graded levels of fertilizers, and $N_0P_{50}K_{100}$ and $N_{100}P_{50}K_0$ were at par and had significantly lower B: C ratio. Among treatment combinations, B: C ratio was the highest (3.71) with chilli + garlic intercrop with $N_{50}P_{50}K_{50}$ (I_1S_3) followed by $N_{25}P_{50}K_{75}$ (I_1S_2).

4.2.7 Correlation studies

A significant and highly positive correlation was observed between yield parameters *viz.,* fruit yield $hill^{-1}$ (0.98), fruit length (0.97) and 100-fruit weight (0.94) and seed to pod ratio (0.93) and chilli yield (kg ha^{-1}) (Table 53a).

A negative correlation was observed between chilli yield (kg ha^{-1}) and entomological parameters *viz.,* thrips $leaf^{-1}$, mites $leaf^{-1}$ and leaf curl index at all the stages of observation and also with the per cent discoloured fruits (-0.34). A significant and highly positive correlation was found between chilli yield (kg ha^{-1}) and yield of good fruits (0.99) and oleoresin yield (0.89).

4.3 EXPERIMENT III: EFFECT OF N SUBSTITUTION AND BIORATIONALS ON THE PERFORMANCE OF CHILLI AND BEHAVIOUR OF LEAF CURL COMPLEX

4.3.1 Growth parameters

4.3.1.1 Plant height (cm)

Plant height varied significantly due to sources of nitrogen, biopesticides sprays and their interactions (Table 54 and 55).

Among the sources of nitrogen, integrated supply of nitrogen through organics and inorganic sources recorded significantly higher plant height at all the stages of plant growth (28.7 cm, 49.7 cm, 59.4 cm and 65.7 cm at 30, 60 and 90 DAT and at final picking, respectively) compared to only inorganic source of N.

Table 53a. Correlation coefficient (r) between chilli yield (kg ha^{-1}) and yield parameters, entomological and quality parameters

Parameters		Correlation coefficient (r) (pooled data)
1. Yield parameters		
Fruit yield $hill^{-1}$ (g $hill^{-1}$)		0.98**
Fruit length (cm)		0.97**
100-fruit weight (g)		0.94**
Seed to pod ratio		0.93**
2. Entomological parameters		
Thrips $leaf^{-1}$	30 DAT	-0.41
Thrips $leaf^{-1}$	60 DAT	-0.26
Thrips $leaf^{-1}$	90 DAT	-0.48
Thrips $leaf^{-1}$	At final picking	-0.43
Mites $leaf^{-1}$	60 DAT	-0.24
Mites $leaf^{-1}$	90 DAT	-0.30
Mites $leaf^{-1}$	At final picking	-0.32
Leaf curl index 60 DAT		-0.48
Leaf curl index 90 DAT		-0.35
Leaf curl index At final picking		-0.43
3. Uptake of N		0.40
4. Uptake of K		0.82**
5. Quality parameters		
Discoloured fruits (%)		-0.34
Yield of good fruits (kg ha^{-1})		0.99**
Ascorbic acid content (mg 100 g^{-1})		0.28
Capsaicin content (%)		0.35
Oleoresin per cent (%)		0.31
Oleoresin yield (kg ha^{-1})		0.89**

* - Significant at 0.05 level
** - Significant at 0.01 level

Among biopesticide sprays, chilli sprayed with alternate sprays of Abamectin and Perfect recorded significantly higher plant height at all the stages of plant growth (29.5 cm, 53.8 cm, 65.3 cm and 71.6 cm at 30, 60 and 90 DAT and at final picking, respectively). While, the lowest plant height was recorded with the treatment receiving no sprays (24.8 cm, 41.7 cm, 46.3 cm and 50.6 cm at 30, 60 and 90 DAT and at final picking, respectively).

The treatment combination revealed that, chilli plant nutritioned with equal proportion of organic and inorganic sources of N coupled with alternate sprays of Abamectin and Perfect (T_2S_7) recorded higher plant height at all the stages of plant growth (31.0 cm, 55.7 cm, 67.0 and 73.1 cm and 30,60 and 90 DAT and at final picking, respectively), while, treatment receiving inorganic N without any sprays (T_1S_{10}) recorded lower plant height than other treatment combinations (23.9 cm, 39.3 cm, 43.6 cm and 47.7 cm at 30, 60 and 90 DAT and at final picking, respectively). Performances with other treatment combinations were intermediate and effects were often overlapping with one another.

4.3.1.2 Secondary branches (no. $plant^{-1}$)

The data revealed significant differences in the secondary branches per plant due to sources of nutrition, biopesticide sprays and their interactions (Table 56 and 57).

Among the sources of nitrogen 50 per cent N substitution through organics recorded significantly higher number of secondary branches per plant at all the stages of plant growth (4.0, 6.2, 7.5 and 11.5 at 30, 60 and 90 DAT and at final picking, respectively) compared to inorganic source of N.

Table 54. Plant height at 30 and 60 DAT as influenced by different sources of nutrition and biopesticides spray

Treatments	30 DAT			60 DAT		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	25.8^{b}	26.0^{b}	25.9^{b}	43.5^{b}	48.8^{b}	46.1^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1}neem cake**	27.7^{a}	29.6^{a}	28.7^{a}	47.9^{a}	51.5^{a}	49.7^{a}
S.Em.±	0.33	0.31	0.22	0.84	0.59	0.51
C.D at5%	0.93	0.91	0.63	2.41	1.70	1.45
Biopesticides sprays***						
S_1: Nimbecidine – GCK	26.6^{bcd}	28.6^{abc}	27.6^{bcd}	45.8^{bc}	50.5^{bcd}	48.1^{bc}
S_2: Nimbecidine – Leaf extract	27.2^{abc}	28.9^{ab}	28.1^{abc}	45.3^{bc}	50.3^{bcd}	47.8^{bc}
S_3: Nimbecidine - Panchgavya	27.8^{abc}	28.6^{abc}	28.2^{ab}	46.6^{abc}	52.0^{abc}	49.3^{bc}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	28.1^{ab}	28.6^{abc}	28.4^{ab}	48.4^{ab}	53.0^{ab}	50.7^{ab}
S_5: Nimbecidine - Silica spray	25.5^{cd}	27.0^{bcd}	26.3^{d}	44.6^{bc}	47.9^{cd}	46.3^{c}
S_6: Nimbecidine - Action 100 spray	25.8^{bcd}	27.5^{abc}	26.6^{cd}	43.8^{bc}	48.4^{cd}	46.1^{c}
S_7: Abamectin (1.9 EC) - Perfect	29.3^{a}	29.7^{a}	29.5^{a}	51.9^{a}	55.7^{a}	53.8^{a}
S_8: Silica	25.9^{bcd}	26.5^{cd}	26.2^{de}	43.9^{bc}	47.5^{d}	45.7^{c}
S_9: RPP	27.6^{abc}	27.5^{abc}	27.5^{bcd}	46.6^{abc}	53.2^{ab}	49.9^{b}
S_{10}: Control	24.6^{d}	25.1^{d}	24.8^{e}	40.4^{c}	42.9^{e}	41.7^{d}
S.Em.±	0.73	0.70	0.50	1.88	1.32	1.15
C.D at 5%	2.09	2.03	1.41	5.39	3.80	3.24
Interaction						
T_1S_1	25.8^{bcd}	26.8^{d-h}	26.3^{d-g}	43.8^{bcd}	49.5^{bcd}	46.6^{c-f}
T_1S_2	26.4^{bcd}	26.6^{e-h}	26.5^{d-g}	41.9^{cd}	50.0^{bcd}	46.0^{def}
T_1S_3	26.8^{a-d}	26.7^{d-h}	26.8^{c-f}	44.0^{bcd}	50.5^{bcd}	47.2^{b-f}
T_1S_4	27.2^{a-d}	27.3^{c-g}	27.3^{b-f}	44.1^{bcd}	52.3^{abc}	48.2^{b-f}
T_1S_5	24.2^{d}	24.6^{gh}	24.4^{gh}	43.7^{bcd}	46.3^{cd}	45.0^{ef}
T_1S_6	24.4^{d}	26.0^{fgh}	25.2^{fgh}	42.0^{cd}	46.6^{cd}	44.3^{ef}
T_1S_7	28.4^{abc}	27.6^{c-g}	28.0^{b-e}	49.7^{abc}	54.1^{ab}	51.9^{abc}
T_1S_8	24.3^{d}	24.6^{gh}	24.5^{gh}	43.6^{bcd}	46.5^{cd}	45.1^{ef}
T_1S_9	26.9^{a-d}	26.0^{fgh}	26.4^{d-g}	43.7^{bcd}	51.7^{a-d}	47.7^{c-f}
T_1S_{10}	24.0^{d}	23.7^{h}	23.9^{h}	38.5^{d}	40.1^{e}	39.3^{g}
T_2S_1	27.4^{a-d}	30.4^{abc}	28.9^{abc}	47.7^{abc}	51.5^{a-d}	49.6^{b-e}
T_2S_2	28.0^{abc}	31.2^{ab}	29.6^{ab}	48.6^{abc}	50.6^{bcd}	49.6^{b-e}
T_2S_3	28.7^{ab}	30.6^{abc}	29.6^{ab}	49.2^{abc}	53.5^{ab}	51.4^{a-d}
T_2S_4	29.0^{ab}	30.0^{a-d}	29.5^{ab}	52.7^{ab}	53.7^{ab}	53.2^{ab}
T_2S_5	26.8^{a-d}	29.4^{a-e}	28.1^{b-e}	45.5^{a-d}	49.5^{bcd}	47.5^{c-f}
T_2S_6	27.1^{a-d}	29.0^{a-f}	28.1^{b-e}	45.5^{a-d}	50.1^{bcd}	47.8^{c-f}
T_2S_7	30.1^{a}	31.8^{a}	31.0^{a}	54.0^{a}	57.4^{a}	55.7^{a}
T_2S_8	27.4^{a-d}	28.4^{b-f}	27.9^{b-e}	44.2^{bcd}	48.5^{bcd}	46.4^{def}
T_2S_9	28.2^{abc}	29.0^{a-f}	28.6^{bcd}	49.4^{abc}	54.6^{ab}	52.0^{abc}
T_2S_{10}	25.1^{cd}	26.4^{e-h}	25.8^{e-h}	42.2^{cd}	45.8^{d}	44.0^{f}
S.Em.±	1.03	1.00	0.71	2.66	1.87	1.62
C.D at 5%	2.95	2.85	1.99	7.62	5.37	4.58
C.V.	6.6	6.0	6.3	10.1	6.5	8.3

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively

Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 55. Plant height at 90 DAT and at final picking as influenced by different sources of nutrition and biopesticides spray

Treatments	90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	50.9^{b}	58.5^{b}	54.7^{b}	57.2^{b}	64.9^{b}	61.0^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	54.6^{a}	64.3^{a}	59.4^{a}	63.6^{a}	67.7^{a}	65.7^{a}
S.Em.±	0.70	0.60	0.46	1.14	0.75	0.68
C.D at5%	2.00	1.73	1.30	3.26	2.16	1.93
Biopesticides sprays***						
S_1: Nimbecidine – GCK	52.5^{bc}	63.1^{bc}	57.8^{cd}	60.0^{bc}	67.3^{bc}	63.6^{c}
S_2: Nimbecidine – Leaf extract	52.8^{bc}	64.0^{bc}	58.4^{bcd}	62.1^{bc}	67.6^{abc}	64.8^{bc}
S_3: Nimbecidine - Panchgavya	54.6^{bc}	65.1^{b}	59.8^{bc}	61.7^{bc}	68.6^{abc}	65.1^{bc}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	56.9^{ab}	65.6^{b}	61.2^{b}	66.8^{ab}	70.5^{ab}	68.6^{ab}
S_5: Nimbecidine - Silica spray	50.5^{c}	60.1^{cd}	55.3^{de}	56.7^{cd}	64.9^{c}	60.8^{c}
S_6: Nimbecidine - Action 100 spray	50.7^{c}	58.1^{d}	54.4^{e}	59.2^{bc}	66.5^{bc}	62.8^{c}
S_7: Abamectin (1.9 EC) - Perfect	60.4^{a}	70.2^{a}	65.3^{a}	70.3^{a}	72.9^{a}	71.6^{a}
S_8: Silica	51.0^{c}	57.1^{d}	54.1^{e}	57.1^{cd}	65.3^{bc}	61.2^{c}
S_9: RPP	53.3^{bc}	63.3^{bc}	58.3^{bcd}	60.7^{bc}	68.2^{abc}	64.5^{bc}
S_{10}: Control	45.2^{d}	47.5^{e}	46.3^{f}	49.8^{d}	51.4^{d}	50.6^{d}
S.Em.±	1.56	1.35	1.03	2.54	1.69	1.53
C.D at 5%	4.49	3.88	2.91	7.29	4.83	4.31
Interaction						
T_1S_1	51.6^{cde}	60.7^{de}	56.2^{ef}	57.4^{b-f}	66.3^{a-d}	61.8^{def}
T_1S_2	50.8^{de}	61.9^{cde}	56.4^{ef}	60.0^{a-e}	66.9^{a-d}	63.4^{c-f}
T_1S_3	52.6^{b-e}	62.7^{b-e}	57.7^{def}	58.0^{b-f}	67.2^{a-d}	62.6^{def}
T_1S_4	54.1^{b-e}	62.4^{b-e}	58.3^{de}	64.8^{a-d}	68.1^{a-d}	66.5^{a-e}
T_1S_5	49.2^{de}	56.8^{ef}	53.0^{fg}	52.1^{ef}	63.6^{cd}	57.9^{fg}
T_1S_6	48.6^{ef}	54.4^{fg}	51.5^{g}	53.6^{c-f}	65.1^{bcd}	59.4^{efg}
T_1S_7	58.4^{abc}	68.8^{ab}	63.6^{abc}	68.5^{ab}	71.5^{abc}	70.0^{abc}
T_1S_8	50.4^{de}	51.4^{fg}	50.9^{g}	52.4^{ef}	63.1^{d}	57.8^{fg}
T_1S_9	51.8^{c-e}	60.8^{de}	56.3^{ef}	58.4^{b-f}	68.3^{a-d}	63.3^{c-f}
T_1S_{10}	42.3^{f}	44.8^{h}	43.6^{h}	46.8^{f}	48.6^{e}	47.7^{h}
T_2S_1	53.4^{b-e}	65.5^{a-d}	59.4^{cde}	62.6^{a-e}	68.3^{a-d}	65.4^{a-e}
T_2S_2	54.7^{b-e}	66.1^{a-d}	60.4^{b-e}	64.1^{a-e}	68.4^{a-d}	66.3^{a-e}
T_2S_3	56.5^{a-d}	67.4^{abc}	62.0^{bcd}	65.4^{abc}	69.9^{a-d}	67.7^{a-d}
T_2S_4	59.6^{ab}	68.7^{ab}	64.2^{ab}	68.7^{ab}	72.8^{ab}	70.8^{ab}
T_2S_5	51.8^{cde}	63.4^{bcd}	57.6^{def}	61.2^{a-e}	66.3^{a-d}	63.7^{b-f}
T_2S_6	52.8^{b-e}	61.7^{cde}	57.3^{def}	64.8^{a-d}	67.8^{a-d}	66.3^{a-e}
T_2S_7	62.4^{a}	71.5^{a}	67.0^{a}	72.0^{a}	74.2^{a}	73.1^{a}
T_2S_8	51.6^{c-e}	62.8^{b-e}	57.2^{def}	61.7^{a-e}	67.4^{a-d}	64.6^{b-f}
T_2S_9	54.8^{b-e}	65.8^{a-d}	60.3^{b-e}	63.0^{a-e}	68.1^{a-d}	65.7^{b-e}
T_2S_{10}	48.1^{ef}	50.1^{gh}	49.1^{g}	52.8^{def}	54.2^{e}	53.5^{gh}
S.Em.±	2.21	1.91	1.46	3.59	2.38	2.16
C.D at 5%	6.35	5.48	4.12	10.31	6.83	6.09
C.V.	7.3	5.4	6.3	10.3	6.2	8.3

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively

Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among biopesticide spray schedules, chilli crop sprayed with Abamectin and Perfect (S_7) alternatively recorded significantly higher number of secondary branches per plant at all the stages of plant growth (4.3, 6.8, 9.3 and 13.4 at 30, 60 and 90 DAT and at final picking, respectively), however it was on par with alternate sprays of nimbecidine and mixture of panchagavya and leaf extract at 30 and 60 DAT only (4.0 and 6.4, respectively). While, the lowest number of secondary branches were recorded in the control treatment (2.6, 5.0, 6.1 and 9.6 at 30, 60 and 90 DAT and at final picking, respectively).

Among the treatment combinations, chilli plant applied with equal proportion of organics and inorganic sources of N coupled with alternate sprays of Abamectin and Perfect (T_2S_7) recorded significantly higher number of secondary branches per plant at all the stages of plant growth (4.7, 7.2, 9.8 and 13.9 at 30, 60 and 90 DAT and at final picking, respectively). Chilli crop nutritioned with RDF and sprayed with Abamectin and Perfect alternatively (T_1S_7) was on par with the former treatment combination (6.5 and 12.9 at 60 DAT and at final picking, respectively), while chilli crop fertilized with RDF without any spray (T_1S_{10}) recorded lower number of secondary branches per plant than other treatment combinations (2.3, 4.8, 5.8 and 9.3 at 30, 60 and 90 DAT and at final picking, respectively).

4.3.1.3 Leaf area (cm² hill^{-1})

Leaf area of chilli varied significantly due to sources of nitrogen, biorational sprays and their interaction at all the stages of crop growth (Table 58 and 59).

Of the two sources of nitrogen, integrated nitrogen supply equally through organics and inorganics resulted in highest leaf area (156, 244.3, 710 and 1060 cm² hill^{-1} at 30, 60 and 90 DAT and at final picking, respectively).

Among the biopesticide sprays chilli sprayed with Abamectin and Perfect (S_7) alternatively recorded highest leaf area (190, 332.4, 883.7 and 1257 cm² hill^{-1} at 30, 60 and 90 DAT and at final picking, respectively). On the other hand, chilli without any spray (S_{10}) recorded lower leaf area at all the stages of plant growth (97, 174.3, 521.4 and 649 cm² hill^{-1} at 30, 60 and 90 DAT and at final picking, respectively). Most of the sprays, comprising of nimbecidine and other bioextracts except silica and Action 100 were comparable and at times superior to recommended plant protection consisting of inorganics. Similarly, application of only silica was as good as/superior to control.

Among the treatment combinations, integrated source of N nutrition coupled with alternate spray of Abamectin and Perfect (T_2S_7) recorded significantly higher leaf area at all the stages of plant growth (197, 352.5, 925 and 1371 cm² hill^{-1} at 30, 60 and 90 DAT and at final picking, respectively). The similar spray combination with inorganic nitrogen supply (T_1S_7) was at par and at times next in the order. While, treatment combination consisting of RDN application without any spray (T_1S_{10}) recorded significantly lower leaf area compared to the other treatment combinations at all the stages of plant growth. Integrated nitrogen supply with no spray (T_2S_{10}) was on par with it.

4.3.1.4 Dry matter production (g plant^{-1})

The variations in the dry matter production due to sources of nitrogen, biopesticide sprays and their interaction were significant at all the stages of plant growth (Table 60 and 61).

Chilli crop nutritioned with both organic and inorganic sources of N recorded the highest dry matter production at all the stages of plant growth (5.0, 12.8, 28.2 and 48.6 at 30, 60 and 90 DAT and at final picking, respectively) compared to entire inorganic N application.

Among the biorational sprays, alternate sprays of Abamectin and Perfect (S_7) resulted in significantly higher dry matter production at all the stages of plant growth (5.8, 15.2, 33.9 and 55.9 g at 30,60 and 90 DAT and at final picking, respectively), while the lowest dry matter production was recorded in the control treatment having no sprays (3.6, 8.9, 20.4 and 36.2 g at 30, 60, 90 DAT and at final picking, respectively).

The interaction effects revealed significantly higher dry matter production by chilli crop nutritioned with equal quantity of organic and inorganic sources of N coupled with alternate sprays of Abamectin and Perfect (T_2S_7) at all the stages of crop growth (5.9, 16.1,

Table 56. Number of secondary branches plant^{-1} at 30 and 60 DAT as influenced by different sources of nutrition and biopesticides spray

Treatments	30 DAT			60 DAT		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	2.9^{b}	3.0^{b}	3.0^{b}	5.1^{b}	6.1^{b}	5.6^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	3.5^{a}	4.4^{a}	4.0^{a}	5.9^{a}	6.4^{a}	6.2^{a}
S.Em.±	0.08	0.07	0.05	0.11	0.11	0.08
C.D at5%	0.24	0.19	0.15	0.32	0.31	0.22
Biopesticides sprays***						
S_1: Nimbecidine – GCK	3.3^{b-e}	3.7^{cd}	3.5^{cd}	5.5^{b}	6.3^{bc}	5.9^{bcd}
S_2: Nimbecidine – Leaf extract	3.4^{bcd}	3.8^{bcd}	3.6^{c}	5.7^{b}	6.3^{bc}	6.0^{bcd}
S_3: Nimbecidine - Panchgavya	3.5^{bc}	4.0^{bc}	3.8^{bc}	5.8^{ab}	6.5^{abc}	6.1^{bc}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	3.7^{ab}	4.2^{ab}	4.0^{ab}	6.0^{ab}	6.7^{ab}	6.4^{ab}
S_5: Nimbecidine - Silica spray	2.9^{de}	3.4^{d}	3.1^{e}	5.2^{bc}	6.0^{bcd}	5.6^{cd}
S_6: Nimbecidine - Action 100 spray	3.0^{cde}	3.5^{d}	3.2^{de}	5.3^{b}	5.8^{cd}	5.5^{d}
S_7: Abamectin (1.9 EC) - Perfect	4.1^{a}	4.5^{a}	4.3^{a}	6.5^{a}	7.2^{a}	6.8^{a}
S_8: Silica	2.8^{e}	3.4^{d}	3.1^{e}	5.3^{b}	5.9^{cd}	5.6^{cd}
S_9: RPP	3.4^{bcd}	3.8^{bcd}	3.6^{c}	5.7^{b}	6.1^{bcd}	5.9^{bcd}
S_{10}: Control	2.2^{f}	2.9^{e}	2.6^{f}	4.5^{c}	5.5^{d}	5.0^{e}
S.Em.±	0.18	0.15	0.12	0.25	0.24	0.17
C.D at 5%	0.53	0.42	0.33	0.72	0.70	0.49
Interaction						
T_1S_1	2.8^{fgh}	3.1^{fgh}	3.0^{hij}	5.1^{cde}	6.1^{b-e}	5.6^{def}
T_1S_2	2.9^{e-h}	3.1^{fgh}	3.0^{hij}	5.2^{b-e}	6.1^{b-e}	5.7^{c-f}
T_1S_3	3.1^{c-g}	3.2^{fgh}	3.2^{ghi}	5.4^{bcd}	6.3^{b-e}	5.9^{b-f}
T_1S_4	3.3^{b-f}	3.5^{def}	3.4^{fgh}	5.6^{bcd}	6.4^{a-e}	6.0^{b-f}
T_1S_5	2.6^{fgh}	2.7^{ghi}	2.7^{ijk}	4.8^{de}	5.8^{cde}	5.3^{efg}
T_1S_6	2.7^{fgh}	2.9^{fghi}	2.8^{ijk}	4.7^{de}	5.6^{cde}	5.2^{fg}
T_1S_7	3.9^{abc}	3.9^{cde}	3.9^{c-f}	6.1^{abc}	6.8^{abc}	6.5^{abc}
T_1S_8	2.5^{fgh}	2.7^{hi}	2.6^{jk}	4.8^{de}	5.9^{b-e}	5.4^{efg}
T_1S_9	3.0^{d-h}	3.1^{fgh}	3.0^{hij}	5.3^{b-e}	5.9^{b-e}	5.6^{def}
T_1S_{10}	2.2^{h}	2.3^{i}	2.3^{k}	4.2^{e}	5.4^{e}	4.8^{g}
T_2S_1	3.7^{a-e}	4.4^{a-c}	4.1^{b-e}	5.9^{a-d}	6.6^{a-e}	6.3^{bcd}
T_2S_2	3.9^{abc}	4.5^{a-c}	4.2^{a-d}	6.1^{abc}	6.5^{a-e}	6.3^{bcd}
T_2S_3	4.0^{ab}	4.7^{ab}	4.4^{abc}	6.1^{abc}	6.7^{a-d}	6.4^{bcd}
T_2S_4	4.1^{ab}	4.9^{a}	4.5^{ab}	6.4^{ab}	7.1^{ab}	6.7^{ab}
T_2S_5	3.1^{c-g}	4.1^{bcd}	3.6^{efg}	5.6^{bcd}	6.2^{b-e}	5.9^{b-f}
T_2S_6	3.3^{b-f}	4.1^{bcd}	3.7^{d-g}	5.8^{a-d}	5.9^{b-e}	5.9^{b-f}
T_2S_7	4.3^{a}	5.0^{a}	4.7^{a}	6.9^{a}	7.5^{a}	7.2^{a}
T_2S_8	3.0^{d-h}	4.2^{bc}	3.6^{efg}	5.7^{bcd}	5.9^{b-e}	5.8^{c-f}
T_2S_9	3.8^{a-d}	4.6^{abc}	4.2^{a-d}	6.0^{abc}	6.3^{b-e}	6.1^{d-e}
T_2S_{10}	2.3^{gh}	3.4^{efg}	2.9^{hij}	4.7^{de}	5.6^{de}	5.2^{fg}
S.Em.±	0.26	0.21	0.17	0.35	0.34	0.25
C.D at 5%	0.75	0.59	0.47	1.02	0.99	0.70
C.V.	14.0	9.6	11.7	11.1	9.6	10.3

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively

Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 57. Secondary branches plant^{-1} at 90 DAT and at final picking as influenced by different sources of nutrition and biopesticides spray

Treatments	90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	7.0^{b}	7.2^{b}	7.1^{b}	10.0^{b}	11.2^{b}	10.6^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	7.5^{a}	7.6^{a}	7.5^{a}	11.1^{a}	11.8^{a}	11.5^{a}
S.Em.±	0.13	0.11	0.09	0.20	0.19	0.14
C.D at5%	0.38	0.32	0.24	0.58	0.55	0.39
Biopesticides sprays***						
S_1: Nimbecidine – GCK	7.4^{bcd}	7.4^{bc}	7.4^{bc}	10.3^{bcd}	11.4^{bc}	10.8^{cd}
S_2: Nimbecidine – Leaf extract	7.5^{bc}	7.6^{b}	7.5^{b}	10.8^{bcd}	11.6^{bc}	11.2^{bc}
S_3: Nimbecidine - Panchgavya	7.7^{b}	7.7^{b}	7.7^{b}	11.2^{bc}	11.8^{bc}	11.5^{bc}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	7.8^{b}	7.8^{b}	7.8^{b}	11.6^{b}	12.3^{b}	11.9^{b}
S_5: Nimbecidine - Silica spray	6.7^{cde}	7.1^{bc}	6.9^{cd}	9.9^{cde}	11.2^{bc}	10.6^{cd}
S_6: Nimbecidine - Action 100 spray	6.6^{cde}	6.7^{cd}	6.7^{d}	9.7^{de}	10.7^{c}	10.2^{de}
S_7: Abamectin (1.9 EC) - Perfect	9.3^{a}	9.3^{a}	9.3^{a}	13.1^{a}	13.7^{a}	13.4^{a}
S_8: Silica	6.5^{de}	6.7^{cd}	6.6^{de}	9.6^{de}	10.5^{c}	10.1^{de}
S_9: RPP	7.5^{bc}	7.4^{bc}	7.4^{bc}	10.4^{bcd}	11.4^{bc}	10.9^{cd}
S_{10}: Control	5.8^{e}	6.3^{d}	6.1^{e}	8.8^{e}	10.4^{c}	9.6^{e}
S.Em.±	0.30	0.25	0.19	0.45	0.43	0.31
C.D at 5%	0.85	0.71	0.55	1.29	1.22	0.87
Interaction						
T_1S_1	7.2^{cde}	7.2^{b-e}	7.2^{c-g}	9.8^{d-g}	11.1^{cd}	10.4^{e-j}
T_1S_2	7.3^{cde}	7.5^{bcd}	7.4^{cde}	10.3^{b-g}	11.4^{bcd}	10.9^{d-li}
T_1S_3	7.5^{b-e}	7.6^{bc}	7.5^{cde}	10.5^{b-g}	11.5^{bcd}	11.0^{d-li}
T_1S_4	7.6^{b-e}	7.7^{b}	7.6^{cde}	10.9^{b-f}	11.8^{bcd}	11.4^{c-f}
T_1S_5	6.5^{c-f}	7.0^{b-e}	6.8^{e-h}	9.3^{efg}	10.7^{cd}	10.0^{f-j}
T_1S_6	6.4^{def}	6.5^{cde}	6.5^{f-i}	9.2^{efg}	10.4^{d}	9.8^{hij}
T_1S_7	8.7^{b}	9.0^{ab}	8.8^{b}	12.4^{ab}	13.3^{ab}	12.9^{ab}
T_1S_8	6.3^{ef}	6.5^{cde}	6.4^{ghi}	9.1^{fg}	10.3^{d}	9.7^{ij}
T_1S_9	7.3^{cde}	7.3^{b-e}	7.3^{c-f}	9.9^{d-g}	11.1^{cd}	10.5^{e-j}
T_1S_{10}	5.4^{f}	6.2^{e}	5.8^{i}	8.6^{g}	10.0^{d}	9.3^{j}
T_2S_1	7.5^{b-e}	7.7^{b}	7.6^{cde}	10.7^{b-g}	11.7^{bcd}	11.2^{c-h}
T_2S_2	7.6^{b-e}	7.8^{b}	7.7^{cde}	11.3^{b-e}	11.7^{bcd}	11.5^{cde}
T_2S_3	7.8^{bcd}	7.9^{b}	7.8^{cd}	11.9^{a-d}	12.0^{bcd}	12.0^{bcd}
T_2S_4	7.9^{bc}	7.9^{b}	7.9^{c}	12.3^{abc}	12.7^{abc}	12.5^{bc}
T_2S_5	6.9^{cde}	7.2^{b-e}	7.1^{c-h}	10.6^{b-g}	11.6^{bcd}	11.1^{c-li}
T_2S_6	6.8^{cde}	6.9^{b-e}	6.9^{d-h}	10.3^{b-g}	11.0^{cd}	10.7^{d-j}
T_2S_7	10.0^{a}	9.7^{a}	9.8^{a}	13.8^{a}	14.0^{a}	13.9^{a}
T_2S_8	6.7^{c-f}	6.8^{b-e}	6.8^{e-h}	10.2^{c-g}	10.8^{cd}	10.5^{e-j}
T_2S_9	7.6^{b-e}	7.5^{bcd}	7.6^{cde}	10.9^{b-f}	11.8^{bcd}	11.3^{c-g}
T_2S_{10}	6.2^{ef}	6.4^{de}	6.3^{hi}	9.0^{fg}	10.9^{cd}	9.9^{g-j}
S.Em.±	0.42	0.35	0.27	0.63	0.60	0.41
C.D at 5%	1.2	1.01	0.77	1.82	1.73	1.23
C.V. (%)	10.0	8.2	9.1	10.4	9.1	9.7

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 58. Leaf area (cm^2 $hill^{-1}$) at 30 and 60 DAT as influenced by different sources of nutrition and biopesticides spray

Treatments	30 DAT			60 DAT		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	116.0^{b}	155.0^{b}	136.0^{b}	215.4^{b}	228.1^{b}	221.8^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	137.0^{a}	174.0^{a}	156.0^{a}	237.4^{a}	251.0^{a}	244.3^{a}
S.Em.±	3.6	4.5	2.9	5.64	7.2	4.58
C.D at5%	10.3	13.0	8.1	16.2	20.7	12.9
Biopesticides sprays***						
S_1: Nimbecidine – GCK	136.0^{bc}	171.0^{bcd}	154.0^{b}	234.5^{bc}	249.0^{bc}	241.8^{c}
S_2: Nimbecidine – Leaf extract	138.0^{bc}	178.0^{a-d}	158.0^{b}	236.0^{bc}	242.0^{bcd}	239.0^{c}
S_3: Nimbecidine - Panchgavya	129.0^{bc}	169.0^{bcd}	149.0^{b}	243.0^{b}	249.0^{bc}	245.8^{c}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	148.0^{b}	187.0^{ab}	168.0^{b}	266.5^{b}	286.0^{b}	276.3^{b}
S_5: Nimbecidine – Silica spray	113.0^{cde}	146.0^{d}	130.0^{c}	199.0^{cd}	210.0^{cde}	204.5^{de}
S_6: Nimbecidine – Action 100 spray	107.0^{def}	148.0^{cd}	128.0^{c}	189.0^{d}	200.0^{cde}	194.5^{e}
S_7: Abamectin (1.9 EC) - Perfect	175.0^{a}	205.0^{a}	190.0^{a}	318.5^{a}	346.0^{a}	332.4^{a}
S_8: Silica	100.0^{ef}	155.0^{bcd}	128.0^{c}	185.5^{d}	195.0^{de}	190.3^{e}
S_9: RPP	135.0^{bc}	180.0^{abc}	157.0^{b}	228.0^{bc}	235.0^{b-e}	231.5^{cd}
S_{10}: Control	87.0^{f}	108.0^{e}	97.0^{d}	164.0^{d}	185.0^{e}	174.3^{e}
S.Em.±	8.0	10.1	6.4	12.6	16.1	10.23
C.D at 5%	22.9	30.0	18.2	36.2	46.2	20.84
Interaction						
T_1S_1	132.0^{bc}	164.0^{a-d}	148.0^{cd}	228.0^{c-g}	245.0^{c-f}	236.5^{de}
T_1S_2	129.0^{cd}	175.0^{a-d}	152.0^{cd}	236.0^{c-f}	238.0^{c-f}	237.0^{de}
T_1S_3	120.0^{cde}	154.0^{b-e}	137.0^{de}	240.0^{b-e}	245.0^{c-f}	242.3^{cde}
T_1S_4	140.0^{bc}	185.0^{abc}	163.0^{bcd}	261.0^{bcd}	273.3^{bcd}	267.2^{cd}
T_1S_5	94.0^{def}	133.0^{def}	113.0^{ef}	183.0^{e-h}	190.0^{ef}	186.5^{fg}
T_1S_6	86.0^{ef}	130.0^{def}	108.0^{f}	174.0^{gh}	184.0^{ef}	179.0^{fg}
T_1S_7	168.0^{ab}	198.0^{ab}	183.0^{ab}	296.0^{ab}	328.7^{ab}	312.3^{ab}
T_1S_8	80.0^{f}	142.0^{c-f}	111.0^{ef}	170.0^{gh}	181.0^{ef}	175.5^{fg}
T_1S_9	130.0^{bcd}	170.0^{a-d}	150.0^{cd}	216.0^{c-g}	228.0^{c-f}	222.0^{def}
T_1S_{10}	80.0^{f}	102.0^{f}	91.0^{f}	150.0^{h}	169.0^{f}	159.5^{g}
T_2S_1	140.0^{bc}	178.0^{a-d}	159.0^{bcd}	241.0^{b-e}	253.0^{cde}	247.0^{cde}
T_2S_2	146.0^{bc}	182.0^{abc}	164.0^{bcd}	236.0^{c-f}	246.0^{c-f}	241.0^{cde}
T_2S_3	138.0^{bc}	184.0^{abc}	161.0^{bcd}	246.0^{bcd}	252.7^{cde}	249.3^{cde}
T_2S_4	156.0^{abc}	190.0^{abc}	173.0^{abc}	272.0^{bc}	298.2^{bc}	285.3^{bc}
T_2S_5	132.0^{bc}	160.0^{b-e}	146.0^{cd}	215.0^{c-g}	230.0^{c-f}	222.5^{def}
T_2S_6	128.0^{cd}	166.0^{a-d}	147.0^{cd}	204.0^{d-h}	216.0^{def}	210.0^{ef}
T_2S_7	182.0^{cde}	212.0^{a}	197.0^{a}	341.0^{a}	364.0^{a}	352.5^{a}
T_2S_8	120.0^{cde}	168.0^{a-d}	144.0^{cd}	201.0^{d-h}	209.0^{def}	205.0^{efg}
T_2S_9	139.0^{bc}	190.0^{abc}	165.0^{bcd}	240.0^{b-e}	242.0^{c-f}	241.0^{cde}
T_2S_{10}	93.0^{def}	114.0^{ef}	104.0^{f}	178.0^{fgh}	200.0^{def}	189.0^{fg}
S.Em.±	11.3	14.3	9.1	17.8	22.8	14.47
C.D at 5%	32.5	41.0	25.7	51.2	65.4	40.79
C.V.(%)	15.5	15.0	15.3	13.6	16.5	15.2

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 59. Leaf area (cm^2 $hill^{-1}$) at 90 DAT and at final picking as influenced by different sources of nutrition and biopesticides spray

Treatments	90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	590.2^{b}	682.0^{b}	636.0^{b}	845.0^{b}	970.0^{b}	907.0^{b}
T_2:50:50:50 kg ha^{-1} NPK+ 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	656.1^{a}	764.0^{a}	710.0^{a}	967.0^{a}	1153.0^{a}	1060.0^{a}
S.Em.±	13.2	18.3	11.3	13.6	25.4	14.4
C.D at5%	37.9	52.4	31.8	39.0	72.8	40.6
Biopesticides sprays***						
S_1: Nimbecidine – GCK	608.3^{cde}	699.0^{cd}	653.8^{cd}	912.0^{cd}	1020.0^{cd}	966.0^{de}
S_2: Nimbecidine – Leaf extract	639.3^{bcd}	742.0^{bcd}	690.5^{c}	965.0^{bc}	1176.0^{abc}	1070.0^{bc}
S_3: Nimbecidine - Panchgavya	685.8^{bc}	754.0^{bcd}	720.0^{bc}	1006.0^{bc}	1189.0^{abc}	1097.0^{bc}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	723.0^{b}	836.0^{b}	779.0^{b}	1057.0^{b}	1217.0^{ab}	1137.0^{b}
S_5: Nimbecidine - Silica spray	542.8^{ef}	653.0^{cde}	597.8^{d}	790.0^{e}	987.0^{d}	888.0^{ef}
S_6: Nimbecidine - Action 100 spray	561.8^{def}	642.0^{cde}	601.8^{d}	830.0^{de}	949.0^{d}	889.0^{ef}
S_7: Abamectin (1.9 EC) - Perfect	810.0^{a}	957.0^{a}	883.7^{a}	1182.0^{a}	1331.0^{a}	1257.0^{a}
S_8: Silica	533.0^{ef}	628.0^{de}	580.3^{de}	772.0^{e}	929.0^{d}	850.0^{f}
S_9: RPP	638.8^{bcd}	765.0^{bc}	701.8^{c}	966.0^{bc}	1096.0^{bcd}	1031.0^{cd}
S_{10}: Control	488.3^{f}	555.0^{e}	521.4^{e}	580.0^{f}	718.0^{e}	649.0^{g}
S.Em.±	29.5	40.8	25.2	30.4	56.7	32.2
C.D at 5%	84.6	117.0	71.0	87.3	162.7	90.8
Interaction						
T_1S_1	580.0^{c-f}	656.0^{c-f}	618.2^{e-h}	842.0^{g-j}	940.0^{c-g}	891.0^{gh}
T_1S_2	610.0^{b-f}	642.0^{d-f}	626.2^{efg}	918.0^{e-h}	1088.0^{b-e}	1003.0^{d-g}
T_1S_3	628.0^{b-e}	665.0^{c-f}	646.7^{ef}	942.0^{c-h}	1103.0^{bcd}	1023.0^{d-g}
T_1S_4	700.0^{bc}	796.0^{a-d}	748.2^{cd}	986.0^{c-f}	1138.0^{bcd}	1062.0^{c-f}
T_1S_5	501.0^{ef}	637.0^{d-f}	569.0^{f-i}	718.0^{jk}	886.0^{d-h}	802.0^{hi}
T_1S_6	535.0^{def}	608.0^{def}	571.2^{f-i}	764.0^{ij}	833.0^{e-h}	799.0^{hi}
T_1S_7	750.0^{b}	935.0^{a}	842.3^{b}	1078.0^{bc}	1208.0^{abc}	1142.0^{bcd}
T_1S_8	498.0^{ef}	599.0^{ef}	548.5^{ghi}	722.0^{jk}	801.0^{fgh}	762.0^{hi}
T_1S_9	622.0^{b-e}	693.0^{b-f}	657.3^{ef}	930.0^{dh}	1049.0^{b-f}	990.0^{efg}
T_1S_{10}	478.0^{f}	586.0^{ef}	532.0^{hi}	548.0^{l}	650.0^{h}	599.0^{j}
T_2S_1	636.7^{b-e}	742.0^{b-e}	689.3^{de}	982.0^{c-g}	1100.0^{b-e}	1041.0^{c-f}
T_2S_2	668.7^{bcd}	841.0^{abc}	754.8^{cd}	1011.0^{b-e}	1263.0^{ab}	1137.0^{b-e}
T_2S_3	743.7^{b}	843.0^{abc}	793.2^{bc}	1069.0^{bcd}	1275.0^{ab}	1172.0^{bc}
T_2S_4	746.0^{b}	875.0^{ab}	810.5^{bc}	1128.0^{b}	1295.0^{ab}	1212.0^{b}
T_2S_5	584.7^{c-f}	668.0^{c-f}	626.5^{efg}	861.0^{f-i}	1088.0^{b-e}	975.0^{fg}
T_2S_6	588.7^{c-f}	675.0^{c-f}	631.8^{efg}	896.0^{e-i}	1064.0^{b-e}	980.0^{fg}
T_2S_7	870.0^{a}	980.0^{a}	925.0^{a}	1286.0^{a}	1455.0^{a}	1371.0^{a}
T_2S_8	568.0^{c-f}	656.0^{c-f}	612.0^{e-h}	821.0^{hij}	1057.0^{b-f}	939.0^{fg}
T_2S_9	655.7^{bcd}	837.0^{abc}	746.3^{cd}	1002.0^{b-f}	1143.0^{bcd}	1072.0^{b-f}
T_2S_{10}	498.7^{ef}	523.0^{f}	510.8^{i}	612.0^{kl}	786.0^{gh}	699.0^{ij}
S.Em.±	41.7	57.7	27.6	43.0	80.2	45.5
C.D at 5%	119.7	165.5	77.8	123.5	230.1	128.3
C.V. (%)	11.6	13.8	13.0	8.2	13.1	11.3

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively

Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 60. Dry matter production plant^{-1} (g) at 30 and 60 DAT as influenced by different sources of nutrition and biopesticides spray

Treatments	30 DAT			60 DAT		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	4.2^{b}	4.6^{b}	4.4^{b}	10.5^{b}	11.3^{b}	10.9^{b}
T_2:50:50:50 kg NPK ha^{-1} + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	4.9^{a}	5.2^{a}	5.0^{a}	12.3^{a}	13.3^{a}	12.8^{a}
S.Em.±	0.11	0.14	0.09	0.23	0.17	0.14
C.D at5%	0.32	0.40	0.25	0.66	0.49	0.41
Biopesticides sprays***						
S_1: Nimbecidine – GCK	4.7^{abc}	5.1^{bcd}	4.9^{bc}	11.5^{bc}	12.4^{cd}	11.9^{de}
S_2: Nimbecidine – Leaf extract	4.9^{abc}	5.2^{bc}	5.0^{bc}	11.5^{bc}	12.9^{bc}	12.2^{cd}
S_3: Nimbecidine - Panchgavya	5.1^{ab}	5.3^{abc}	5.2^{bc}	12.5^{b}	13.4^{bc}	12.9^{bc}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	5.3^{a}	5.5^{ab}	5.4^{ab}	13.0^{b}	14.0^{b}	13.5^{b}
S_5: Nimbecidine - Silica spray	4.2^{cde}	4.4^{c-f}	4.3^{de}	10.5^{cde}	11.2^{e}	10.8^{f}
S_6: Nimbecidine - Action 100 spray	4.2^{cde}	4.2^{def}	4.2^{de}	10.7^{cd}	11.3^{de}	11.0^{ef}
S_7: Abamectin (1.9 EC) - Perfect	5.5^{a}	6.2^{a}	5.8^{a}	14.7^{a}	15.7^{a}	15.2^{a}
S_8: Silica	3.8^{de}	4.1^{ef}	4.0^{ef}	9.5^{de}	10.7^{e}	10.1^{f}
S_9: RPP	4.5^{bcd}	5.0^{b-e}	4.7^{cd}	11.4^{bc}	12.7^{c}	12.1^{cd}
S_{10}: Control	3.5^{e}	3.8^{f}	3.6^{f}	9.0^{e}	8.9^{f}	8.9^{g}
S.Em.±	0.25	0.31	0.20	0.52	0.39	0.32
C.D at 5%	0.73	0.90	0.57	1.48	1.11	0.91
Interaction						
T_1S_1	4.3^{b-f}	4.8^{a-f}	4.6^{d-h}	10.6^{d-h}	11.6^{fg}	11.1^{ef}
T_1S_2	4.6^{a-e}	4.8^{a-f}	4.7^{c-g}	10.8^{d-g}	11.9^{efg}	11.4^{de}
T_1S_3	4.7^{a-e}	5.0^{a-f}	4.9^{b-f}	11.3^{c-g}	12.2^{def}	11.8^{cde}
T_1S_4	5.2^{ab}	5.2^{a-e}	5.2^{a-f}	12.3^{bcd}	12.8^{def}	12.6^{cd}
T_1S_5	3.6^{ef}	3.9^{def}	3.8^{ghi}	9.4^{bcd}	10.2^{gh}	9.8^{fg}
T_1S_6	3.7^{def}	3.7^{ef}	3.7^{hi}	9.3^{fgh}	9.8^{hi}	9.6^{gh}
T_1S_7	5.4^{ab}	6.1^{ab}	5.8^{ab}	14.1^{ab}	14.6^{bc}	14.3^{b}
T_1S_8	3.3^{f}	3.8^{ef}	3.5^{i}	8.9^{gh}	9.4^{hi}	9.1^{gh}
T_1S_9	3.9^{c-f}	4.6^{b-f}	4.3^{f-i}	10.2^{d-h}	11.7^{fg}	11.0^{ef}
T_1S_{10}	3.4^{f}	3.6^{f}	3.5^{i}	8.3^{h}	8.4^{i}	8.3^{h}
T_2S_1	5.2^{ab}	5.4^{a-d}	5.3^{a-e}	12.3^{bcd}	13.1^{c-f}	12.7^{cd}
T_2S_2	5.2^{ab}	5.5^{abc}	5.4^{a-d}	12.2^{bcd}	13.8^{bcd}	13.0^{bc}
T_2S_3	5.4^{ab}	5.6^{abc}	5.5^{a-d}	13.6^{abc}	14.6^{bc}	14.1^{b}
T_2S_4	5.4^{ab}	5.8^{abc}	5.6^{abc}	13.6^{abc}	15.2^{b}	14.4^{b}
T_2S_5	4.8^{a-d}	4.8^{a-f}	4.8^{c-f}	11.5^{c-f}	12.1^{def}	11.8^{cde}
T_2S_6	4.6^{a-e}	4.6^{b-f}	4.6^{d-h}	12.1^{b-e}	12.8^{def}	12.4^{cde}
T_2S_7	5.6^{a}	6.2^{a}	5.9^{a}	15.3^{a}	16.8^{a}	16.1^{a}
T_2S_8	4.4^{a-e}	4.4^{c-f}	4.4^{e-i}	10.2^{d-h}	11.9^{efg}	11.1^{ef}
T_2S_9	5.1^{abc}	5.4^{a-d}	5.2^{a-f}	12.5^{bcd}	13.6^{b-e}	13.1^{bc}
T_2S_{10}	3.6^{ef}	3.9^{def}	3.8^{ghi}	9.7^{e-h}	9.3^{hi}	9.5^{gh}
S.Em.±	0.36	0.44	0.29	0.73	0.54	0.45
C.D at 5%	1.03	1.28	0.80	2.09	1.56	1.28
C.V. (%)	13.6	15.9	14.8	11.1	7.7	9.4

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 61. Dry matter production hill^{-1} (g) at 90 DAT and at final picking as influenced by different sources of nutrition and biopesticides spray

Treatments	90 DAT			At final picking		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	22.3^{b}	26.5^{b}	24.4^{b}	40.3^{b}	42.7^{b}	41.5^{b}
T_2:50:50:50 kg NPK ha^{-1} + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	25.4^{a}	30.8^{a}	28.2^{a}	45.9^{a}	51.3^{a}	48.6^{a}
S.Em.±	0.65	0.58	0.43	0.69	0.83	0.54
C.D at5%	1.86	1.66	1.23	1.98	2.38	1.52
Biopesticides sprays***						
S_1: Nimbecidine – GCK	24.5^{bc}	28.4^{cde}	26.4^{c}	43.0^{bc}	46.5^{c}	44.7^{def}
S_2: Nimbecidine – Leaf extract	25.2^{bc}	28.6^{b-e}	26.9^{bc}	45.1^{b}	50.6^{b}	47.8^{bcd}
S_3: Nimbecidine - Panchgavya	26.0^{b}	30.4^{bc}	28.2^{bc}	45.8^{b}	51.3^{h}	48.5^{bc}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	26.9^{b}	32.6^{b}	29.7^{b}	47.5^{b}	52.3^{h}	49.9^{b}
S_5: Nimbecidine - Silica spray	20.6^{cd}	26.7^{c-f}	23.6^{d}	39.9^{cd}	44.4^{cd}	42.2^{efg}
S_6: Nimbecidine - Action 100 spray	21.1^{cd}	25.6^{def}	23.4^{d}	39.1^{cd}	43.4^{cd}	41.2^{fg}
S_7: Abamectin (1.9 EC) - Perfect	31.2^{a}	36.6^{a}	33.9^{a}	53.4^{a}	58.5^{a}	55.9^{a}
S_8: Silica	20.7^{cd}	24.7^{ef}	22.7^{de}	38.6^{cd}	39.4^{de}	39.0^{gh}
S_9: RPP	25.0^{bc}	29.6^{bcd}	27.3^{bc}	43.5^{bc}	46.9^{bc}	45.2^{cde}
S_{10}: Control	17.4^{d}	23.4^{f}	20.4^{e}	35.5^{d}	36.8^{c}	36.2^{h}
S.Em.±	1.45	1.30	0.97	1.55	1.86	1.21
C.D at 5%	4.16	3.72	2.74	4.43	5.32	3.41
Interaction						
T_1S_1	22.6^{b-e}	25.7^{e-h}	24.2^{def}	39.8^{fgh}	40.4^{g-j}	40.1^{efg}
T_1S_2	22.8^{b-e}	26.1^{e-h}	24.4^{def}	42.3^{d-g}	45.6^{e-l}	43.9^{cde}
T_1S_3	23.1^{b-e}	26.5^{e-h}	24.8^{def}	43.1^{b-g}	46.0^{e-h}	44.5^{cde}
T_1S_4	24.6^{b-e}	30.4^{d-g}	27.5^{cde}	44.6^{b-f}	46.8^{d-h}	45.7^{cd}
T_1S_5	20.3^{def}	24.9^{fgh}	22.6^{fg}	36.9^{gh}	38.9^{hij}	37.9^{fg}
T_1S_6	20.8^{c-f}	23.6^{h}	22.2^{fg}	36.4^{gh}	38.2^{hij}	37.3^{fg}
T_1S_7	29.2^{ab}	35.6^{ab}	32.4^{ab}	50.0^{bc}	55.0^{a-d}	52.5^{b}
T_1S_8	20.4^{def}	23.2^{f}	21.8^{fg}	36.1^{gh}	37.3^{ij}	36.7^{fg}
T_1S_9	23.4^{b-e}	26.5^{e-h}	24.9^{def}	39.6^{fgh}	42.4^{f-j}	41.0^{def}
T_1S_{10}	15.5^{f}	22.6^{h}	19.1^{g}	34.2^{h}	36.3^{j}	35.3^{g}
T_2S_1	26.3^{bcd}	31.0^{b-e}	28.7^{bcd}	46.2^{b-f}	52.3^{b-e}	49.4^{bc}
T_2S_2	27.6^{abc}	31.2^{c-e}	29.4^{bc}	47.8^{b-e}	55.7^{abc}	51.8^{b}
T_2S_3	28.9^{ab}	34.2^{abc}	31.6^{abc}	48.4^{bcd}	56.6^{abc}	52.5^{b}
T_2S_4	29.2^{ab}	34.7^{ab}	32.0^{abc}	50.3^{b}	57.7^{ab}	54.0^{b}
T_2S_5	20.8^{c-f}	28.5^{c-h}	24.7^{def}	42.9^{c-g}	49.9^{b-f}	46.4^{cd}
T_2S_6	21.4^{c-f}	27.6^{d-h}	24.5^{def}	41.7^{d-g}	48.7^{c-g}	45.2^{cde}
T_2S_7	33.4^{a}	37.6^{a}	35.4^{a}	56.8^{a}	61.9^{a}	59.4^{a}
T_2S_8	21.0^{c-f}	26.1^{e-h}	23.6^{ef}	41.0^{e-h}	41.4^{f-j}	41.2^{def}
T_2S_9	26.6^{a-d}	32.8^{a-d}	29.7^{bc}	47.3^{b-e}	51.3^{b-e}	49.3^{bc}
T_2S_{10}	19.3^{ef}	24.3^{gh}	21.8^{fg}	36.8^{gh}	37.3^{ij}	37.1^{fg}
S.Em.±	2.05	1.83	1.38	2.19	2.63	1.71
C.D at 5%	5.88	5.23	3.88	6.27	7.53	4.82
C.V. (%)	14.9	11.1	12.8	8.8	9.7	9.3

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

35.4 and 59.4 g at 30, 60 and 90 DAT and at harvest, respectively). While, significantly lower dry matter production was recorded with chilli crop supplied with only inorganic nitrogen and receiving no sprays for sucking pest control (T_1S_{10}) (3.5, 8.3, 19.1 and 35.3 g at 30, 60 and 90 DAT and at harvest, respectively) compared to other treatment combinations intermediate.

4.3.2 Yield parameters

4.3.2.1 Number of fruit (no.hill^{-1})

The data revealed significant differences in fruits per plant due to sources of nitrogen, biopesticide sprays and their interactions (Table 62).

Among the sources of nitrogen, integrated nitrogen management equally through organic and inorganic sources resulted in significantly higher number of fruits per plant (32.5) compared to only inorganic sources of nitrogen (29.2).

Among the biopesticide sprays, alternate sprays of Abamectin and Perfect (S_7) recorded the highest number of fruits per hill (43.1). Nimbecidine alternated with GCK extract, leaf extract, leaf extract + panchagavya and silica spray were next in the order and were comparable to RPP (S_9), while no spray (S_{10}) recorded the lowest number of fruits per hill (12.4).

Interaction effects revealed the highest number of fruits hill^{-1} with combined sources of N coupled with alternate spray of Abamectin and Perfect (T_2S_7), among the treatment combinations (45.7 plant^{-1}). T_1S_7 was next in the order, while the lowest number of fruits was recorded with no chemical sprays irrespective of sources of N nutrition (T_1S_{10} and T_2S_{10}).

4.3.2.2 Fruit length (cm)

The variations in fruit length as influenced by sources of nitrogen, biorational sprays and their interaction were significant (Table 62).

Among the sources of nitrogen applied to chilli crop, N supply equally through organic and inorganic sources recorded the highest fruit length (10.3 cm). Of all the biopesticides alternate spray of Abamectin and Perfect (S_7) recorded the highest fruit length (10.9 cm). Only silica application and nimbecidine alternated with other biorational except silica and Action 100 were next in the order and were comparable statistically to RPP. While, the lowest (9.3 cm) fruit length was recorded when no spray was undertaken.

Among the treatment combinations, integrated nitrogen supply through organic and inorganic sources of nitrogen coupled with Abamectin and Perfect spray schedule (T_2S_7) recorded significantly higher fruit length (11.2 cm). While, chilli nutritioned with RDF sprayed with Abamectin and Perfect (T_1S_7) and T_2S_4 were on par (10.7 and 10.6 cm, respectively). On the other hand, no chemical spray for the sucking pests irrespective of the nitrogen sources (T_1S_{10} and T_2S_{10}) recorded significantly lower fruit length (9.0 and 9.5 cm, respectively).

4.3.2.3 100-fruit weight (g)

The influences due to N sources and pesticide spray and their interaction were significant with regard to 100-fruit weight (Table 63).

Supply of nitrogen equally through organic and inorganic sources recorded the highest fruit weight (102.6 g). While, in the biopesticide sprays, alternate sprays of Abamectin and Perfect (S_7) recorded highest fruit weight (114.2 g). Nimbecidine sprays alternated with other biopesticides except GCK, silica and Action 100 were next in the order and were comparable to RPP and infact S_4 was superior to the recommended practice. Significantly lower 100-fruit weight was observed in no spray treatment (87.5 g) followed by silica applied treatment.

Among treatment combinations, significantly higher fruit weight (118.0 g) was obtained with Abamectin alternated with Perfect spray to chilli receiving N equally through organic and inorganic sources (T_2S_7). Among the other treatment combinations, similar spray schedule to chilli receiving N entirely through inorganic was at par, while significantly lower fruit weight (85.5 g) was obtained with inorganic nitrogen + no spray (T_1S_{10}).

Table 62. Number of fruits hill^{-1} and fruit length (cm) as influenced by different sources of nutrition and biopesticides spray

Treatments	Number of fruits hill^{-1}			Fruit length (cm)		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	28.0^{b}	30.5^{b}	29.2^{b}	8.40^{b}	11.4^{b}	9.90^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	31.7^{a}	33.2^{a}	32.5^{a}	8.80^{a}	11.8^{a}	10.3^{a}
S.Em.±	0.73	0.61	0.47	0.10	0.11	0.07
C.D at5%	2.08	1.75	1.34	0.28	0.32	0.21
Biopesticides sprays***						
S_1: Nimbecidine – GCK	31.6^{bc}	34.9^{b}	33.3^{bc}	8.60^{b}	11.8^{ab}	10.2^{bc}
S_2: Nimbecidine – Leaf extract	34.8^{b}	35.8^{b}	35.3^{bc}	8.70^{b}	11.9^{ab}	10.3^{bc}
S_3: Nimbecidine - Panchgavya	31.3^{bc}	33.7^{b}	32.5^{c}	8.80^{ab}	11.7^{abc}	10.3^{bc}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	35.4^{b}	36.9^{b}	36.2^{b}	8.80^{ab}	11.9^{ab}	10.4^{b}
S_5: Nimbecidine - Silica spray	27.0^{cd}	28.3^{c}	27.7^{d}	8.50^{b}	11.1^{bc}	9.8^{cd}
S_6: Nimbecidine - Action 100 spray	24.5^{d}	25.7^{c}	25.1^{d}	8.50^{b}	11.1^{bc}	9.8^{cd}
S_7: Abamectin (1.9 EC) - Perfect	40.5^{a}	45.6^{a}	43.1^{a}	9.40^{a}	12.5^{a}	10.9^{a}
S_8: Silica	27.0^{cd}	27.8^{c}	27.4^{d}	8.30^{bc}	11.4^{bc}	9.8^{cd}
S_9: RPP	34.5^{b}	36.5^{b}	35.5^{bc}	8.70^{b}	11.6^{bc}	10.1^{bc}
S_{10}: Control	11.9^{e}	12.8^{d}	12.4^{e}	7.70^{c}	10.9^{c}	9.3^{d}
S.Em.±	1.62	1.36	1.06	0.22	0.25	0.17
C.D at 5%	4.66	3.91	3.00	0.62	0.72	0.47
Interaction						
T_1S_1	29.2^{def}	33.1^{c-f}	31.1^{ef}	8.40^{bc}	11.6^{abc}	10.0^{b-f}
T_1S_2	32.6^{bcd}	33.9^{cde}	33.3^{de}	8.60^{abc}	11.7^{abc}	10.2^{b-f}
T_1S_3	30.6^{b-e}	34.2^{cde}	32.4^{e}	8.70^{abc}	11.6^{abc}	10.2^{b-f}
T_1S_4	32.8^{bcd}	35.4^{cd}	34.1^{cde}	8.60^{abc}	11.8^{abc}	10.2^{b-f}
T_1S_5	24.0^{ef}	25.7^{gh}	24.8^{g}	8.30^{bc}	11.0^{bc}	9.6^{efg}
T_1S_6	22.0^{f}	24.1^{h}	23.0^{g}	8.40^{bc}	11.0^{bc}	9.7^{d-g}
T_1S_7	38.0^{ab}	42.9^{ab}	40.5^{b}	9.20^{ab}	12.1^{ab}	10.7^{ab}
T_1S_8	27.0^{def}	28.2^{e-h}	27.6^{fg}	8.10^{cd}	10.9^{bc}	9.5^{fg}
T_1S_9	32.0^{bcd}	35.1^{cd}	33.6^{cde}	8.50^{abc}	11.3^{bc}	9.9^{c-f}
T_1S_{10}	11.4^{g}	12.0^{i}	11.7^{h}	7.30^{d}	10.8^{c}	9.0^{g}
T_2S_1	34.0^{bcd}	36.8^{bcd}	34.5^{cde}	8.80^{abc}	12.0^{abc}	10.4^{bcd}
T_2S_2	38.0^{ab}	37.6^{bc}	37.3^{bcd}	8.70^{abc}	12.0^{abc}	10.4^{bcd}
T_2S_3	32.0^{bcd}	33.3^{c-f}	32.6^{de}	8.90^{abc}	11.9^{abc}	10.4^{bcd}
T_2S_4	38.0^{ab}	38.4^{bc}	38.2^{bc}	9.00^{abc}	12.1^{abc}	10.6^{abc}
T_2S_5	30.0^{cde}	31.0^{d-g}	30.5^{ef}	8.60^{abc}	11.2^{bc}	9.9^{c-f}
T_2S_6	27.0^{def}	27.4^{fgh}	27.2^{fg}	8.60^{abc}	11.3^{bc}	10.0^{b-f}
T_2S_7	43.0^{a}	48.3^{a}	45.7^{a}	9.50^{a}	12.8^{a}	11.2^{a}
T_2S_8	27.0^{def}	27.4^{fgh}	27.2^{fg}	8.50^{abc}	11.8^{abc}	10.2^{b-f}
T_2S_9	37.0^{abc}	37.8^{bc}	37.4^{bcd}	8.80^{abc}	11.8^{abc}	10.3^{b-e}
T_2S_{10}	12.4^{g}	13.6^{i}	13.0^{h}	8.10^{cd}	10.9^{bc}	9.5^{fg}
S.Em.±	2.30	1.93	1.50	0.31	0.36	0.24
C.D at 5%	6.59	5.53	4.23	0.87	1.02	0.66
C.V. (%)	13.3	10.5	11.9	6.2	5.3	5.7

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively

Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 63. 100-fruit weight (g) and 1000-seed weight (g) as influenced by different sources of nutrition and biopesticides spray

Treatments	100-fruit weight (g)			1000-seed weight (g)		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	96.6^{b}	98.0^{b}	97.7^{b}	6.28^{b}	6.42^{b}	6.35^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	101.2^{a}	104.0^{a}	102.6^{a}	6.70^{a}	7.56^{a}	7.03^{a}
S.Em.±	1.30	1.25	0.90	0.08	0.01	0.06
C.D at5%	3.73	3.59	2.55	0.24	0.03	0.18
Biopesticides sprays***						
S_1: Nimbecidine – GCK	98.0^{bc}	101.5^{bcd}	99.8^{cd}	6.37^{cde}	6.90^{bc}	6.63^{c}
S_2: Nimbecidine – Leaf extract	101.5^{bc}	105.8^{bc}	103.7^{bc}	6.45^{cd}	7.10^{b}	6.75^{c}
S_3: Nimbecidine - Panchgavya	104.0^{ab}	106.8^{bc}	105.5^{bc}	6.62^{bc}	7.20^{b}	6.90^{bc}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	104.5^{ab}	108.5^{b}	106.5^{b}	7.07^{b}	7.50^{b}	7.27^{b}
S_5: Nimbecidine - Silica spray	95.8^{bc}	96.5^{def}	96.2^{de}	5.97^{def}	6.30^{cd}	6.13^{d}
S_6: Nimbecidine - Action 100 spray	96.5^{bc}	96.5^{def}	96.5^{de}	6.00^{def}	6.40^{cd}	6.18^{d}
S_7: Abamectin (1.9 EC) - Perfect	110.5^{a}	117.8^{a}	114.2^{a}	8.25^{a}	8.40^{a}	8.31^{a}
S_8: Silica	91.5^{cd}	92.5^{ef}	92.0^{ef}	5.85^{ef}	6.20^{d}	6.03^{d}
S_9: RPP	100.0^{bc}	99.5^{cde}	99.8^{cd}	6.70^{bc}	7.20^{b}	6.95^{bc}
S_{10}: Control	86.5^{d}	88.5^{f}	87.5^{f}	5.65^{f}	5.90^{d}	5.76^{d}
S.Em.±	2.91	2.80	2.02	0.18	0.22	0.14
C.D at 5%	8.35	8.03	5.70	0.53	0.63	0.40
Interaction						
T_1S_1	96.0^{b-e}	99.0^{b-g}	97.5^{d-h}	6.33^{c-h}	6.40^{d-h}	6.37^{fg}
T_1S_2	99.0^{bcd}	105.0^{b-f}	102.0^{b-g}	6.40^{c-g}	6.70^{c-g}	6.55^{efg}
T_1S_3	102.0^{a-d}	106.0^{b-f}	104.0^{b-e}	6.57^{c-f}	6.70^{c-g}	6.67^{d-g}
T_1S_4	103.0^{a-d}	107.0^{bcd}	105.0^{b-e}	6.93^{bcd}	7.10^{b-e}	7.02^{c-f}
T_1S_5	93.0^{cde}	95.0^{d-g}	94.0^{ghi}	5.67^{ghi}	5.70^{gh}	5.70^{h}
T_1S_6	94.0^{b-e}	93.0^{fg}	93.5^{ghi}	5.70^{f-i}	5.80^{fgh}	5.73^{h}
T_1S_7	108.0^{ab}	112.0^{b}	110.0^{ab}	7.70^{b}	7.80^{b}	7.75^{b}
T_1S_8	89.0^{de}	90.0^{g}	89.5^{hi}	5.50^{hi}	5.60^{h}	5.55^{h}
T_1S_9	98.0^{bcd}	94.0^{efg}	96.0^{e-h}	6.60^{cde}	6.70^{c-g}	6.65^{d-g}
T_1S_{10}	84.0^{e}	87.0^{g}	85.5^{i}	5.40^{i}	5.60^{h}	5.5^{h}
T_2S_1	100.0^{a-d}	104.0^{b-f}	102.0^{b-g}	6.40^{c-g}	7.40^{bcd}	6.90^{c-f}
T_2S_2	104.0^{abc}	106.7^{b-f}	105.0^{b-e}	6.50^{c-g}	7.40^{bcd}	6.95^{c-f}
T_2S_3	106.0^{abc}	107.7^{bcd}	107.0^{bcd}	6.67^{cde}	7.60^{bc}	7.13^{b-e}
T_2S_4	106.0^{abc}	110.0^{bc}	108.0^{bcd}	7.20^{bc}	7.80^{b}	7.52^{bc}
T_2S_5	98.7^{bcd}	98.0^{c-g}	98.0^{d-h}	6.23^{d-i}	6.80^{b-f}	6.55^{efg}
T_2S_6	99.0^{bcd}	100.0^{b-g}	99.5^{c-g}	6.30^{d-h}	6.90^{b-e}	6.62^{d-g}
T_2S_7	113.0^{a}	123.7^{a}	118.0^{a}	8.80^{a}	8.90^{a}	8.87^{a}
T_2S_8	94.0^{b-e}	95.0^{d-g}	94.5^{f-i}	6.20^{d-l}	6.80^{b-f}	6.52^{efg}
T_2S_9	102.0^{a-d}	105.0^{b-f}	103.5^{b-f}	6.80^{cd}	7.70^{bc}	7.25^{bcd}
T_2S_{10}	89.0^{de}	90.0^{g}	89.5^{hi}	5.90^{e-i}	6.10^{e-h}	6.02^{gh}
S.Em.±	4.12	3.96	2.86	0.26	0.31	0.20
C.D at 5%	11.80	11.35	8.06	0.75	0.89	0.57
C.V. (%)	7.2	6.8	7.0	7.00	7.8	7.4

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

4.3.2.4 1000-seed weight (g)

The variations in 1000-seed weight due to sources of nitrogen, biorational sprays and their interactions were significant (Table 63).

Among the source of nitrogen, integrated N supply recorded the highest 1000-seed weight (7.03). While, in the biopesticide sprays, alternate sprays of Abamectin and Perfect (S_7) recorded highest 1000 seed weight (8.31g). Nimbecidine alternated with panchagavya (S_3) or leaf extract + panchagavya (S_4) was next in order and were on par with the recommended chemical spray. While, no spray recorded significantly lower 1000-seed weight (5.76 g).

The interaction effects revealed that chilli crop nutritioned with equal proportion of organic and inorganic sources of nitrogen combined with Abamectin and Perfect spray alternatively (T_2S_7) recorded the highest 1000-seed weight (8.87 g). T_2S_3, T_2S_4 and T_2S_9 were next in the order, while significantly lower 1000-seed weight (5.5 g) was recorded with chilli supplied with only inorganic source of nitrogen and without any chemical spray (T_1S_{10}).

4.3.2.5 Seed to pod ratio

The variations in seed to pod ratio as influenced by sources of nitrogen, biopesticide sprays and their interaction were significant (Table 64).

Among sources of N, combination of both organic and inorganic sources resulted in highest seed to pod ratio (38.4).

Among the biopesticides averaged over nitrogen treatment, alternate spray of Abamectin and Perfect (S_7) recorded higher seed to pod ratio (43.4) followed by nimbecidine alternated with leaf extract + panchagavya. The latter treatment was also on par with recommended practice, while seed to pod ratio was the lowest when no spray was scheduled (27.5).

Among the treatment combinations, chilli nutritioned with 50 per cent each of organic and inorganic N sources and sprayed with Abamectin and Perfect (T_2S_7) resulted in significantly higher seed to pod ratio (44.7). On the other hand, the lowest seed to pod ratio was recorded with inorganic source of N applied without any sprays (25.9)

4.3.2.6 Dry fruit yield (kg ha^{-1})

Chilli yield differed significantly due to sources of nitrogen, biopesticides and their interaction (Table 65).

Of the two-nitrogen treatments the highest yield was recorded with 50 per cent N substitution through organics (795 kg ha^{-1}). Among the spray schedules alternate spray of Abamectin and Perfect (S_7) recorded the highest chilli yield (1050 kg ha^{-1}). Nimbecidine sprays alternated with other biopesticides except silica and Action 100 were next in the order and were on par with recommended plant protection practices. The lowest chilli yield was obtained when chilli was not protected against the sucking pests (479 kg ha^{-1}).

Among treatment combinations, chilli nutritioned with both organic and inorganic sources in equal proportion coupled with Abamectin and Perfect spray the alternatively (T_2S_7) recorded the highest chilli yield (1131 kg ha^{-1}). Chilli receiving entire N in the inorganic form and sprayed alternatively with Abamectin and Perfect (T_1S_7) recorded the next higher yield (969 kg ha^{-1}) and both the treatments were superior to recommended pesticide spray schedule irrespective of nitrogen sources, while lowest yield was recorded with T_1S_{10} treatment combination (428 kg ha^{-1}) (Fig.12).

4.3.3 Entomological observations

4.3.3.1 Thrips population (no. $leaf^{-1}$)

Thrips population varied significantly due to sources of nitrogen, biopesticide sprays and their interaction (Table 66, 67, 68, 69 and 70).

Population of thrips before first spray (3 WAT) varied significantly due to sources of nitrogen. Integrated supply of nitrogen through vermicompost and neem cake besides

Table 64. Seed to pod ratio as influenced by different sources of nutrition and biopesticides spray

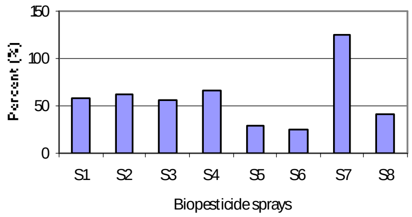
Treatments	Seed to pod ratio		
	2005-06	2006-07	Pooled
Sources of nitrogen			
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	34.1[b]	36.1[b]	35.1[b]
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	37.3[a]	39.5[a]	38.4[a]
S.Em.±	0.71	0.68	0.49
C.D at5%	2.03	1.96	1.39
Biopesticides sprays***			
S_1: Nimbecidine – GCK	36.1[bc]	38.7[bcd]	37.4[bcd]
S_2: Nimbecidine – Leaf extract	37.0[abc]	39.7[bc]	38.4[b]
S_3: Nimbecidine - Panchgavya	37.8[abc]	40.7[ab]	39.3[b]
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	39.3[ab]	42.2[ab]	40.7[ab]
S_5: Nimbecidine - Silica spray	32.9[c]	35.1[cd]	33.9[e]
S_6: Nimbecidine - Action 100 spray	34.2[bc]	34.3[d]	34.3[de]
S_7: Abamectin (1.9 EC) - Perfect	42.0[a]	44.7[a]	43.4[a]
S_8: Silica	33.9[c]	35.4[bcd]	34.7[cde]
S_9: RPP	37.3[abc]	38.4[bcd]	37.8[bc]
S_{10}: Control	26.6[d]	28.4[e]	27.5[f]
S.Em.±	1.58	1.53	1.10
C.D at 5%	4.54	4.38	3.10
Interaction			
T_1S_1	34.4[b-e]	36.2[c-g]	35.3[d-g]
T_1S_2	35.8[b-e]	37.6[b-f]	36.7[c-g]
T_1S_3	36.8[a-d]	39.8[a-f]	38.3[b-f]
T_1S_4	38.2[a-d]	40.4[a-f]	39.3[b-f]
T_1S_5	31.3[def]	33.9[e-h]	32.6[gh]
T_1S_6	32.8[b-e]	34.2[e-g]	33.5[fgh]
T_1S_7	40.2[ab]	43.8[ab]	42.0[ab]
T_1S_8	31.8[cde]	33.2[fgh]	32.5[gh]
T_1S_9	35.4[b-e]	34.4[d-g]	34.9[efg]
T_1S_{10}	24.6[f]	27.3[h]	25.9[i]
T_2S_1	37.8[a-d]	41.2[a-e]	39.5[b-e]
T_2S_2	38.2[a-d]	41.8[abc]	40.0[a-e]
T_2S_3	38.8[a-d]	41.6[a-d]	40.2[a-d]
T_2S_4	40.4[ab]	43.9[ab]	42.2[ab]
T_2S_5	34.4[b-e]	36.3[c-g]	35.4[d-g]
T_2S_6	35.9[b-e]	34.5[d-g]	35.2[d-g]
T_2S_7	43.8[a]	45.6[a]	44.7[a]
T_2S_8	36.1[b-e]	37.7[b-f]	36.9[c-g]
T_2S_9	39.1[abc]	42.4[abc]	40.8[abc]
T_2S_{10}	28.6[ef]	29.6[gh]	29.1[hi]
S.Em.±	2.24	2.16	1.56
C.D at 5%	6.43	6.20	4.39
C.V. (%)	10.9	9.9	10.4

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

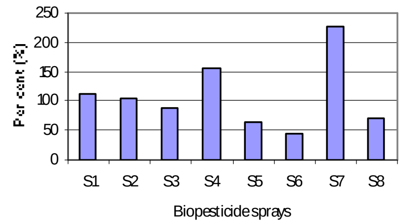
Table 65. Dry pod yield (kg ha^{-1}) as influenced by different sources of nutrition and biopesticides spray

Treatments	Dry pod yield (kg ha^{-1})		
	2005-06	2006-07	Pooled
Sources of nitrogen			
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	550^{b}	759^{b}	654^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	693^{a}	896^{a}	795^{a}
S.Em.±	10.9	14.1	8.9
C.D at5%	31.2	40.5	79.5
Biopesticides sprays***			
S_1: Nimbecidine – GCK	628^{bc}	872^{b}	750^{b}
S_2: Nimbecidine – Leaf extract	646^{bc}	890^{b}	768^{b}
S_3: Nimbecidine - Panchgavya	627^{bc}	855^{b}	741^{b}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	670^{b}	894^{b}	782^{b}
S_5: Nimbecidine - Silica spray	525^{d}	745^{c}	636^{c}
S_6: Nimbecidine – Action 100 spray	511^{d}	718^{c}	614^{c}
S_7: Abamectin (1.9 EC) - Perfect	1002^{a}	1098^{a}	1050^{a}
S_8: Silica	574^{cd}	757^{c}	665^{c}
S_9: RPP	651^{bc}	864^{b}	758^{b}
S_{10}: Control	383^{e}	577^{d}	479^{d}
S.Em.±	24.3	31.6	19.9
C.D at 5%	69.7	90.7	56.2
Interaction			
T_1S_1	550^{efg}	803^{d-g}	677^{de}
T_1S_2	561^{ef}	829^{c-f}	695^{d}
T_1S_3	543^{efg}	793^{efg}	668^{de}
T_1S_4	591^{ef}	832^{c-f}	712^{d}
T_1S_5	448^{ghi}	669^{gh}	558^{f}
T_1S_6	431^{hi}	646^{h}	538^{f}
T_1S_7	925^{b}	1012^{b}	969^{b}
T_1S_8	511^{fgh}	697^{fgh}	604^{ef}
T_1S_9	589^{ef}	797^{efg}	693^{d}
T_1S_{10}	348^{i}	507^{i}	428^{g}
T_2S_1	705^{cd}	941^{b-e}	823^{c}
T_2S_2	731^{cd}	951^{bcd}	841^{c}
T_2S_3	711^{cd}	916^{b-e}	814^{c}
T_2S_4	749^{c}	956^{bc}	853^{c}
T_2S_5	601^{ef}	827^{c-f}	714^{d}
T_2S_6	590^{ef}	791^{efg}	691^{d}
T_2S_7	1077^{a}	1184^{a}	1131^{a}
T_2S_8	637^{de}	816^{c-f}	724^{d}
T_2S_9	713^{cd}	931^{b-e}	822^{c}
T_2S_{10}	418^{hi}	644^{h}	532^{f}
S.Em.±	34.4	44.7	28.2
C.D at 5%	98.5	128.2	79.5
C.V. (%)	9.6	9.4	9.5

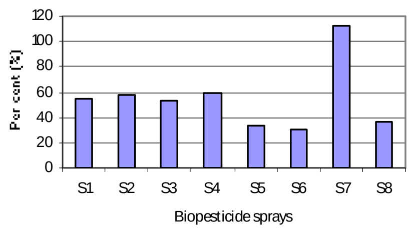
* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)



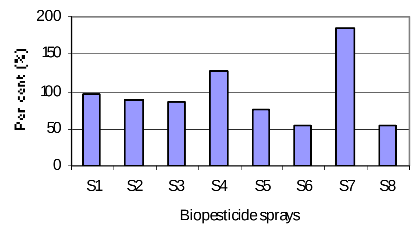
A. Increase in fruit yield under RDN as infuenced by different biopesticides sprays over control



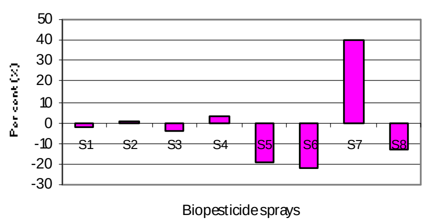
E. Increase in oleoresin yield over control as influenced by different biopesticides sprays under RDN



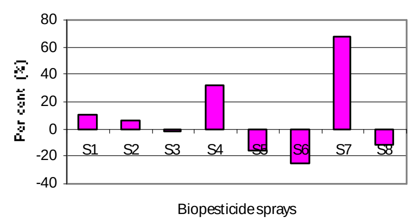
B. Increse in fruit yield under integrated N supply as infuenced by different biopesticide sprays over control



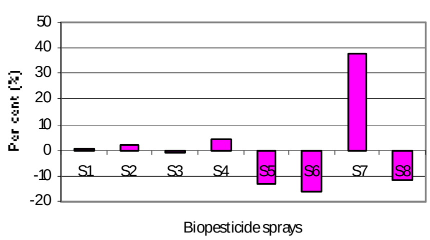
F. Increase in oleoresin yield over control as influenced by different biopesticide sprays under integrated N supply



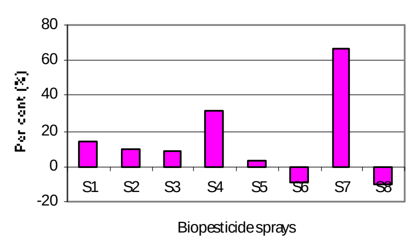
C. Increase/decrease in fruit yield under RDN as influenced by different biopesticide sprays over RPP



G. Per cent increase oleoresin yield of RDN nutrioned chilli as influenced by different biopesticide sprays over RPP



D. Increase/decrease in fruit yield under integrated N supply as infuenced by biopesticide sprays over RPP



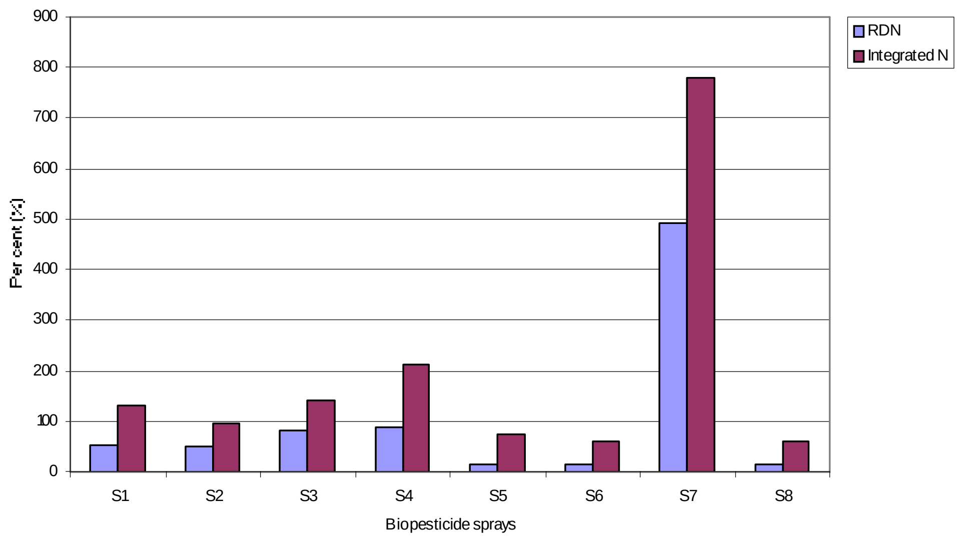
H. Per cent increase in oleoresin yield of integrated N supply as influenced by different biopesticide sprays over RPP

LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

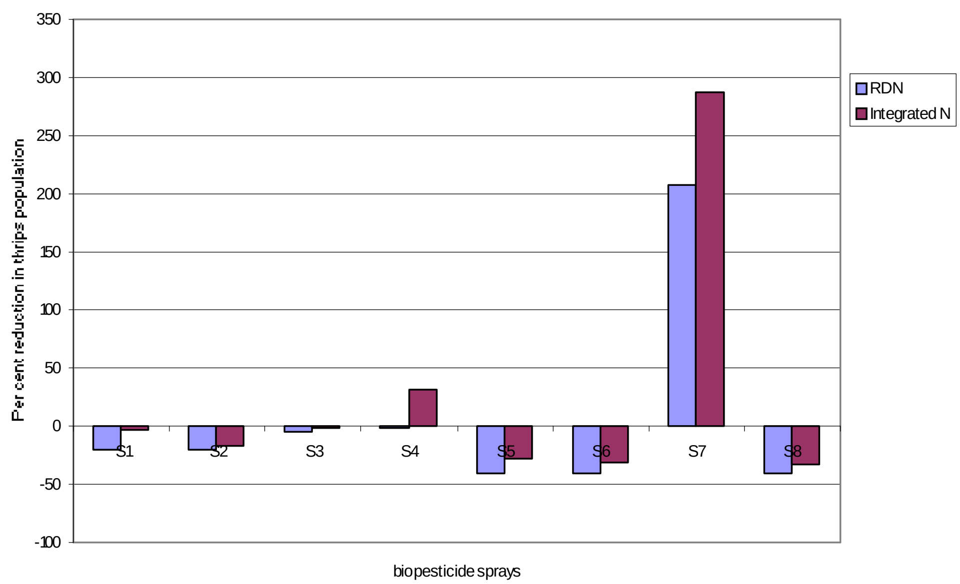
Fig.12: Percent increase in fruits yield and oleoresin yield of chilli over control(no spray)and RPP (Recommended plant protection) treatments as influenced by different biopesticide sprays

Table 66. Thrips population (no. leaf^{-1}) before first spray (3 WAT) and after 1 week of first spray (4 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before first spray			After 1 week of first spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	1.48^{a} (1.57)	0.87^{a} (1.37)	1.18^{a} (1.47)	1.02^{a} (1.42)	0.84^{a} (1.36)	0.93^{a} (1.39)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	1.23^{b} (1.49)	0.67^{b} (1.29)	0.93^{b} (1.39)	0.72^{b} (1.31)	0.63^{b} (1.28)	0.68^{b} (1.29)
S.Em.±	0.03	0.04	0.02	0.03	0.03	0.02
C.D at5%	0.08	0.12	0.05	0.09	0.07	0.06
Biopesticides sprays***						
S_1: Nimbecidine – GCK	1.52^{a} (1.59)	0.73^{a} (1.32)	1.10^{a} (1.45)	0.82^{b} (1.35)	0.67^{abc} (1.29)	0.75^{bc} (1.32)
S_2: Nimbecidine – Leaf extract	1.35^{a} (1.53)	0.77^{a} (1.33)	1.05^{a} (1.43)	0.87^{b} (1.37)	0.75^{abc} (1.32)	0.81^{bc} (1.34)
S_3: Nimbecidine - Panchgavya	1.27^{a} (1.51)	0.77^{a} (1.33)	1.02^{a} (1.42)	0.72^{bc} (1.31)	0.58^{bc} (1.26)	0.65^{c} (1.28)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	1.30^{a} (1.52)	0.80^{a} (1.34)	1.05^{a} (1.43)	0.67^{bc} (1.29)	0.52^{c} (1.23)	0.60^{c} (1.26)
S_5: Nimbecidine - Silica spray	1.37^{a} (1.54)	0.77^{a} (1.33)	1.08^{a} (1.44)	1.02^{b} (1.42)	1.02^{ab} (1.42)	1.02^{ab} (1.42)
S_6: Nimbecidine - Action 100 spray	1.37^{a} (1.54)	0.82^{a} (1.35)	1.10^{a} (1.45)	1.06^{ab} (1.44)	1.00^{abc} (1.41)	1.03^{ab} (1.43)
S_7: Abamectin (1.9 EC) - Perfect	1.30^{a} (1.52)	0.77^{a} (1.33)	1.02^{a} (1.42)	0.25^{c} (1.12)	0.12^{d} (1.06)	0.20^{d} (1.10)
S_8: Silica	1.35^{a} (1.53)	0.80^{a} (1.34)	1.05^{a} (1.43)	1.10^{ab} (1.45)	1.02^{ab} (1.42)	1.06^{ab} (1.43)
S_9: RPP	1.25^{a} (1.50)	0.80^{a} (1.34)	1.02^{a} (1.42)	0.62^{bc} (1.27)	0.67^{abc} (1.29)	0.65^{c} (1.28)
S_{10}: Control	1.40^{a} (1.53)	0.80^{a} (1.34)	1.05^{a} (1.43)	1.68^{a} (1.64)	1.10^{a} (1.45)	1.39^{a} (1.54)
S.Em.±	0.06	0.04	0.04	0.07	0.06	0.04
C.D at 5%	NS	NS	NS	0.20	0.16	0.13
Interaction						
T_1S_1	1.73^{a} (1.65)	0.88^{a} (1.37)	1.30^{a} (1.51)	1.00^{a-d} (1.41)	0.83^{ab} (1.35)	0.92^{a-d} (1.38)
T_1S_2	1.47^{a} (1.56)	0.88^{a} (1.36)	1.17^{a} (1.47)	1.00^{a-d} (1.41)	0.85^{ab} (1.36)	0.94^{a-d} (1.39)
T_1S_3	1.37^{a} (1.54)	0.87^{a} (1.37)	1.10^{a} (1.45)	0.88^{a-d} (1.37)	0.67^{a-d} (1.29)	0.78^{b-e} (1.33)
T_1S_4	1.47^{a} (1.56)	0.93^{a} (1.39)	1.20^{a} (1.48)	0.82^{a-d} (1.35)	0.67^{a-d} (1.29)	0.75^{cde} (1.32)
T_1S_5	1.56^{a} (1.59)	0.90^{a} (1.38)	1.20^{a} (1.48)	1.28^{abc} (1.51)	1.16^{a} (1.47)	1.23^{a-d} (1.49)
T_1S_6	1.47^{a} (1.57)	0.95^{a} (1.40)	1.22^{a} (1.49)	1.28^{abc} (1.51)	1.22^{a} (1.49)	1.25^{abc} (1.50)
T_1S_7	1.40^{a} (1.54)	0.83^{a} (1.35)	1.10^{a} (1.45)	0.32^{d} (1.15)	0.16^{cd} (1.08)	0.24^{cde} (1.12)
T_1S_8	1.47^{a} (1.56)	0.92^{a} (1.39)	1.17^{a} (1.47)	1.28^{abc} (1.51)	1.20^{a} (1.48)	1.25^{a} (1.50)
T_1S_9	1.43^{a} (1.55)	0.92^{a} (1.39)	1.17^{a} (1.47)	0.72^{bcd} (1.31)	0.78^{abc} (1.33)	0.74^{de} (1.31)
T_1S_{10}	1.47^{a} (1.56)	0.87^{a} (1.37)	1.17^{a} (1.47)	1.80^{a} (1.67)	1.05^{ab} (1.43)	1.42^{a} (1.55)
T_2S_1	1.40^{a} (1.53)	0.63^{a} (1.27)	1.01^{a} (1.41)	0.67^{bcd} (1.29)	0.52^{a-d} (1.23)	0.60^{def} (1.26)
T_2S_2	1.27^{a} (1.49)	0.69^{a} (1.30)	0.95^{a} (1.40)	0.76^{bcd} (1.32)	0.60^{a-d} (1.27)	0.70^{cde} (1.30)



A. Per cent reduction in thrips population over control after a week of first spray of different biopesticides under recommended dose of nitrogen and integrated N supply



B. Per cent variation in thrips population over RPP after a week of first spray of different biopesticides under RDN and integrated N supply

LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

Fig.13. Percent variation in thripspopulation over control and RPP after a week of first spray of different biopesticides under RDN and integrated N supply

Table 67. Thrips population (no. leaf^{-1}) before second spray (5 WAT) and after 1 week of second spray (6 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before second spray			After 1 week of second spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.64^{a} (1.28)	0.49^{a} (1.22)	0.57^{a} (1.25)	0.57^{a} (1.25)	0.47^{a} (1.21)	0.52^{a} (1.23)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.57^{b} (1.25)	0.44^{b} (1.20)	0.49^{b} (1.22)	0.49^{b} (1.22)	0.40^{b} (1.18)	0.43^{b} (1.20)
S.Em.± C.D at5%	0.01 0.03	0.01 0.02	0.01 0.02	0.01 0.02	0.01 0.02	0.01 0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.60^{b} (1.26)	0.47^{bc} (1.21)	0.52^{b} (1.23)	0.53^{b} (1.24)	0.45^{bcd} (1.20)	0.49^{bc} (1.22)
S_2: Nimbecidine – Leaf extract	0.60^{b} (1.26)	0.49^{bc} (1.22)	0.53^{b} (1.24)	0.50^{bc} (1.22)	0.38^{cde} (1.17)	0.43^{cd} (1.20)
S_3: Nimbecidine - Panchgavya	0.60^{b} (1.26)	0.42^{c} (1.19)	0.52^{b} (1.23)	0.47^{bc} (1.21)	0.34^{de} (1.16)	0.42^{d} (1.19)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.57^{b} (1.25)	0.44^{bc} (1.20)	0.49^{b} (1.22)	0.47^{bc} (1.21)	0.34^{de} (1.16)	0.40^{d} (1.18)
S_5: Nimbecidine - Silica spray	0.60^{b} (1.27)	0.49^{bc} (1.22)	0.56^{b} (1.25)	0.53^{b} (1.24)	0.50^{b} (1.22)	0.52^{b} (1.23)
S_6: Nimbecidine - Action 100 spray	0.67^{b} (1.29)	0.49^{bc} (1.22)	0.56^{b} (1.25)	0.53^{b} (1.24)	0.50^{b} (1.22)	0.52^{b} (1.23)
S_7: Abamectin (1.9 EC) - Perfect	0.28^{c} (1.13)	0.23^{d} (1.11)	0.25^{c} (1.12)	0.26^{d} (1.12)	0.28^{e} (1.13)	0.27^{e} (1.12)
S_8: Silica	0.67^{b} (1.29)	0.53^{b} (1.24)	0.60^{b} (1.26)	0.57^{b} (1.25)	0.47^{bc} (1.21)	0.52^{b} (1.23)
S_9: RPP	0.53^{b} (1.24)	0.47^{bc} (1.21)	0.49^{b} (1.22)	0.42^{c} (1.19)	0.40^{bcd} (1.18)	0.41^{d} (1.19)
S_{10}: Control	1.10^{a} (1.45)	0.72^{a} (1.31)	0.90^{a} (1.38)	0.96^{a} (1.40)	0.70^{a} (1.30)	0.82^{a} (1.35)
S.Em.± C.D at 5%	0.02 0.06	0.01 0.04	0.01 0.04	0.01 0.04	0.01 0.04	0.01 0.03
Interaction						
T_1S_1	0.67^{c} (1.29)	0.47^{cd} (1.21)	0.57^{bc} (1.25)	0.61^{b} (1.27)	0.45^{cd} (1.20)	0.53^{c} (1.24)
T_1S_2	0.64^{c} (1.28)	0.50^{cd} (1.22)	0.57^{bc} (1.25)	0.57^{bc} (1.25)	0.40^{c-f} (1.18)	0.49^{cd} (1.22)
T_1S_3	0.64^{c} (1.28)	0.44^{cd} (1.20)	0.53^{bc} (1.24)	0.53^{bcd} (1.24)	0.38^{c-f} (1.17)	0.47^{cde} (1.21)
T_1S_4	0.60^{c} (1.26)	0.42^{d} (1.19)	0.52^{bc} (1.23)	0.52^{bcd} (1.23)	0.34^{def} (1.16)	0.43^{cde} (1.20)
T_1S_5	0.67^{c} (1.29)	0.53^{bcd} (1.24)	0.60^{bc} (1.26)	0.57^{bc} (1.25)	0.51^{bc} (1.23)	0.53^{c} (1.24)
T_1S_6	0.67^{c} (1.29)	0.53^{bcd} (1.24)	0.60^{bc} (1.26)	0.57^{bc} (1.25)	0.51^{bc} (1.23)	0.53^{c} (1.24)
T_1S_7	0.33^{de} (1.15)	0.28^{ef} (1.13)	0.30^{d} (1.14)	0.30^{ef} (1.14)	0.28^{ef} (1.13)	0.29^{fg} (1.14)
T_1S_8	0.73^{bc} (1.32)	0.60^{bc} (1.26)	0.67^{b} (1.29)	0.57^{bc} (1.25)	0.46^{cd} (1.21)	0.52^{c} (1.23)
T_1S_9	0.57^{cd} (1.25)	0.49^{cd} (1.22)	0.53^{bc} (1.24)	0.45^{cd} (1.20)	0.45^{cd} (1.20)	0.45^{cde} (1.20)
T_1S_{10}	1.02^{a} (1.42)	0.78^{a} (1.33)	0.87^{a} (1.38)	1.00^{a} (1.41)	0.74^{a} (1.32)	0.87^{a} (1.37)
T_2S_1	0.53^{cd} (1.24)	0.44^{cd} (1.20)	0.49^{c} (1.22)	0.47^{bcd} (1.21)	0.42^{cde} (1.19)	0.43^{cde} (1.20)
T_2S_2	0.57^{cd} (1.25)	0.47^{cd} (1.21)	0.52^{bc} (1.23)	0.45^{cd} (1.20)	0.34^{def} (1.16)	0.40^{def} (1.18)
T_2S_3	0.53^{cd} (1.24)	0.40^{de} (1.18)	0.47^{c} (1.21)	0.40^{de} (1.18)	0.33^{def} (1.15)	0.36^{ef} (1.17)

T_2S_4	0.52 [cd] (1.23)	0.44 [cd] (1.20)	0.47 [c] (1.21)	0.40 [de] (1.18)	0.33 [def] (1.15)	0.36 [ef] (1.17)
T_2S_5	0.57 [cd] (1.25)	0.47 [cd] (1.21)	0.52 [bc] (1.23)	0.53 [bcd] (1.24)	0.46 [cd] (1.21)	0.50 [cd] (1.22)
T_2S_6	0.67 [c] (1.29)	0.44 [cd] (1.20)	0.57 [bc] (1.25)	0.52 [bcd] (1.23)	0.46 [cd] (1.21)	0.50 [cd] (1.22)
T_2S_7	0.23 [e] (1.11)	0.18 [f] (1.09)	0.20 [d] (1.10)	0.20 [f] (1.10)	0.25 [f] (1.12)	0.23 [g] (1.11)
T_2S_8	0.60 [c] (1.26)	0.47 [cd] (1.21)	0.53 [bc] (1.24)	0.57 [bc] (1.25)	0.47 [cd] (1.21)	0.52 [c] (1.23)
T_2S_9	0.50 [cd] (1.22)	0.44 [cd] (1.20)	0.47 [c] (1.21)	0.40 [de] (1.18)	0.34 [def] (1.16)	0.36 [ef] (1.17)
T_2S_{10}	1.00 [ab] (1.41)	0.67 [ab] (1.29)	0.83 [a] (1.35)	0.94 [a] (1.39)	0.61 [ab] (1.27)	0.77 [b] (1.33)
S.Em.±	0.03	0.02	0.02	0.02	0.02	0.013
C.D at 5%	0.09	0.05	0.05	0.05	0.05	0.04
C.V. (%)	4.3	3.0	3.7	3.1	3.0	3.0

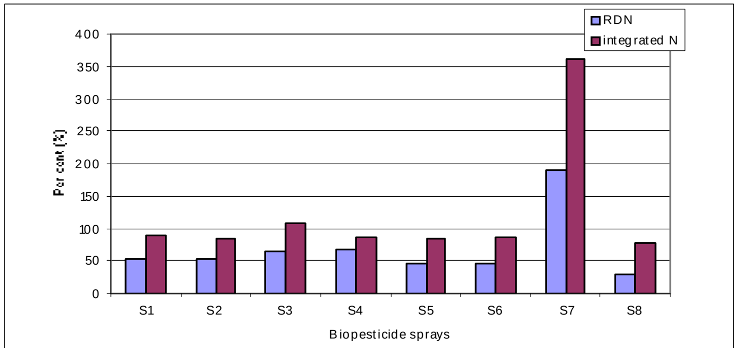
* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate √x+1 transformation values, In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

inorganic source of N recorded the lowest population of thrips (0.93). Prior to biopesticide spray there was no significant variation in the thrips population. Similar was the case due to nitrogen sources and biopesticide interaction.

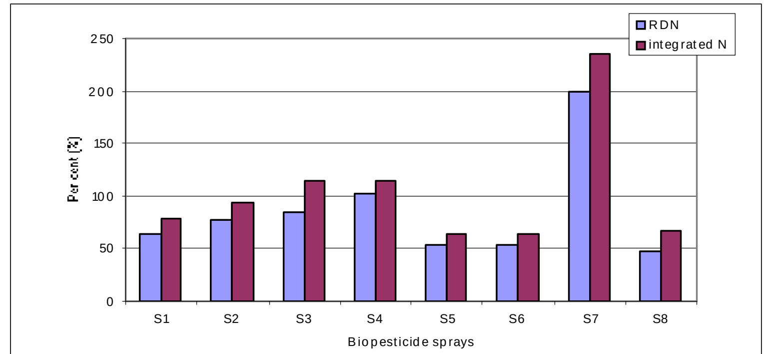
Thrips population after a week of first spray (4 WAT) varied due to nitrogen sources averaged over biopesticides behaved similarly as before the spray recording the lowest with integration of different N sources (Table 66). Among the spray, schedules alternate spray of Abamectin and Perfect (S_7) recorded the lowest thrips population (0.20). Nimbecidine sprays alternated with GCK, leaf extract, panchagavya and leaf extract + panchagavya were next in the order and were on par with recommended plant protection practices. The highest thrips population was recorded when chilli was not protected from the sucking pests (no spray) (1.39). Among treatment combinations, chilli nutritioned with vermicompost and neem cake along with inorganic sources in equal proportion coupled with Abamectin and Perfect alternatively (T_2S_7) recorded significantly lower thrips population at 4 WAT (0.15 leaf^{-1}) (Fig. 13). T_2S_1, T_2S_3, T_2S_4 and T_2S_9 were at par with the former treatment. While, significantly higher thrips population was recorded with chilli supplied with inorganic source of nitrogen only besides any chemical spray as control measure for thrips (T_1S_{10}) followed by only silica application (T_1S_8) and both treatments were on par (1.42 and 1.25, respectively).

Thrips population before a week of second spray varied significantly due to nitrogen sources (Table 67). Of the two sources of nitrogen, integrated supply of N comprising of vermicompost and neem cake along with inorganic N resulted in the lowest thrips population (0.49 leaf^{-1}). While, in the biopesticide sprays, alternate spray of Abamectin and Perfect (S_7) recorded the lowest thrips population (0.25 leaf^{-1}). Sprays of Nimbecidine alternated with other biopesticides were next in the order and were comparable to RPP (S_9). The highest thrips population (0.90 leaf^{-1}) was recorded in the no spray treatment (S_{10}). Among the treatment combinations, significantly lower thrips population (0.20 leaf^{-1}) was registered with Abamectin alternated with Perfect spray and receiving N equally through organic and inorganic sources (T_2T_7) (Fig. 14). Among all the treatment combinations, similar spray schedule to chilli receiving N entirely through inorganics were at par with each other. While, no significant differences were observed between the rest of the treatment combinations except chilli supplied with integrated source of N and only inorganic sources of N without any chemical spray (T_2S_{10} and T_1S_{10}) (0.83 and 0.87 leaf^{-1}, respectively).

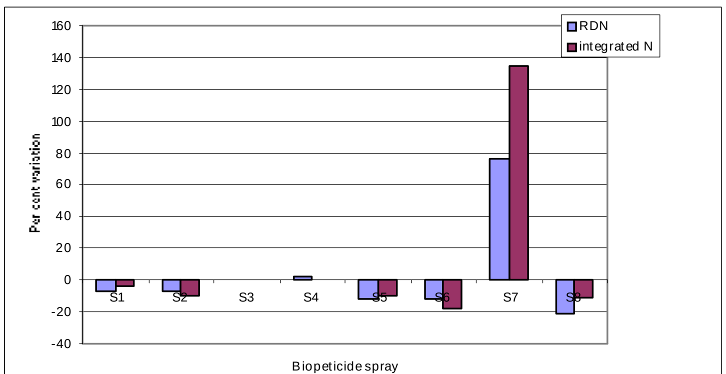
Thrips population varied significantly after a week of second spray due to sources of nitrogen (Table 67). Supply of N equally through organic and inorganic sources averaged over biopesticides recorded the lowest thrips population (0.43 leaf^{-1}). Among the biorational sprays, the lowest thrips population (0.27 leaf^{-1}) was recorded with alternate sprays of Abamectin and Perfect (S_7). Most of the sprays receiving nimbecidine and other bio-extracts



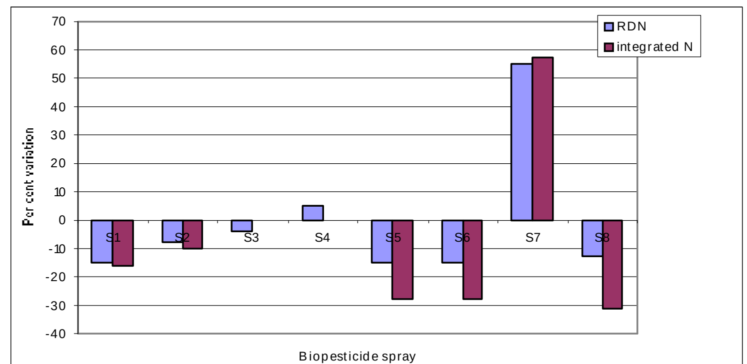
Per cent reduction in thrips population over control before second spray under RDN and integrated N supply



Per cent reduction in thrips population over control after a week of second spray under RDN and integrated N supply



Per cent variation in thrips population over RPP before second spray under RDN and integrated N supply



Per cent variation in thrips population over RPP after week second spray of biopesticides under RDN and integrated N supply

LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

Fig.14: Percent variation in thrips population over control and RPP before and after a week second spray of different biopesticides under RDN and integrated N supply

Table 68. Thrips population (no. leaf^{-1}) before third spray (7 WAT) and after 1 week of third spray (8 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before third spray			After 1 week of third spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	1.20 ^{a} (1.48)	0.94 ^{a} (1.39)	1.05 ^{a} (1.43)	0.70 ^{a} (1.30)	0.60 ^{a} (1.26)	0.65 ^{a} (1.28)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	1.05 ^{b} (1.43)	0.72 ^{b} (1.31)	0.89 ^{b} (1.37)	0.60 ^{b} (1.27)	0.47 ^{b} (1.21)	0.53 ^{b} (1.24)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.03	0.04	0.02	0.02	0.04	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	1.08 ^{cd} (1.44)	0.73 ^{bc} (1.31)	0.88 ^{cd} (1.37)	0.67 $^{b-e}$ (1.29)	0.50 ^{b} (1.22)	0.57 ^{c} (1.25)
S_2: Nimbecidine – Leaf extract	1.02 ^{de} (1.42)	0.75 ^{bc} (1.32)	0.88 ^{cd} (1.37)	0.60 ^{de} (1.27)	0.50 ^{b} (1.22)	0.53 ^{c} (1.24)
S_3: Nimbecidine - Panchgavya	1.02 ^{de} (1.42)	0.72 ^{bc} (1.31)	0.88 ^{cd} (1.37)	0.60 ^{de} (1.27)	0.50 ^{b} (1.22)	0.53 ^{c} (1.24)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.95 ^{de} (1.40)	0.72 ^{bc} (1.31)	0.83 ^{de} (1.35)	0.57 ^{e} (1.25)	0.43 ^{b} (1.20)	0.52 ^{c} (1.23)
S_5: Nimbecidine - Silica spray	1.16 ^{bcd} (1.47)	0.83 ^{bc} (1.35)	1.00 ^{bc} (1.41)	0.72 ^{bcd} (1.31)	0.53 ^{b} (1.24)	0.65 ^{bc} (1.28)
S_6: Nimbecidine - Action 100 spray	1.23 ^{bc} (1.49)	0.90 ^{b} (1.38)	1.05 ^{b} (1.43)	0.76 ^{bc} (1.33)	0.60 ^{b} (1.26)	0.70 ^{b} (1.30)
S_7: Abamectin (1.9 EC) - Perfect	0.85 ^{e} (1.36)	0.60 ^{c} (1.26)	0.72 ^{e} (1.31)	0.20 ^{f} (1.10)	0.13 ^{c} (1.06)	0.17 ^{d} (1.08)
S_8: Silica	1.27 ^{b} (1.51)	1.00 ^{b} (1.41)	1.12 ^{b} (1.46)	0.80 ^{ab} (1.34)	0.69 ^{b} (1.29)	0.74 ^{b} (1.32)
S_9: RPP	1.02 ^{de} (1.42)	0.74 ^{bc} (1.32)	0.88 ^{cd} (1.37)	0.65 ^{cde} (1.28)	0.50 ^{b} (1.22)	0.57 ^{c} (1.25)
S_{10}: Control	1.52 ^{a} (1.59)	1.40 ^{a} (1.55)	1.48 ^{a} (1.57)	0.93 ^{a} (1.34)	1.03 ^{a} (1.42)	1.00 ^{a} (1.41)
S.Em.±	0.02	0.03	0.02	0.02	0.03	0.02
C.D at 5%	0.06	0.09	0.05	0.05	0.08	0.04
Interaction						
T_1S_1	1.12 $^{b-e}$ (1.46)	0.80 $^{c-f}$ (1.34)	0.96 $^{c-g}$ (1.40)	0.69 $^{b-e}$ (1.30)	0.52 ^{c} (1.23)	0.60 $^{b-e}$ (1.27)
T_1S_2	1.10 $^{b-e}$ (1.45)	0.90 ^{cde} (1.38)	1.00 $^{c-f}$ (1.41)	0.65 ^{cde} (1.28)	0.60 ^{c} (1.26)	0.62 $^{b-e}$ (1.27)
T_1S_3	1.10 $^{b-e}$ (1.45)	0.90 ^{cde} (1.38)	1.00 $^{c-f}$ (1.41)	0.67 $^{b-e}$ (1.29)	0.60 ^{c} (1.26)	0.65 $^{b-e}$ (1.28)
T_1S_4	1.02 ^{bcd} (1.42)	0.85 $^{c-f}$ (1.36)	0.92 $^{d-g}$ (1.39)	0.60 ^{cde} (1.27)	0.50 ^{c} (1.22)	0.57 ^{cde} (1.25)
T_1S_5	1.25 ^{bcd} (1.50)	0.95 ^{bcd} (1.40)	1.10 ^{cde} (1.45)	0.76 ^{bcd} (1.33)	0.62 ^{c} (1.27)	0.70 ^{bcd} (1.30)
T_1S_6	1.25 ^{bcd} (1.50)	1.00 ^{bcd} (1.41)	1.14 ^{cd} (1.46)	0.80 ^{abc} (1.34)	0.67 ^{bc} (1.29)	0.74 ^{bc} (1.32)
T_1S_7	0.90 ^{ef} (1.38)	0.70 $^{c-f}$ (1.30)	0.80 ^{fgh} (1.34)	0.25 ^{f} (1.12)	0.17 ^{de} (1.08)	0.20 ^{f} (1.10)
T_1S_8	1.30 ^{bc} (1.52)	1.05 ^{bc} (1.43)	1.20 ^{bc} (1.48)	0.82 ^{abc} (1.35)	0.72 ^{abc} (1.31)	0.78 ^{c} (1.33)
T_1S_9	1.10 $^{b-e}$ (1.44)	0.88 $^{c-f}$ (1.37)	1.00 $^{c-f}$ (1.41)	0.70 $^{b-e}$ (1.30)	0.60 ^{c} (1.26)	0.65 $^{b-e}$ (1.28)
T_1S_{10}	1.70 ^{a} (1.64)	1.45 ^{a} (1.57)	1.56 ^{a} (1.60)	1.01 ^{a} (1.42)	1.00 ^{ab} (1.41)	1.02 ^{a} (1.42)

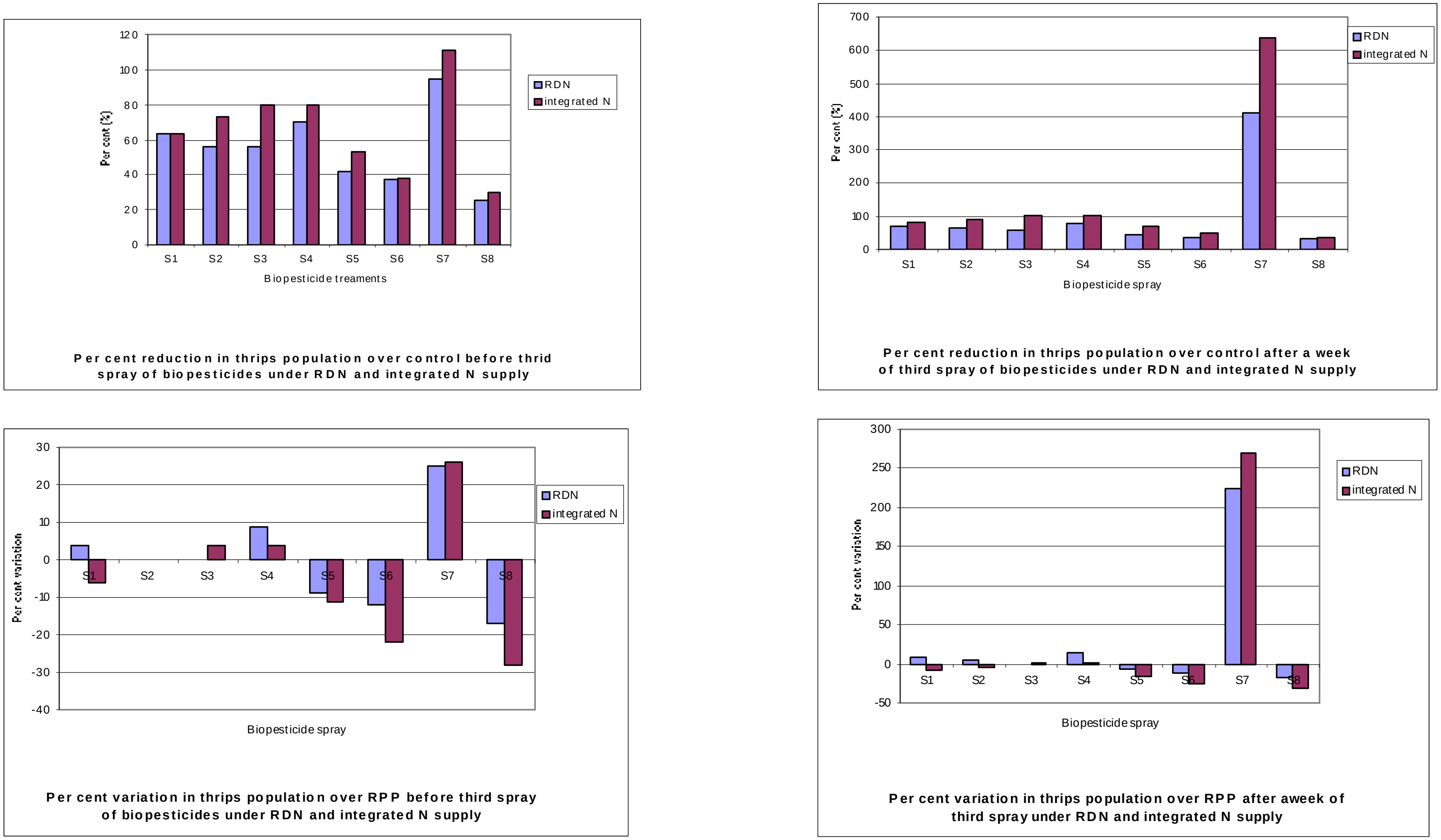
T_2S_1	1.00 ^{def} (1.41)	0.65 $^{c-f}$ (1.28)	0.83 ^{fgh} (1.35)	0.65 ^{cde} (1.28)	0.43 ^{cd} (1.20)	0.53 ^{de} (1.24)
T_2S_2	0.95 ^{def} (1.40)	0.60 ^{def} (1.26)	0.78 ^{fgh} (1.33)	0.57 ^{de} (1.25)	0.40 ^{cd} (1.18)	0.50 ^{e} (1.22)
T_2S_3	0.95 ^{def} (1.40)	0.54 ^{ef} (1.24)	0.75 ^{gh} (1.32)	0.57 ^{de} (1.25)	0.37 ^{cd} (1.17)	0.47 ^{e} (1.21)
T_2S_4	0.90 ^{ef} (1.38)	0.60 ^{def} (1.26)	0.75 ^{gh} (1.32)	0.53 ^{e} (1.24)	0.40 ^{cd} (1.18)	0.47 ^{e} (1.21)
T_2S_5	1.10 $^{b-e}$ (1.45)	0.70 $^{c-f}$ (1.30)	0.88 ^{efg} (1.37)	0.67 $^{b-e}$ (1.29)	0.47 ^{cd} (1.21)	0.57 ^{cde} (1.25)
T_2S_6	1.20 $^{b-e}$ (1.48)	0.80 $^{c-f}$ (1.34)	1.00 $^{c-f}$ (1.41)	0.74 $^{b-e}$ (1.32)	0.54 ^{c} (1.24)	0.65 $^{b-e}$ (1.28)
T_2S_7	0.80 ^{f} (1.34)	0.50 ^{f} (1.22)	0.64 ^{h} (1.28)	0.18 ^{f} (1.09)	0.07 ^{e} (1.03)	0.13 ^{f} (1.06)
T_2S_8	1.25 ^{bcd} (1.50)	0.90 ^{cde} (1.38)	1.08 ^{cde} (1.44)	0.78 ^{bcd} (1.33)	0.60 ^{c} (1.26)	0.70 ^{bcd} (1.30)
T_2S_9	0.95 ^{def} (1.40)	0.60 ^{def} (1.26)	0.78 ^{fgh} (1.33)	0.57 ^{de} (1.25)	0.40 ^{cd} (1.18)	0.48 ^{e} (1.22)
T_2S_{10}	1.40 ^{ab} (1.55)	1.35 ^{ab} (1.53)	1.38 ^{ab} (1.54)	0.88 ^{ab} (1.37)	1.03 ^{a} (1.42)	0.96 ^{a} (1.40)
S.Em.±	0.03	0.05	0.03	0.03	0.04	0.02
C.D at 5%	0.09	0.13	0.07	0.07	0.12	0.06
C.V. (%)	3.7	5.6	4.7	3.2	5.5	4.4

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate √x+1 transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

except GCK, silica and Action 100 were next in the order and comparable to RPP. The highest thrips population (0.82 leaf^{-1}) was recorded in the no spray (control) treatment (S_{10}). Among the treatment combinations, chilli sprayed with Abamectin and Perfect alternatively and supplied with both organic and inorganic N sources (T_2S_7) registered lower thrips population (0.23 leaf^{-1}) (Fig. 14). Similar spray combination with inorganic nitrogen (T_1S_7) supply was at par. T_2S_2, T_2S_3, T_2S_4 and T_2S_9 were next in the order. While, significantly higher thrips population (0.87 leaf^{-1}) was recorded with chilli crop supplied with inorganic nitrogen and without any spray (T_1S_{10}).

Thrips population before third spray varied significantly due to sources of nitrogen (Table 68). Between the two sources of N, integrated supply of N through organic and inorganic sources registered lower thrips populations (0.89 leaf^{-1}). Among the biopesticides sprays alternate spray of Abamectin and Perfect recorded significantly lower thrips population (0.72 leaf^{-1}). Nimbecidine sprays alternated with other biopesticides except silica and Action 100 were next in the order and were comparable to RPP and infact S_4 was superior to the recommended spray schedules. The highest thrips population was observed in the no spray treatment (1.48). Among the treatment combinations, significantly lower thrips population (0.64 leaf^{-1}) was recorded with the treatment combination consisted of Abamectin and Perfect spray nutritioned with 50 per cent each of organic and inorganic N sources (T_2S_7) (Fig. 15). T_1S_7, T_2S_1, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 were on par with the former treatment combination. While, significantly higher thrips population (1.56 leaf^{-1}) was recorded with chilli supplied with only inorganic nitrogen without any biopesticide or chemical spray (T_1S_{10}).

Population of thrips after a week of third spray varied significantly due to source of N (Table 68). The integrated N supply through organics and inorganics registered the lowest thrips population (0.53 leaf^{-1}). Abamectin alternated with Perfect (S_7) recorded the lowest thrips population (0.17 leaf^{-1}). While, nimbecidine alternated with other biorationals except silica and Action 100 were next in order and comparable with RPP (S_9). While, the highest thrips population was recorded in the no spray (S_{10}) treatment (1.0 leaf^{-1}). Among the



LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

Fig. 15: Percent variation in thrips population over control and RPP before and after aweek of third spray of different biopesticides under RDN and integrated N supply

Table 69. Thrips population (no. leaf $^{-1}$) before fourth spray (9 WAT) and after 1 week of fourth spray (10 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before fourth spray			After 1 week of fourth spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.57 ^{a} (1.25)	0.50 ^{a} (1.22)	0.52 ^{a} (1.23)	0.41 ^{a} (1.19)	0.40 ^{a} (1.18)	0.41 ^{a} (1.19)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.46 ^{b} (1.21)	0.37 ^{b} (1.17)	0.41 ^{b} (1.19)	0.35 ^{b} (1.16)	0.33 ^{b} (1.15)	0.34 ^{b} (1.16)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.03	0.04	0.02	0.02	0.02	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.46 ^{b} (1.21)	0.43 ^{cde} (1.19)	0.43 ^{cd} (1.20)	0.28 ^{de} (1.13)	0.30 ^{cd} (1.14)	0.30 ^{e} (1.14)
S_2: Nimbecidine – Leaf extract	0.50 ^{b} (1.22)	0.39 ^{de} (1.17)	0.43 ^{cd} (1.20)	0.38 ^{bcd} (1.17)	0.30 ^{cd} (1.14)	0.34 ^{de} (1.15)
S_3: Nimbecidine - Panchgavya	0.50 ^{b} (1.22)	0.34 ^{e} (1.16)	0.41 ^{d} (1.19)	0.34 ^{cd} (1.15)	0.21 ^{b} (1.10)	0.27 ^{e} (1.13)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.50 ^{b} (1.22)	0.34 ^{e} (1.16)	0.41 ^{d} (1.19)	0.35 ^{bcd} (1.16)	0.23 ^{b} (1.11)	0.29 ^{e} (1.13)
S_5: Nimbecidine - Silica spray	0.54 ^{b} (1.24)	0.50 ^{bcd} (1.22)	0.52 ^{bcd} (1.23)	0.41 ^{bc} (1.19)	0.42 ^{bc} (1.19)	0.41 ^{bcd} (1.19)
S_6: Nimbecidine - Action 100 spray	0.56 ^{b} (1.25)	0.51 ^{bc} (1.23)	0.54 ^{bc} (1.24)	0.47 ^{b} (1.21)	0.50 ^{b} (1.22)	0.48 ^{b} (1.21)
S_7: Abamectin (1.9 EC) - Perfect	0.19 ^{c} (1.19)	0.18 ^{f} (1.09)	0.19 ^{e} (1.09)	0.19 ^{e} (1.09)	0.17 ^{d} (1.08)	0.18 ^{f} (1.08)
S_8: Silica	0.59 ^{b} (1.26)	0.58 ^{b} (1.25)	0.58 ^{b} (1.26)	0.41 ^{bc} (1.19)	0.47 ^{b} (1.21)	0.45 ^{bc} (1.20)
S_9: RPP	0.52 ^{b} (1.23)	0.33 ^{e} (1.15)	0.42 ^{d} (1.19)	0.39 ^{bcd} (1.18)	0.30 ^{cd} (1.14)	0.35 ^{cde} (1.16)
S_{10}: Control	0.83 ^{a} (1.35)	0.77 ^{a} (1.33)	0.80 ^{a} (1.34)	0.69 ^{a} (1.30)	0.71 ^{a} (1.31)	0.69 ^{a} (1.30)
S.Em.±	0.03	0.02	0.02	0.02	0.02	0.02
C.D at 5%	0.07	0.05	0.05	0.05	0.06	0.04
Interaction						
T_1S_1	0.50 ^{bc} (1.22)	0.50 $^{b-f}$ (1.22)	0.50 ^{cde} (1.22)	0.30 ^{de} (1.14)	0.35 $^{c-f}$ (1.16)	0.33 $^{d-g}$ (1.15)
T_1S_2	0.54 ^{b} (1.24)	0.45 $^{c-g}$ (1.20)	0.50 ^{cde} (1.22)	0.40 ^{cd} (1.18)	0.30 $^{c-f}$ (1.14)	0.35 $^{c-f}$ (1.16)
T_1S_3	0.52 ^{b} (1.23)	0.40 $^{e-h}$ (1.18)	0.46 ^{cde} (1.21)	0.37 ^{cde} (1.17)	0.25 $^{c-f}$ (1.12)	0.30 $^{d-g}$ (1.14)
T_1S_4	0.52 ^{b} (1.23)	0.47 $^{c-g}$ (1.21)	0.50 ^{cde} (1.22)	0.37 ^{cde} (1.17)	0.25 $^{c-f}$ (1.12)	0.30 $^{d-g}$ (1.14)
T_1S_5	0.57 ^{b} (1.25)	0.55 $^{b-e}$ (1.24)	0.57 ^{bcd} (1.25)	0.44 ^{cd} (1.20)	0.45 ^{bcd} (1.20)	0.45 ^{cd} (1.20)
T_1S_6	0.64 ^{ab} (1.28)	0.60 $^{a-d}$ (1.27)	0.62 ^{bc} (1.28)	0.54 ^{bc} (1.24)	0.50 ^{bc} (1.22)	0.52 ^{bc} (1.23)
T_1S_7	0.20 ^{cd} (1.10)	0.23 ^{hi} (1.11)	0.23 ^{fg} (1.11)	0.19 ^{e} (1.09)	0.18 ^{ef} (1.09)	0.19 ^{fg} (1.09)
T_1S_8	0.61 ^{b} (1.27)	0.65 ^{abc} (1.28)	1.64 ^{bc} (1.28)	0.41 ^{cd} (1.19)	0.50 ^{bc} (1.22)	0.45 ^{cd} (1.20)
T_1S_9	0.57 ^{b} (1.25)	0.32 $^{f-i}$ (1.14)	0.43 ^{de} (1.20)	0.45 ^{cd} (1.20)	0.35 $^{c-f}$ (1.16)	0.40 ^{cde} (1.18)

T_1S_{10}	0.94^{a} (1.39)	0.83^{a} (1.35)	0.87^{a} (1.37)	0.74^{a} (1.32)	0.82^{a} (1.35)	0.77^{a} (1.33)
T_2S_1	0.44^{bc} (1.20)	0.35^{e-h} (1.16)	0.40^{def} (1.18)	0.27^{de} (1.13)	0.27^{c-f} (1.13)	0.27^{d-g} (1.13)
T_2S_2	0.44^{bc} (1.20)	0.33^{fgh} (1.15)	0.40^{def} (1.18)	0.35^{cde} (1.16)	0.27^{c-f} (1.13)	0.32^{d-g} (1.15)
T_2S_3	0.44^{bc} (1.20)	0.28^{ghi} (1.13)	0.36^{ef} (1.17)	0.30^{de} (1.14)	0.17^{ef} (1.08)	0.23^{efg} (1.11)
T_2S_4	0.46^{bc} (1.21)	0.23^{hi} (1.11)	0.35^{ef} (1.16)	0.33^{de} (1.15)	0.20^{def} (1.10)	0.27^{d-g} (1.13)
T_2S_5	0.50^{bc} (1.22)	0.45^{c-g} (1.20)	0.46^{cde} (1.21)	0.37^{cd} (1.17)	0.40^{b-e} (1.18)	0.39^{cde} (1.18)
T_2S_6	0.46^{bc} (1.21)	0.42^{d-h} (1.19)	0.43^{de} (1.20)	0.40^{cd} (1.18)	0.47^{bc} (1.21)	0.44^{cd} (1.20)
T_2S_7	0.17^{d} (1.08)	0.13^{i} (1.06)	0.15^{g} (1.07)	0.18^{e} (1.09)	0.15^{f} (1.07)	0.17^{g} (1.08)
T_2S_8	0.57^{b} (1.25)	0.50^{b-f} (1.22)	0.52^{cde} (1.23)	0.40^{cd} (1.18)	0.45^{bcd} (1.20)	0.41^{cd} (1.19)
T_2S_9	0.46^{bcd} (1.21)	0.33^{fgh} (1.15)	0.40^{def} (1.18)	0.33^{de} (1.15)	0.27^{c-f} (1.13)	0.30^{d-g} (1.14)
T_2S_{10}	0.72^{ab} (1.31)	0.70^{ab} (1.30)	0.71^{ab} (1.31)	0.63^{ab} (1.28)	0.60^{ab} (1.27)	0.62^{ab} (1.27)
S.Em.±	0.04	0.03	0.02	0.03	0.03	0.02
C.D at 5%	0.10	0.07	0.06	0.08	0.09	0.06
C.V. (%)	5.1	3.3	4.3	3.8	4.8	4.3

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica*, *Pongamia pinnata*, *Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate $\sqrt{x+1}$ transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

treatment combinations, alternate spray of Abamectin and Perfect coupled with 50 per cent N each through organic and inorganic sources (T_2S_7) recorded significantly lower thrips population (0.13 $leaf^{-1}$) (Fig. 15). T_1S_7 was on par with the former treatment combination, while T_1S_9, T_2S_1, T_2S_2, T_2S_9, T_2S_4 and T_2S_9 were next in the order and were on par with one another. While, significantly higher thrips population (1.02 $leaf^{-1}$) was recorded with inorganic nitrogen + no biopesticide or chemical spray (T_1S_{10}).

Thrips population varied significantly before fourth spray (Table 69). The integrated N supply registered the lowest thrips population (0.41 $leaf^{-1}$). The Abamectin and Perfect (S_7) spray recorded the lowest thrips population (0.19 $leaf^{-1}$). Nimbecidine sprays alternated with other biorationals except silica and Action 100 were comparable with RPP. While, the lowest thrips population was recorded in the no spray treatment (0.80 $leaf^{-1}$). Chilli with integrated N supply coupled with Abamectin and Perfect (T_2S_7) alternatively registered significantly lower thrips population (0.15 $leaf^{-1}$). Among the other treatment combinations, T_1S_7 was on par with the former treatment combination (T_2S_7) (Fig. 16). T_2S_1, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 were next in the order while significantly higher thrips population (0.87 $leaf^{-1}$) was recorded with inorganic nitrogen + no biopesticide or chemical spray (T_1S_{10}) treatment combination.

The lowest thrips population (0.34 $leaf^{-1}$) was observed after a week of fourth spray with the crop nutritioned N equally through organic and inorganic sources (Table 69). While, in the biopesticide sprays, alternate sprays of Abamectin and Perfect (S_7) recorded the lowest thrips population (0.18 $leaf^{-1}$). Sprays of Nimbecidine alternated with other biopesticides except silica and Action 100 were comparable with RPP. While, the highest thrips population was recorded with no spray treatment (0.69 $leaf^{-1}$). Among the treatment combinations, alternate spray of Abamectin and Perfect with integrated N supply through organic and inorganic sources (T_2S_7) resulted in significantly lower thrips population (0.17 $leaf^{-1}$) (Fig. 16). T_1S_1, T_1S_3, T_1S_4, T_1S_7, T_2S_1, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 treatment combinations were on par

Table 70. Thrips population (no. leaf $^{-1}$) before fifth spray (11 WAT) and after 1 week of fifth spray (12 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before fifth spray			After 1 week of fifth spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.43 ^{a} (1.20)	0.42 ^{a} (1.19)	0.43 ^{a} (1.20)	0.40 ^{a} (1.18)	0.37 ^{a} (1.17)	0.38 ^{a} (1.17)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.37 ^{b} (1.17)	0.33 ^{b} (1.15)	0.35 ^{b} (1.16)	0.33 ^{b} (1.15)	0.28 ^{b} (1.13)	0.30 ^{b} (1.14)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.03	0.03	0.02	0.02	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.35 ^{bc} (1.16)	0.37 ^{bcd} (1.17)	0.36 ^{bcd} (1.17)	0.35 ^{b} (1.16)	0.33 ^{bc} (1.15)	0.34 ^{bc} (1.15)
S_2: Nimbecidine – Leaf extract	0.42 ^{b} (1.19)	0.35 ^{bcd} (1.16)	0.40 ^{bcd} (1.18)	0.38 ^{b} (1.17)	0.29 ^{bc} (1.14)	0.35 ^{bc} (1.16)
S_3: Nimbecidine - Panchgavya	0.38 ^{bc} (1.17)	0.30 ^{bcd} (1.14)	0.35 ^{bcd} (1.16)	0.38 ^{b} (1.17)	0.29 ^{bc} (1.14)	0.32^{bc} (1.15)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.38 ^{bc} (1.17)	0.28 ^{cd} (1.13)	0.33 ^{cd} (1.15)	0.32 ^{b} (1.15)	0.28 ^{cd} (1.13)	0.30 ^{c} (1.14)
S_5: Nimbecidine - Silica spray	0.42 ^{b} (1.19)	0.45 ^{bc} (1.20)	0.43 ^{b} (1.20)	0.40 ^{b} (1.18)	0.40 ^{bc} (1.18)	0.40 ^{bc} (1.18)
S_6: Nimbecidine - Action 100 spray	0.44 ^{b} (1.20)	0.50 ^{b} (1.22)	0.47 ^{b} (1.21)	0.42 ^{b} (1.19)	0.42 ^{b} (1.19)	0.42 ^{b} (1.19)
S_7: Abamectin (1.9 EC) - Perfect	0.23 ^{c} (1.11)	0.08 ^{e} (1.04)	0.17 ^{e} (1.08)	0.10 ^{c} (1.05)	0.02 ^{d} (1.01)	0.06 ^{d} (1.03)
S_8: Silica	0.44 ^{b} (1.20)	0.50 ^{b} (1.22)	0.47 ^{b} (1.21)	0.40 ^{b} (1.18)	0.45 ^{b} (1.20)	0.42 ^{b} (1.19)
S_9: RPP	0.37 ^{bc} (1.17)	0.19 ^{de} (1.09)	0.28 ^{d} (1.13)	0.35 ^{b} (1.16)	0.23 ^{c} (1.18)	0.30 ^{c} (1.14)
S_{10}: Control	0.64 ^{a} (1.28)	0.72 ^{a} (1.31)	0.67 ^{a} (1.29)	0.55 ^{a} (1.25)	0.60 ^{a} (1.27)	0.58 ^{a} (1.26)
S.Em.±	0.02	0.03	0.02	0.02	0.02	0.01
C.D at 5%	0.06	0.07	0.04	0.05	0.06	0.04
Interaction						
T_1S_1	0.38 ^{bcd} (1.17)	0.45 ^{bc} (1.20)	0.42 $^{b-f}$ (1.19)	0.38 ^{b} (1.17)	0.38 ^{bcd} (1.17)	0.38 $^{b-e}$ (1.17)
T_1S_2	0.44 ^{bcd} (1.20)	0.37 $^{b-e}$ (1.17)	0.42 $^{b-f}$ (1.19)	0.38 ^{b} (1.17)	0.33 ^{bcd} (1.15)	0.35 ^{cde} (1.16)
T_1S_3	0.40 ^{bcd} (1.18)	0.37 $^{b-e}$ (1.17)	0.40 $^{c-f}$ (1.18)	0.40 ^{ab} (1.18)	0.33 ^{bcd} (1.15)	0.38 $^{b-e}$ (1.17)
T_1S_4	0.40 ^{bcd} (1.18)	0.32 $^{b-f}$ (1.15)	0.35 $^{d-g}$ (1.16)	0.38 ^{b} (1.17)	0.29 ^{bcd} (1.14)	0.32 ^{cde} (1.15)
T_1S_5	0.48 ^{bc} (1.21)	0.50 ^{bc} (1.22)	0.49 $^{b-e}$ (1.22)	0.42 ^{ab} (1.19)	0.40 ^{bcd} (1.18)	0.41 ^{bcd} (1.19)
T_1S_6	0.50 ^{abc} (1.22)	0.57 ^{ab} (1.25)	0.53 ^{bc} (1.24)	0.45 ^{ab} (1.20)	0.53 ^{ab} (1.24)	0.50 ^{b} (1.22)
T_1S_7	0.25 ^{cd} (1.12)	0.10 ^{ef} (1.05)	0.18 ^{gh} (1.09)	0.15^{cd} (1.07)	0.04 ^{ef} (1.02)	0.10 ^{f} (1.04)
T_1S_8	0.47 ^{bc} (1.21)	0.57 ^{ab} (1.25)	0.52 ^{bcd} (1.23)	0.42 ^{ab} (1.19)	0.50 ^{abc} (1.22)	0.46 ^{bc} (1.21)

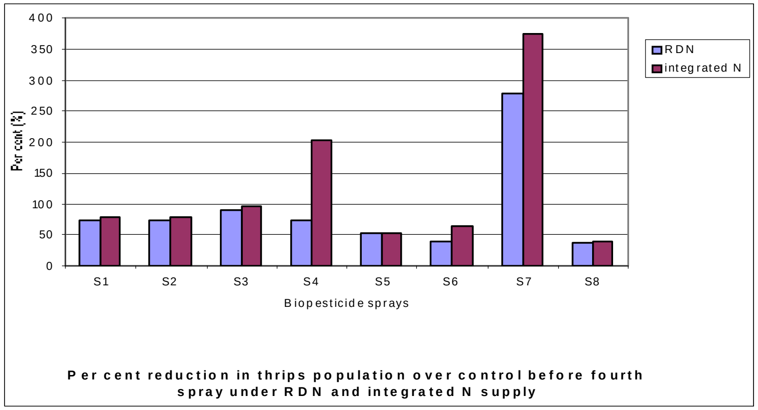
T_1S_9	0.40 ^{bcd} (1.18)	0.23 $^{c-f}$ (1.11)	0.33 ^{efg} (1.15)	0.38 ^{b} (1.17)	0.23 ^{de} (1.11)	0.31 ^{de} (1.14)
T_1S_{10}	0.72 ^{a} (1.31)	0.83 ^{a} (1.35)	0.77 ^{a} (1.33)	0.60 ^{a} (1.26)	0.72 ^{a} (1.31)	0.67 ^{a} (1.29)
T_2S_1	0.32 ^{bcd} (1.15)	0.30 $^{b-f}$ (1.14)	0.30 ^{fgh} (1.14)	0.30 ^{bc} (1.14)	0.27 ^{cde} (1.12)	0.28 ^{e} (1.13)
T_2S_2	0.40 ^{bcd} (1.18)	0.33 $^{b-f}$ (1.15)	0.37 $^{c-f}$ (1.17)	0.38 ^{b} (1.17)	0.28 ^{cd} (1.13)	0.32 ^{cde} (1.15)
T_2S_3	0.35 ^{bcd} (1.16)	0.25 $^{c-f}$ (1.12)	0.30 ^{fgh} (1.14)	0.35 ^{b} (1.16)	0.27 ^{cde} (1.12)	0.30 ^{de} (1.14)
T_2S_4	0.32 ^{bcd} (1.15)	0.23 $^{c-f}$ (1.11)	0.28 ^{fgh} (1.13)	0.30 ^{bc} (1.14)	0.23 ^{de} (1.11)	0.28 ^{e} (1.13)
T_2S_5	0.38 ^{bcd} (1.17)	0.40 ^{bcd} (1.18)	0.40 $^{c-f}$ (1.18)	0.40 ^{b} (1.18)	0.32 ^{bcd} (1.15)	0.35 ^{cde} (1.16)
T_2S_6	0.42 ^{bcd} (1.19)	0.40 ^{bcd} (1.18)	0.40 $^{c-f}$ (1.18)	0.38 ^{b} (1.17)	0.32 ^{bcd} (1.15)	0.35 ^{cde} (1.16)
T_2S_7	0.20 ^{d} (1.10)	0.07 ^{f} (1.03)	0.14 ^{h} (1.07)	0.07 ^{d} (1.03)	0.00 ^{f} (1.00)	0.04 ^{f} (1.02)
T_2S_8	0.40 ^{bcd} (1.18)	0.45 ^{bc} (1.20)	0.42 $^{b-f}$ (1.19)	0.38 ^{b} (1.17)	0.38 ^{bcd} (1.17)	0.38 $^{b-e}$ (1.17)
T_2S_9	0.35 ^{bcd} (1.16)	0.15 ^{def} (1.07)	0.26 ^{fgh} (1.12)	0.32 ^{bc} (1.15)	0.23 ^{de} (1.11)	0.28 ^{e} (1.13)
T_2S_{10}	0.57 ^{ab} (1.25)	0.60 ^{ab} (1.26)	0.60 ^{b} (1.26)	0.50 ^{ab} (1.22)	0.50 ^{abc} (1.22)	0.50 ^{b} (1.22)
S.Em.±	0.03	0.04	0.02	0.03	0.03	0.02
C.D at 5%	0.09	0.11	0.06	0.08	0.09	0.05
C.V. (%)	4.3	5.3	4.8	3.9	4.6	4.3

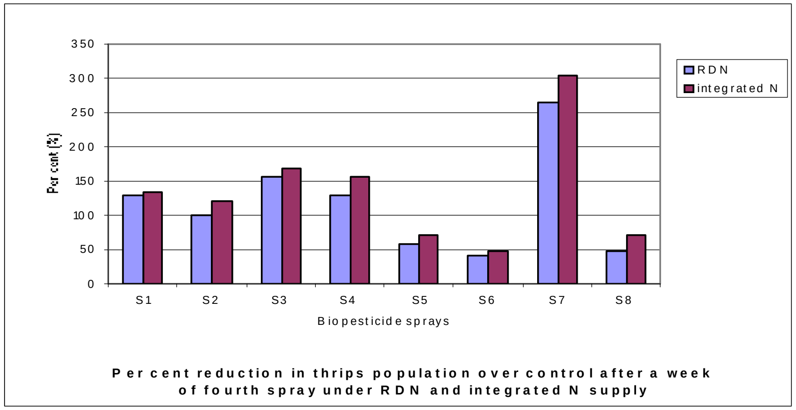
* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate $\sqrt{x+1}$ transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

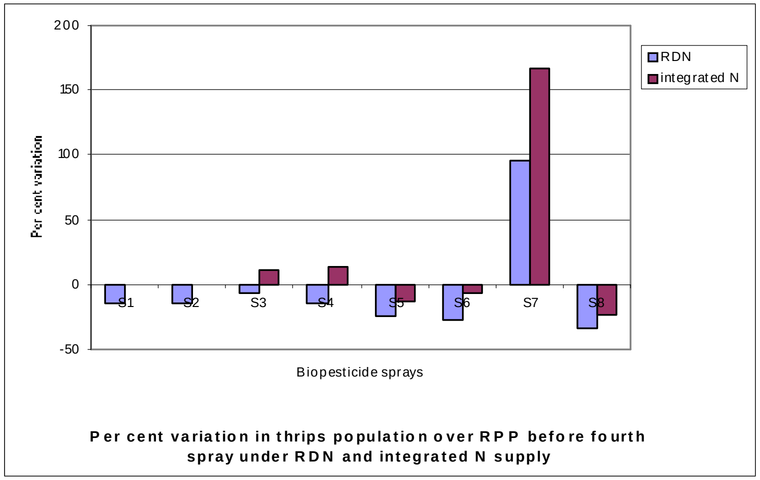
with the former treatment combination (T_2S_7). While, significantly higher thrips population (0.77 leaf^{-1}) was recorded with T_1S_{10} treatment combination.

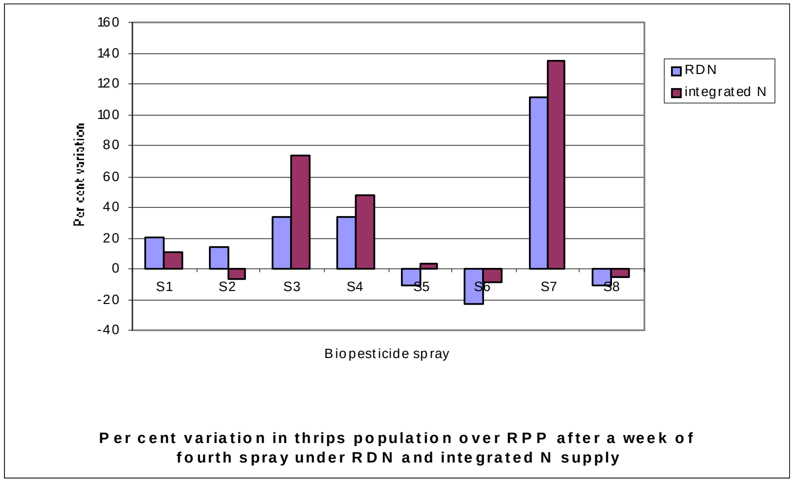
Before fifth spray also similar trend was noticed with integrated N supply treatment, which registered the lowest thrips population (0.35 leaf^{-1}) (Table 70), while alternate sprays of Abamectin and Perfect (S_7) continued to record the lowest thrips population (0.17 leaf^{-1}). Nimbecidine alternated with other biorationals except silica and Action 100 were comparable with RPP. The highest thrips population was observed in control (S_{10}) treatments having no sprays at all (0.67 leaf^{-1}). Among the treatment combinations, integrated N supplied treatment coupled with Abamectin and Perfect sprays (T_2S_7) recorded significantly lower thrips population (0.14 leaf^{-1}) (Fig.17). T_1S_7, T_2S_1, T_2S_3, T_2S_4 and T_2S_9 were at par with the former treatment combination. While, highest thrips population (0.77 leaf^{-1}) was observed with chilli crop supplied with inorganic nitrogen receiving no chemical or biorational sprays for thrips control (T_1S_{10}).

Significant differences in the thrips population were observed between two sources of nitrogen after a week of fifth spray also (11 WAT) (Table 70). Integrated N supply equally through organic and inorganic sources recorded the lowest thrips population (0.30 leaf^{-1}). Among the biopesticide sprays, Abamectin and Perfect (S_7) sprays recorded the lowest thrips population (0.06 leaf^{-1}). Sprays of Nimbecidine alternated with other biorational except silica and Action 100 were comparable with the recommended spray practices. While, the highest thrips population was recorded when no spray was undertaken (0.58 leaf^{-1}). Among the treatment combinations, significantly lower thrips population (0.04 leaf^{-1}) was again recorded



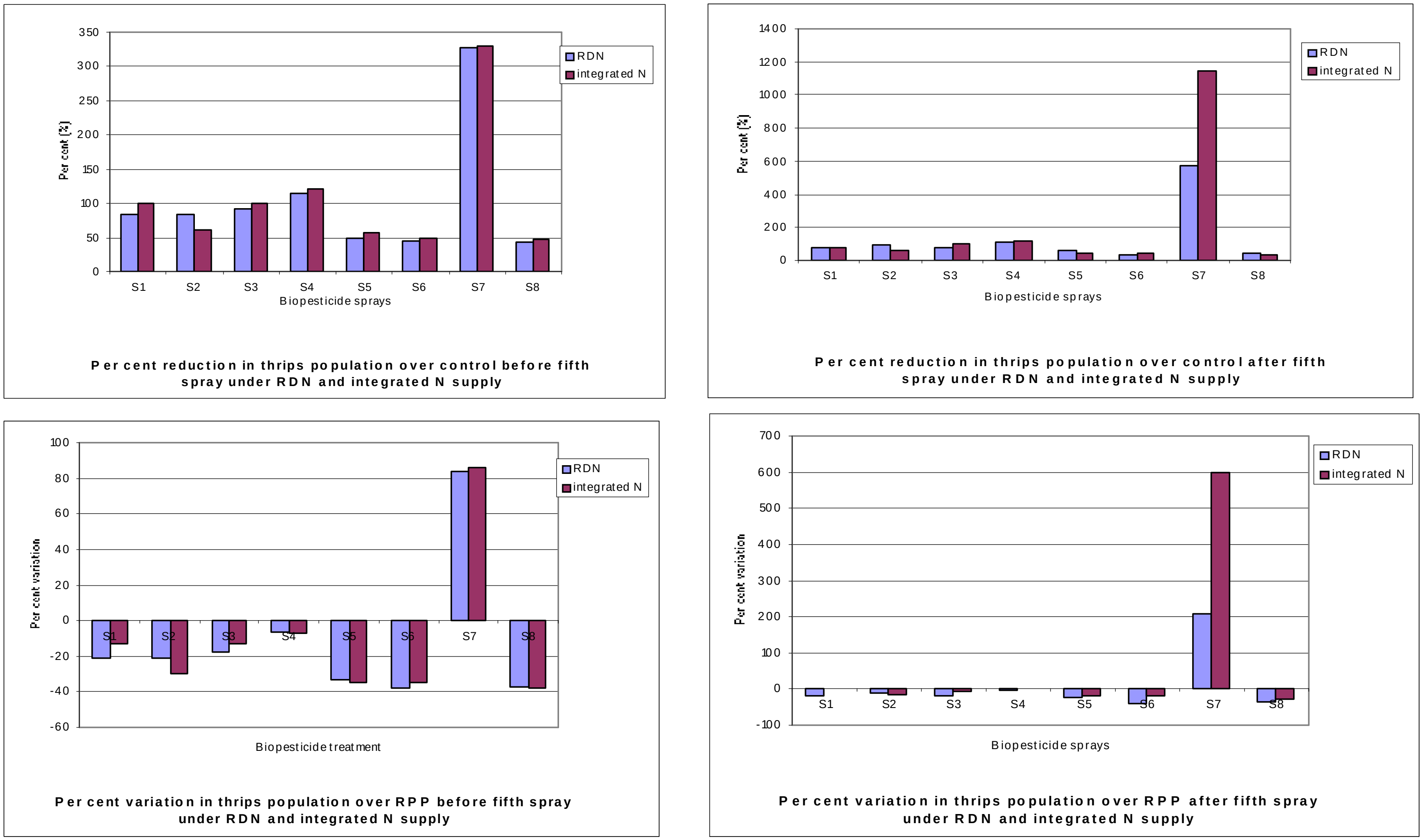






LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

Fig.16: Percent variation inthrips population over control and RPP before and after aweek of fourth spray of different biopesticides under RDN and integrated N supply



LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

Fig.17: Percent variation in thrips population over control and RPP before and after a week of fifth spray of different biopesticides under RDN and integrated N supply

with alternate sprays of Abamectin and Perfect nutritioned with 50 per cent of N both through organic and inorganic sources (T_2S_7) (Fig. 17). Chilli receiving entire N in the inorganic from coupled with Abamectin and Perfect (T_1S_7) recorded on par thrips population with the former treatment combination (T_2S_7). While the highest thrips population (0.67 leaf^{-1}) was recorded with chilli nutritioned with inorganic source of N without any pesticide spray.

4.3.3.2 Mites population (no. leaf^{-1})

The influences of N sources and pesticide sprays and their interaction were significant with regard to mites population at all the stages of observation (Table 71, 72, 73 and 74).

The mites population followed the same trend as that of thrips population and registered the lowest mites population (0.52 leaf^{-1}) before second spray with integrated source of N nutrition through organic and inorganic sources equally. Alternate spray of Abamectin and Perfect recorded the lowest mites population (0.33 leaf^{-1}), among pesticide treatments. The S_4 and S_9 spray treatments were on par with the former treatment during this stage of observation. While, the highest mites population (0.93 leaf^{-1}) was registered in the control treatment having no sprays (S_{10}). Among the treatment combinations, 50 per cent N supply each equally through organic and inorganic sources coupled with Abamectin and Perfect spray (T_2S_7) recorded significantly lower mites population (0.31 leaf^{-1}) (Fig. 18). While T_1S_4, T_1S_9, T_2S_1, T_2S_1, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 treatment combinations were at par with the former treatment combination (T_2S_7). On the other hand the highest mites population (1.02) was recorded with chilli crop nutritioned with inorganic source of nitrogen without any pesticide sprays.

Mites population a day before second spray was higher compared to mites population after a week of second spray (Table 71). Mites population varied significantly due to sources of N nutrition and registered the lowest mites population (0.44 leaf^{-1}) with integrated N supply to chilli crop. Among the biopesticide sprays, alternate sprays of Abamectin and Perfect (S_7) registered the lowest mites population (0.24 leaf^{-1}). Schedules of Nimbecidine alternatively sprayed with other biorationals except silica and Action 100 were comparable with RPP. On the other hand, the highest mites population (0.75 leaf^{-1}) was recorded when no sprays (S_{10}) were undertaken. Among the treatment combinations, significantly lower mites population (0.20 leaf^{-1}) was recorded in the T_2S_7 treatment combinations (Fig. 18). T_1S_7, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 were on par with the former treatment combination (T_2S_7). On the other hand, no chemical and biopesticide sprays to the sucking pests irrespective of the nitrogen source recorded significantly lower mites population (0.75 leaf^{-1} with both T_1S_{10} and T_2S_{10} treatment combinations).

Before third spray schedule, significant variations were observed between sources of nitrogen to chilli crop (Table 72). Integrated N supply registered the lowest mites population (0.60 leaf^{-1}). In the biopesticide sprays, alternate sprays of Abamectin and Perfect (S_7) registered the lowest mites population (0.41 leaf^{-1}). Most of the sprays receiving nimbecidine and other bioextracts except silica and Action 100 were next in the order and were comparable to the recommended plant protection comprising of inorganics only (Dimethoate, dicofal and carbaryl sprays), while the highest mites population (0.91 leaf^{-1}) was recorded in the chilli crop without any sprays. Among treatment combinations, chilli receiving integrated N supply through both organic and inorganic sources coupled with Abamectin and Perfect spray (T_2S_7) recorded significantly lower mites population (0.34 leaf^{-1}) (Fig. 19). T_1S_7 treatment combination was on par with the former treatment (T_2S_7). While RDN, applied treatment without any sprays (T_1S_{10}) recorded significantly higher mites population (0.96 leaf^{-1}) compared to other treatment combinations. Integrated N supply with no spray was on par with the latter treatment combination.

Mites population after a week of third spray was again the highest (0.40 leaf^{-1}) with T_2 treatment (Table 72). Among the biorational sprays, Abamectin and Perfect (S_7) spray recorded the lowest mites population (0.17 leaf^{-1}). Schedules of Nimbecidine alternated with most of the other biorationals except S_8 were next in the order and comparable to the recommended plant protection practices. On the other hand, the highest mites population (0.72 leaf^{-1}) was recorded with S_{10} treatment. The treatment combination of integrated N supply coupled with Abamectin and Perfect spray registered significantly lower mites population (0.15 leaf^{-1}) (Fig. 19). T_1S_7 treatment combination was on par with the former

Table 71. Mites population (no. leaf^{-1}) before second spray (5 WAT) and after 1 week of second spray (6 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before second spray			After 1 week of second spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.75 ^{a} (1.32)	0.53 ^{a} (1.24)	0.65 ^{a} (1.28)	0.64 ^{a} (1.28)	0.40 ^{a} (1.18)	0.52 ^{a} (1.23)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.60 ^{b} (1.27)	0.42 ^{b} (1.19)	0.52 ^{b} (1.23)	0.55 ^{b} (1.24)	0.33 ^{b} (1.15)	0.44 ^{b} (1.20)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.04	0.04	0.03	0.03	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.70 ^{b} (1.30)	0.45 ^{bcd} (1.20)	0.58 ^{bcd} (1.25)	0.58 ^{bcd} (1.25)	0.33 ^{b} (1.15)	0.45 ^{cd} (1.20)
S_2: Nimbecidine – Leaf extract	0.63 ^{b} (1.28)	0.42 ^{bcd} (1.19)	0.53 ^{cd} (1.23)	0.55 ^{bcd} (1.24)	0.33 ^{b} (1.15)	0.41 ^{cd} (1.20)
S_3: Nimbecidine - Panchgavya	0.60 ^{bc} (1.26)	0.42 ^{bcd} (1.19)	0.53 ^{cd} (1.23)	0.55 ^{bcd} (1.24)	0.33 ^{b} (1.15)	0.41 ^{d} (1.18)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.60 ^{bc} (1.26)	0.36 ^{cd} (1.17)	0.48 ^{de} (1.21)	0.47 ^{d} (1.21)	0.28 ^{b} (1.13)	0.36 ^{d} (1.17)
S_5: Nimbecidine - Silica spray	0.83 ^{ab} (1.35)	0.52 ^{bc} (1.23)	0.67 ^{bc} (1.29)	0.66 ^{bc} (1.29)	0.37 ^{b} (1.17)	0.52 ^{bc} (1.23)
S_6: Nimbecidine - Action 100 spray	0.80 ^{ab} (1.34)	0.52 ^{bc} (1.23)	0.67 ^{bc} (1.29)	0.68 ^{b} (1.30)	0.45 ^{ab} (1.20)	0.57 ^{b} (1.25)
S_7: Abamectin (1.9 EC) - Perfect	0.38 ^{c} (1.17)	0.25 ^{d} (1.12)	0.33 ^{e} (1.15)	0.25 ^{e} (1.12)	0.23 ^{c} (1.11)	0.24 ^{e} (1.11)
S_8: Silica	0.81 ^{ab} (1.34)	0.64 ^{ab} (1.28)	0.74 ^{b} (1.31)	0.71 ^{b} (1.31)	0.45 ^{ab} (1.20)	0.57 ^{b} (1.25)
S_9: RPP	0.56 ^{de} (1.25)	0.34 ^{cd} (1.16)	0.45 ^{de} (1.20)	0.50 ^{cd} (1.22)	0.30 ^{b} (1.14)	0.40 ^{d} (1.18)
S_{10}: Control	1.03 ^{a} (1.42)	0.83 ^{a} (1.35)	0.93 ^{a} (1.39)	0.94 ^{a} (1.39)	0.57 ^{a} (1.25)	0.75 ^{a} (1.32)
S.Em.±	0.03	0.03	0.02	0.02	0.02	0.02
C.D at 5%	0.09	0.08	0.06	0.06	0.06	0.04
Interaction						
T_1S_1	0.80 ^{abc} (1.34)	0.50 ^{bcd} (1.22)	0.65 $^{b-e}$ (1.28)	0.62 ^{be} (1.27)	0.37 ^{abc} (1.17)	0.50 $^{b-f}$ (1.22)
T_1S_2	0.70 ^{bcd} (1.30)	0.53 ^{bcd} (1.24)	0.62 $^{b-e}$ (1.27)	0.60 ^{cde} (1.26)	0.38 ^{abc} (1.17)	0.50 $^{b-f}$ (1.22)
T_1S_3	0.62 ^{bcd} (1.27)	0.52 ^{bcd} (1.23)	0.58 $^{b-f}$ (1.25)	0.60 ^{cde} (1.26)	0.39 ^{abc} (1.18)	0.50 $^{b-f}$ (1.22)
T_1S_4	0.60 ^{bcd} (1.26)	0.42 ^{bcd} (1.19)	0.52 $^{c-g}$ (1.23)	0.53 $^{c-f}$ (1.24)	0.31 ^{bc} (1.14)	0.41 $^{d-g}$ (1.19)
T_1S_5	0.96 ^{ab} (1.40)	0.58 ^{bc} (1.26)	0.77 ^{abc} (1.33)	0.72 $^{a-d}$ (1.31)	0.42 ^{abc} (1.19)	0.57 $^{a-d}$ (1.25)
T_1S_6	0.88 ^{abc} (1.37)	0.58 ^{bc} (1.26)	0.75 ^{bcd} (1.32)	0.73 $^{a-d}$ (1.32)	0.50 ^{ab} (1.22)	0.61 ^{abc} (1.27)
T_1S_7	0.40 ^{d} (1.18)	0.27 ^{cd} (1.13)	0.33 ^{fg} (1.15)	0.30 ^{fg} (1.14)	0.28 ^{bc} (1.13)	0.29 ^{gh} (1.14)
T_1S_8	0.94 ^{ab} (1.39)	0.70 ^{ab} (1.30)	0.83 ^{ab} (1.35)	0.80 ^{abc} (1.34)	0.50 ^{ab} (1.22)	0.63 ^{ab} (1.28)

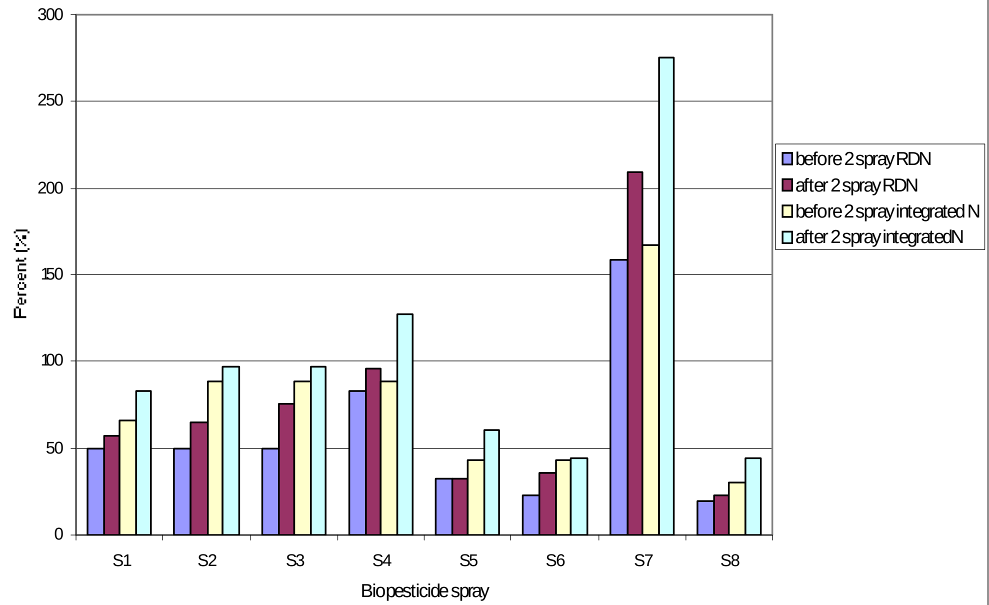
T_1S_9	0.60^{bcd} (1.26)	0.35^{cd} (1.16)	0.47^{efg} (1.21)	0.57^{cde} (1.25)	0.30^{bc} (1.14)	0.45^{c-g} (1.20)
T_1S_{10}	1.10^{a} (1.45)	0.93^{a} (1.39)	1.02^{a} (1.42)	0.87^{ab} (1.37)	0.61^{a} (1.27)	0.75^{a} (1.32)
T_2S_1	0.56^{bcd} (1.25)	0.40^{bcd} (1.18)	0.50^{d-g} (1.22)	0.53^{c-f} (1.24)	0.30^{bc} (1.14)	0.41^{d-g} (1.19)
T_2S_2	0.56^{bcd} (1.25)	0.30^{cd} (1.14)	0.44^{efg} (1.20)	0.50^{def} (1.22)	0.27^{bc} (1.13)	0.38^{e-h} (1.17)
T_2S_3	0.58^{bcd} (1.25)	0.33^{cd} (1.15)	0.44^{efg} (1.20)	0.50^{def} (1.22)	0.27^{bc} (1.13)	0.38^{e-h} (1.17)
T_2S_4	0.60^{bcd} (1.26)	0.30^{cd} (1.14)	0.44^{efg} (1.20)	0.40^{efg} (1.18)	0.25^{bc} (1.12)	0.33^{fgh} (1.15)
T_2S_5	0.70^{bcd} (1.30)	0.47^{bcd} (1.21)	0.58^{b-e} (1.26)	0.60^{cde} (1.26)	0.33^{bc} (1.15)	0.47^{b-g} (1.21)
T_2S_6	0.72^{a-d} (1.31)	0.47^{bcd} (1.21)	0.58^{b-e} (1.26)	0.63^{b-e} (1.28)	0.37^{abc} (1.18)	0.52^{b-e} (1.23)
T_2S_7	0.35^{d} (1.16)	0.23^{d} (1.11)	0.31^{g} (1.14)	0.20^{g} (1.10)	0.20^{c} (1.10)	0.20^{h} (1.10)
T_2S_8	0.67^{bcd} (1.29)	0.58^{bc} (1.26)	0.64^{b-e} (1.28)	0.62^{b-e} (1.27)	0.41^{abc} (1.19)	0.52^{b-e} (1.23)
T_2S_9	0.52^{cd} (1.23)	0.33^{cd} (1.15)	0.42^{efg} (1.19)	0.42^{efg} (1.19)	0.30^{bc} (1.14)	0.36^{e-h} (1.17)
T_2S_{10}	0.96^{ab} (1.40)	0.72^{ab} (1.31)	0.83^{ab} (1.35)	1.00^{a} (1.41)	0.50^{ab} (1.22)	0.75^{a} (1.32)
S.Em.±	0.03	0.04	0.03	0.03	0.03	0.02
C.D at 5%	0.09	0.12	0.09	0.09	0.09	0.06
C.V. (%)	6.1	6.0	6.1	4.6	4.7	4.7

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate $\sqrt{x+1}$ transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

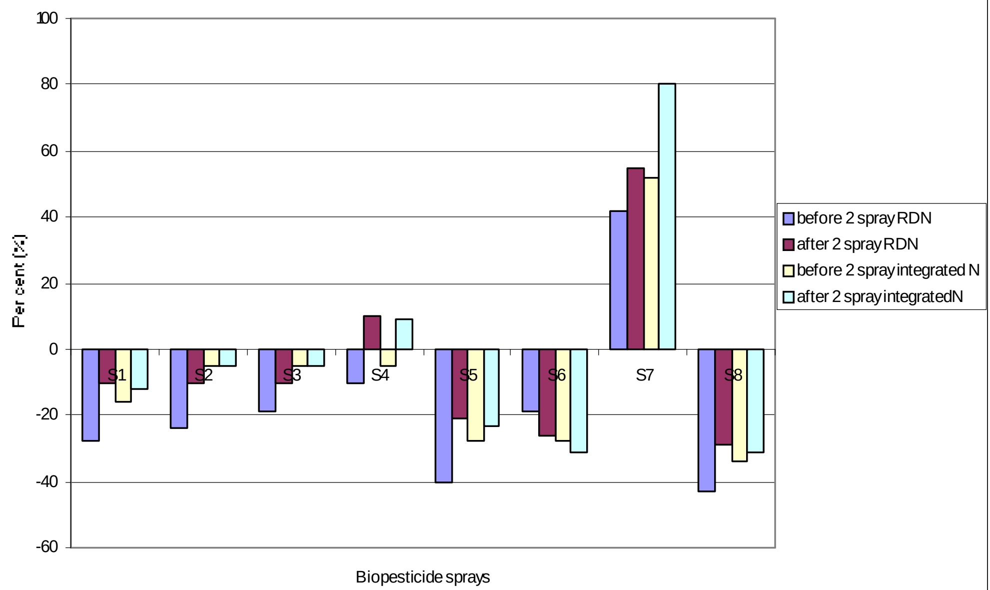
treatment combination. T_2S_1, T_2S_2, T_2S_4 and T_2S_9 were next in the order, while the highest mites population (0.83 leaf^{-1}) was recorded with T_1S_{10} treatment combination.

Before fourth spray (Table 73), integrated N supply to chilli 50 per cent each through organic and inorganic sources registered the lowest mites population (0.60 leaf^{-1}). Among the biopesticide sprays alternate spray of Abamectin and Perfect (S_7) recorded the lowest mites population (0.40 leaf^{-1}). Nimbecidine alternated with many other biorationals except silica and Action 100 followed order and these spray schedules were comparable with RPP. While, no spray (S_{10}) treatment recorded the highest mites population (0.92 leaf^{-1}). Chilli nutritioned with integrated sources of N coupled with Abamectin and Perfect (T_2S_7) recorded significantly lower mites population (0.34 leaf^{-1}) (Fig. 20). T_1S_7 treatment combination was on par with the former treatment combination (T_2S_7). T_1S_4, T_2S_1, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 were next in the order. On the other hand, significantly lower mites population (1.00 leaf^{-1}) was recorded in the T_1S_{10}.

After fourth spray (Table 73), the trend remained same and integrated N supply treatment recorded the lowest mites population (0.40 leaf^{-1}). Among biorational sprays, S_7 treatment recorded the lowest mites population per leaf (0.22). Treatments of Nimbecidine alternated with other biorationals except silica were next in the order and were comparable with the recommended spray practice. While, the lowest mites population (0.76 leaf^{-1}) was



A. Per cent reduction in mites population over control before and after a week of second spray of biopesticides under RDN and integrated N supply



B. Per cent variation in mites population over RPP before and after a week of second spray of biopesticides under RDN and integrated N supply

LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

Fig.18: Percent variation in mites population before and after a week of second spray of different biopesticides over control and RPP under RDN and integrated N supply

Table 72. Mites population (no. leaf^{-1}) before third spray (5 WAT) and after 1 week of second spray (6 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before third spray			After 1 week of third spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	1.00^{a} (1.41)	0.42^{a} (1.19)	0.70^{a} (1.30)	0.60^{a} (1.26)	0.40^{a} (1.18)	0.50^{a} (1.22)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.85^{b} (1.36)	0.35^{b} (1.16)	0.60^{b} (1.26)	0.47^{b} (1.21)	0.33^{b} (1.15)	0.40^{b} (1.18)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.03	0.02	0.02	0.04	0.02	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.89^{bc} (1.38)	0.35^{bc} (1.16)	0.62^{c} (1.27)	0.54^{b} (1.24)	0.31^{c} (1.14)	0.42^{c} (1.19)
S_2: Nimbecidine – Leaf extract	0.88^{bc} (1.37)	0.36^{bc} (1.16)	0.62^{c} (1.27)	0.50^{b} (1.22)	0.31^{c} (1.14)	0.41^{c} (1.18)
S_3: Nimbecidine - Panchgavya	0.85^{c} (1.36)	0.40^{b} (1.18)	0.62^{c} (1.27)	0.52^{b} (1.23)	0.35^{bc} (1.16)	0.45^{c} (1.20)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.81^{c} (1.35)	0.36^{bc} (1.16)	0.57^{c} (1.25)	0.50^{b} (1.22)	0.31^{c} (1.14)	0.40^{c} (1.20)
S_5: Nimbecidine - Silica spray	1.04^{b} (1.43)	0.43^{b} (1.19)	0.72^{b} (1.31)	0.57^{b} (1.25)	0.42^{bc} (1.19)	0.48^{bc} (1.22)
S_6: Nimbecidine - Action 100 spray	1.07^{b} (1.44)	0.43^{b} (1.19)	0.72^{b} (1.31)	0.57^{b} (1.25)	0.42^{bc} (1.19)	0.48^{bc} (1.22)
S_7: Abamectin (1.9 EC) - Perfect	0.56^{d} (1.26)	0.25^{c} (1.12)	0.41^{d} (1.18)	0.17^{c} (1.08)	0.17^{d} (1.08)	0.17^{d} (1.08)
S_8: Silica	1.07^{b} (1.44)	0.43^{b} (1.19)	0.73^{b} (1.32)	0.68^{ab} (1.29)	0.46^{ab} (1.21)	0.57^{b} (1.25)
S_9: RPP	0.85^{c} (1.36)	0.33^{bc} (1.15)	0.57^{c} (1.25)	0.45^{b} (1.20)	0.31^{c} (1.14)	0.37^{c} (1.17)
S_{10}: Control	1.28^{a} (1.51)	0.54^{a} (1.24)	0.91^{a} (1.38)	0.86^{a} (1.36)	0.57^{a} (1.25)	0.72^{a} (1.31)
S.Em.±	0.02	0.01	0.01	0.03	0.02	0.02
C.D at 5%	0.06	0.04	0.04	0.08	0.05	0.04
Interaction						
T_1S_1	0.95^{b-e} (1.40)	0.40^{b-e} (1.18)	0.67^{c-g} (1.29)	0.60^{b} (1.26)	0.34^{bcd} (1.16)	0.47^{b-e} (1.21)
T_1S_2	0.95^{b-e} (1.40)	0.42^{b-e} (1.19)	0.67^{c-g} (1.29)	0.56^{b} (1.25)	0.34^{bcd} (1.16)	0.47^{b-e} (1.21)
T_1S_3	0.93^{b-e} (1.39)	0.46^{abc} (1.21)	0.70^{c-f} (1.30)	0.56^{b} (1.25)	0.40^{bcd} (1.18)	0.50^{b-e} (1.22)
T_1S_4	0.85^{c-f} (1.36)	0.40^{b-e} (1.18)	0.62^{c-g} (1.27)	0.53^{b} (1.24)	0.35^{bcd} (1.16)	0.45^{b-e} (1.20)
T_1S_5	1.10^{abc} (1.45)	0.45^{a-d} (1.20)	0.77^{bc} (1.33)	0.60^{b} (1.26)	0.45^{bc} (1.20)	0.52^{bcd} (1.23)
T_1S_6	1.13^{abc} (1.46)	0.45^{a-d} (1.20)	0.77^{bc} (1.33)	0.60^{b} (1.26)	0.46^{bc} (1.21)	0.52^{bcd} (1.23)
T_1S_7	0.62^{fg} (1.27)	0.32^{c-f} (1.15)	0.47^{hi} (1.21)	0.20^{cd} (1.10)	0.20^{de} (1.10)	0.20^{fg} (1.10)
T_1S_8	1.10^{a-d} (1.45)	0.45^{a-d} (1.20)	0.73^{bcd} (1.32)	0.72^{ab} (1.31)	0.52^{ab} (1.23)	0.62^{b} (1.27)
T_1S_9	0.89^{c-f} (1.37)	0.33^{c-f} (1.15)	0.60^{d-h} (1.26)	0.50^{bc} (1.22)	0.34^{bcd} (1.16)	0.42^{cde} (1.19)
T_1S_{10}	1.36^{a} (1.54)	0.57^{a} (1.25)	0.96^{a} (1.40)	1.00^{a} (1.41)	0.67^{a} (1.29)	0.83^{a} (1.35)

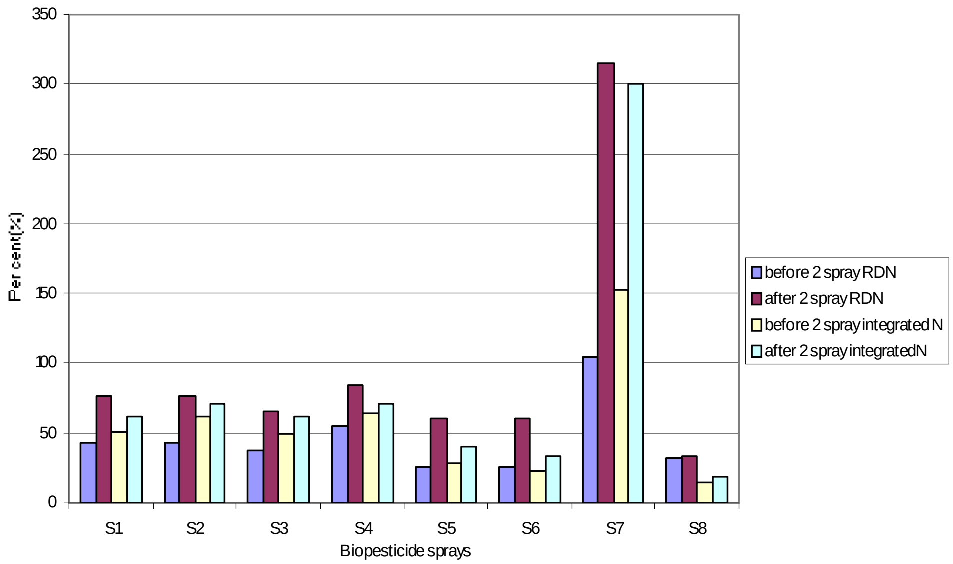
T_2S_1	0.83 ^{def} (1.35)	0.32 ^{def} (1.14)	0.57 $^{e-h}$ (1.25)	0.47 ^{bc} (1.21)	0.27 ^{cde} (1.13)	0.37 ^{def} (1.17)
T_2S_2	0.80 ^{ef} (1.34)	0.32 ^{def} (1.14)	0.53 ^{fgh} (1.24)	0.45 ^{bc} (1.20)	0.27 ^{cde} (1.13)	0.35 ^{def} (1.16)
T_2S_3	0.77 ^{ef} (1.33)	0.33 $^{c-f}$ (1.15)	0.53 ^{fgh} (1.24)	0.47 ^{bc} (1.21)	0.30 ^{cde} (1.14)	0.40 ^{de} (1.18)
T_2S_4	0.77 ^{ef} (1.33)	0.27 ^{ef} (1.13)	0.52 ^{gh} (1.23)	0.45 ^{bc} (1.20)	0.27 ^{cde} (1.13)	0.35 ^{def} (1.16)
T_2S_5	0.97 $^{b-e}$ (1.40)	0.40 $^{b-e}$ (1.18)	0.67 $^{c-g}$ (1.29)	0.52 ^{bc} (1.23)	0.37 ^{bcd} (1.17)	0.43 $^{b-e}$ (1.20)
T_2S_6	1.00 $^{b-e}$ (1.41)	0.40 $^{b-e}$ (1.18)	0.70 $^{c-f}$ (1.30)	0.53 ^{b} (1.24)	0.37 ^{bcd} (1.17)	0.45 $^{b-e}$ (1.20)
T_2S_7	0.50 ^{g} (1.22)	0.18 ^{f} (1.09)	0.34 ^{i} (1.16)	0.15 ^{d} (1.07)	0.15 ^{e} (1.07)	0.15 ^{g} (1.07)
T_2S_8	1.03 $^{b-e}$ (1.42)	0.42 $^{b-e}$ (1.19)	0.72 $^{b-c}$ (1.31)	0.64 ^{b} (1.28)	0.40 ^{bcd} (1.18)	0.52 ^{bcd} (1.23)
T_2S_9	0.80 ^{ef} (1.34)	0.33 $^{c-f}$ (1.15)	0.56 ^{fgh} (1.24)	0.40 ^{bcd} (1.18)	0.27 ^{cde} (1.13)	0.33 ^{ef} (1.15)
T_2S_{10}	1.20 ^{ab} (1.48)	0.52 ^{ab} (1.23)	0.86 ^{ab} (1.36)	0.72 ^{ab} (1.31)	0.47 ^{bc} (1.21)	0.60^{bc} (1.26)
S.Em.±	0.03	0.02	0.02	0.04	0.03	0.02
C.D at 5%	0.09	0.05	0.05	0.12	0.07	0.06
C.V. (%)	3.7	3.2	3.5	5.5	3.7	4.8

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate √x+1 transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

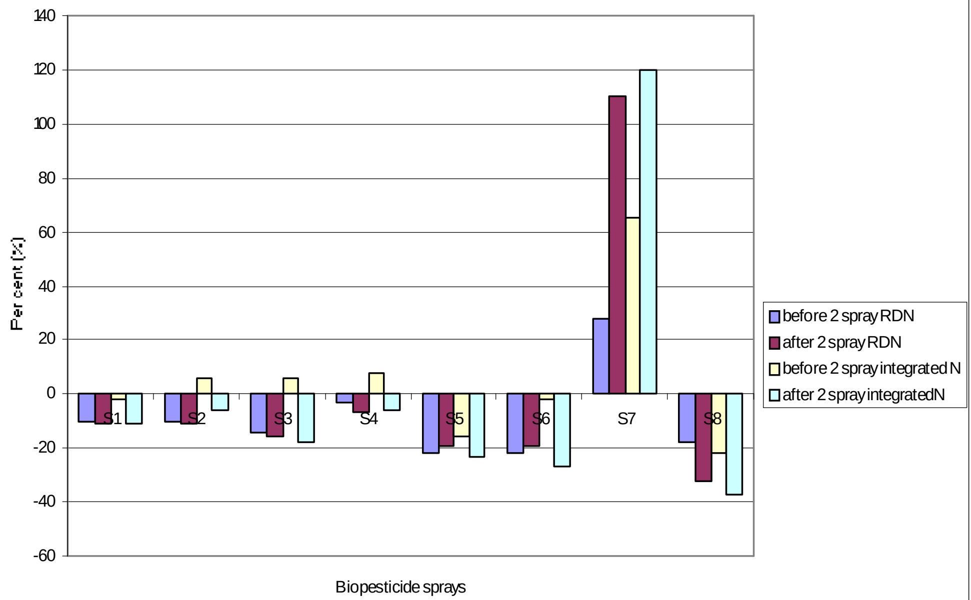
recorded with control treatment having no sprays. Among the treatment combinations, T_2S_7 recorded significantly lower mites population (0.18 leaf^{-1}) (Fig. 20). T_1S_7, T_2S_1, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 treatment combinations were next in the order. While, significantly higher mites population (0.85 leaf^{-1}) was recorded with inorganic sources of nitrogen applied without any spray for the sucking pests control.

Before fifth spray also the lowest mites population (0.57 leaf^{-1}) was recorded with the treatment nutritioned with equal doses of N through organic and inorganic sources (Table 74). Among the biopesticide sprays, alternate spray of Abamectin and Perfect (S_7) registered the lowest mites population (0.30 leaf^{-1}). Nimbecidine sprays alternated with other biorationals except silica were next in the order and comparable with RPP. While, the highest mites population (0.91 leaf^{-1}) was recorded with chilli unprotected against the sucking pests. Among the treatment combinations, T_2S_7 recorded the lowest mites population (0.25 leaf^{-1}) (Fig. 21). T_1S_7 recorded on par mites population with the former treatment combination (T_2S_7). T_2S_1, T_2S_2, T_2S_4 and T_2S_9 were next in the order. On the other hand, significantly higher mites population (1.02 leaf^{-1}) was recorded with T_1S_{10} treatment combination.

After fifth spray (Table 74), the trend continued to remain same and the lowest mites population was recorded with integrated N supply (0.35 leaf^{-1}). Among biopesticides, alternate spray of Abamectin and Perfect (S_7) registered the lowest mites population (0.11 leaf^{-1}). Sprays comprising of Nimbecidine alternated with rest of the bioextracts except silica and Action 100 were next in the order and were comparable with RPP. On the other hand, the highest mites population (0.68 leaf^{-1}) was recorded with control treatment having no sprays. Among the treatment combinations, T_2S_7 recorded significantly lower mites population (0.05 leaf^{-1}) (Fig.21). T_1S_7 was on par with the former treatment combination. T_2S_1, T_2S_2, T_2S_4 and T_2S_9 were next in the order. While, significantly higher mites population (0.77 leaf^{-1}) was recorded with chilli crop supplied with inorganic N but without any sprays (T_1S_{10}).



A. Per cent reduction in mites population over control before and after a week of third spray of different biopesticides under RDN and integrated N supply.



B. Per cent variation in mites population over RPP before and after a week of third spray of different biopesticides under RDN and integrated N supply

LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

Fig.19: Percent variation in mites population over control before and after a week of third spray of biopesticides and RPP under RDN and integrated N supply

Table 73. Mites population (no. leaf^{-1}) before fourth spray (9 WAT) and after 1 week of fourth spray (10 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before fourth spray			After 1 week of fourth spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.93 ^{a} (1.39)	0.50 ^{a} (1.22)	0.73 ^{a} (1.31)	0.62 ^{a} (1.27)	0.40 ^{a} (1.18)	0.50 ^{a} (1.22)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.83 ^{b} (1.35)	0.40 ^{b} (1.18)	0.60 ^{b} (1.26)	0.50 ^{b} (1.22)	0.31 ^{b} (1.14)	0.40 ^{b} (1.18)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.03	0.03	0.02	0.04	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.87 ^{bc} (1.37)	0.40 ^{bc} (1.18)	0.65 ^{cd} (1.28)	0.54 ^{b} (1.24)	0.33 ^{bc} (1.15)	0.43 ^{bc} (1.19)
S_2: Nimbecidine – Leaf extract	0.85 ^{bc} (1.36)	0.45 ^{bc} (1.20)	0.65 ^{cd} (1.28)	0.50 ^{b} (1.22)	0.33 ^{bc} (1.15)	0.40 ^{c} (1.18)
S_3: Nimbecidine - Panchgavya	0.90 ^{bc} (1.38)	0.45 ^{bc} (1.20)	0.67 ^{bcd} (1.29)	0.52 ^{b} (1.23)	0.33 ^{bc} (1.15)	0.43 ^{bc} (1.19)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.80 ^{bc} (1.34)	0.37 ^{c} (1.17)	0.58 ^{d} (1.25)	0.47 ^{bc} (1.21)	0.27 ^{bc} (1.13)	0.37 ^{c} (1.17)
S_5: Nimbecidine - Silica spray	0.96 ^{bc} (1.40)	0.50 ^{abc} (1.22)	0.73 ^{bc} (1.31)	0.57 ^{b} (1.25)	0.40 ^{ab} (1.18)	0.50 ^{bc} (1.22)
S_6: Nimbecidine - Action 100 spray	0.96 ^{bc} (1.40)	0.50 ^{abc} (1.22)	0.73 ^{bc} (1.31)	0.61 ^{b} (1.27)	0.37 ^{ab} (1.17)	0.50 ^{bc} (1.22)
S_7: Abamectin (1.9 EC) - Perfect	0.59 ^{d} (1.26)	0.22 ^{d} (1.10)	0.40 ^{e} (1.18)	0.28 ^{c} (1.13)	0.15 ^{c} (1.07)	0.22 ^{d} (1.10)
S_8: Silica	1.00 ^{b} (1.41)	0.58 ^{ab} (1.25)	0.78 ^{b} (1.33)	0.64 ^{b} (1.28)	0.47 ^{ab} (1.21)	0.55 ^{b} (1.24)
S_9: RPP	0.78 ^{c} (1.33)	0.45 ^{bc} (1.20)	0.63 ^{cd} (1.27)	0.50 ^{b} (1.22)	0.33 ^{bc} (1.15)	0.40 ^{c} (1.18)
S_{10}: Control	1.20 ^{a} (1.48)	0.66 ^{a} (1.28)	0.90 ^{a} (1.38)	1.00 ^{a} (1.41)	0.55 ^{a} (1.24)	0.76 ^{a} (1.33)
S.Em.±	0.02	0.02	0.01	0.03	0.03	0.02
C.D at 5%	0.06	0.06	0.04	0.08	0.07	0.05
Interaction						
T_1S_1	0.96 ^{bcd} (1.40)	0.45 $^{b-e}$ (1.20)	0.70 $^{b-f}$ (1.30)	0.60 ^{b} (1.26)	0.37 $^{a-d}$ (1.17)	0.50 $^{b-e}$ (1.22)
T_1S_2	0.90 $^{b-e}$ (1.38)	0.50 $^{a-e}$ (1.22)	0.70 $^{b-f}$ (1.30)	0.53 ^{bcd} (1.24)	0.35 $^{a-d}$ (1.16)	0.45 $^{c-f}$ (1.20)
T_1S_3	0.93 ^{bcd} (1.39)	0.52 $^{a-d}$ (1.23)	0.73 $^{b-e}$ (1.31)	0.60 ^{bc} (1.26)	0.37 $^{a-d}$ (1.17)	0.47 $^{b-e}$ (1.21)
T_1S_4	0.85 $^{b-e}$ (1.36)	0.42 $^{b-f}$ (1.19)	0.63 $^{d-g}$ (1.27)	0.53 ^{bcd} (1.24)	0.33 $^{a-d}$ (1.15)	0.45 $^{c-f}$ (1.20)
T_1S_5	1.00 ^{bcd} (1.41)	0.53 $^{a-d}$ (1.24)	0.78 ^{bcd} (1.33)	0.60 ^{bc} (1.26)	0.47 ^{abc} (1.21)	0.55 ^{bcd} (1.24)
T_1S_6	1.02 ^{bc} (1.42)	0.55 $^{a-d}$ (1.24)	0.78 ^{bcd} (1.33)	0.63 ^{bc} (1.28)	0.42 ^{abc} (1.19)	0.52 $^{b-e}$ (1.23)
T_1S_7	0.64 ^{fg} (1.28)	0.25 ^{ef} (1.12)	0.45 ^{gh} (1.20)	0.33 ^{cd} (1.15)	0.18 ^{cd} (1.09)	0.25 ^{fg} (1.12)
T_1S_8	1.07 ^{ab} (1.44)	0.65 ^{ab} (1.28)	0.85 ^{ab} (1.36)	0.67 ^{bc} (1.29)	0.50 ^{ab} (1.22)	0.58 ^{bc} (1.25)
T_1S_9	0.80 $^{b-f}$ (1.34)	0.50 $^{a-e}$ (1.22)	0.65 $^{c-f}$ (1.28)	0.53 ^{bcd} (1.24)	0.40 $^{a-d}$ (1.18)	0.47 $^{b-e}$ (1.21)

T_1S_{10}	1.30 ^{a} (1.52)	0.73 ^{a} (1.31)	1.00 ^{a} (1.41)	1.13 ^{a} (1.46)	0.60 ^{a} (1.26)	0.85 ^{a} (1.36)
T_2S_1	0.80 $^{b-f}$ (1.34)	0.35 $^{c-f}$ (1.16)	0.58 ^{efg} (1.25)	0.47 ^{cd} (1.21)	0.27 ^{bcd} (1.13)	0.37 $^{c-g}$ (1.17)
T_2S_2	0.80 $^{b-f}$ (1.34)	0.37 $^{c-f}$ (1.17)	0.60 $^{d-g}$ (1.26)	0.42 ^{cd} (1.19)	0.27 ^{bcd} (1.13)	0.35 $^{d-g}$ (1.16)
T_2S_3	0.87 $^{b-e}$ (1.37)	0.40 $^{b-f}$ (1.18)	0.63 $^{d-g}$ (1.27)	0.47 ^{cd} (1.21)	0.27 ^{bcd} (1.13)	0.37 $^{c-g}$ (1.17)
T_2S_4	0.72 ^{def} (1.31)	0.30 ^{def} (1.14)	0.53 ^{fg} (1.23)	0.40 ^{cd} (1.18)	0.23 ^{bcd} (1.11)	0.33 ^{efg} (1.15)
T_2S_5	0.90 $^{b-e}$ (1.38)	0.41 $^{b-f}$ (1.19)	0.65 $^{c-f}$ (1.28)	0.55 ^{bcd} (1.24)	0.35 $^{a-d}$ (1.16)	0.45 $^{c-f}$ (1.20)
T_2S_6	0.90 $^{b-e}$ (1.38)	0.45 $^{b-e}$ (1.20)	0.67 $^{b-f}$ (1.29)	0.58 ^{bc} (1.25)	0.33 $^{a-d}$ (1.15)	0.45 $^{c-f}$ (1.20)
T_2S_7	0.53 ^{f} (1.24)	0.18 ^{f} (1.09)	0.34 ^{h} (1.16)	0.23 ^{d} (1.11)	0.13 ^{d} (1.06)	0.18 ^{g} (1.09)
T_2S_8	0.93 ^{bcd} (1.39)	0.50 $^{a-e}$ (1.22)	0.70 $^{b-f}$ (1.30)	0.60 ^{bc} (1.26)	0.42 ^{abc} (1.19)	0.52 $^{b-e}$ (1.23)
T_2S_9	0.77 $^{c-f}$ (1.33)	0.40 $^{b-f}$ (1.18)	0.58 ^{efg} (1.25)	0.45 ^{cd} (1.20)	0.25 ^{bcd} (1.12)	0.35 $^{d-g}$ (1.16)
T_2S_{10}	1.07 ^{ab} (1.44)	0.60 ^{abc} (1.26)	0.83 ^{abc} (1.35)	0.87 ^{ab} (1.37)	0.50 ^{ab} (1.22)	0.67 ^{ab} (1.29)
S.Em.±	0.03	0.03	0.02	0.04	0.04	0.03
C.D at 5%	0.09	0.09	0.06	0.12	0.11	0.07
C.V (%)	4.1	4.5	4.3	5.9	5.2	5.6

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate $\sqrt{x+1}$ transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

4.3.3.3 Coccinellid population (no. plant^{-1})

The influences of sources of N, biopesticides sprays and their interaction were significant with regard to coccinellid population during the periodical observations (Table 75, 76, 77 and 78).

The highest coccinellid population before second spray (0.67 plant^{-1}) was recorded with crop supplied with inorganic sources of N (Table 75). Among the spray treatments control treatment having no sprays recorded the highest coccinellid population (0.82 plant^{-1}). The recommended chemicals sprayed treatment (S_9) recorded significantly lower coccinellid population (0.43 plant^{-1}). Among the treatment combinations, chilli supplied with inorganic source of N (RDF) without any sprays (T_1S_{10}) recorded significantly higher spider population (0.86 plant^{-1}). T_1S_3, T_1S_5, T_1S_6, T_1S_8, T_2S_5, T_2S_6 and T_2S_{10} were on par with the former treatment combination. On the other hand, significantly lower coccinellid population (0.38 plant^{-1}) was registered with T_2S_9 treatment combination.

Coccinellid population a week after second spray revealed the highest values (0.62 plant^{-1}) with N application through inorganic source (Table 75). The treatment having no sprays (S_{10}) recorded significantly higher coccinellid population (0.85 plant^{-1}). While, the lowest coccinellid population (0.33 plant^{-1}) was recorded in the chemical spray treatment (RPP). Among the treatment combinations, inorganic N nutritioned crop without any sprays (T_1S_{10}) recorded significantly higher coccinellid population (0.85 plant^{-1}). T_1S_1, T_1S_6, T_1S_8 and T_2S_{10} were on par with the former treatment combination. While, significantly lower coccinellid population (0.26 plant^{-1}) was recorded with T_2S_9 treatment combination.

Table 74. Mites population (no. leaf^{-1}) before fifth spray (11 WAT) and after 1 week of fifth spray (12 WAT) as influenced by different sources of nutrition and biopesticides spray

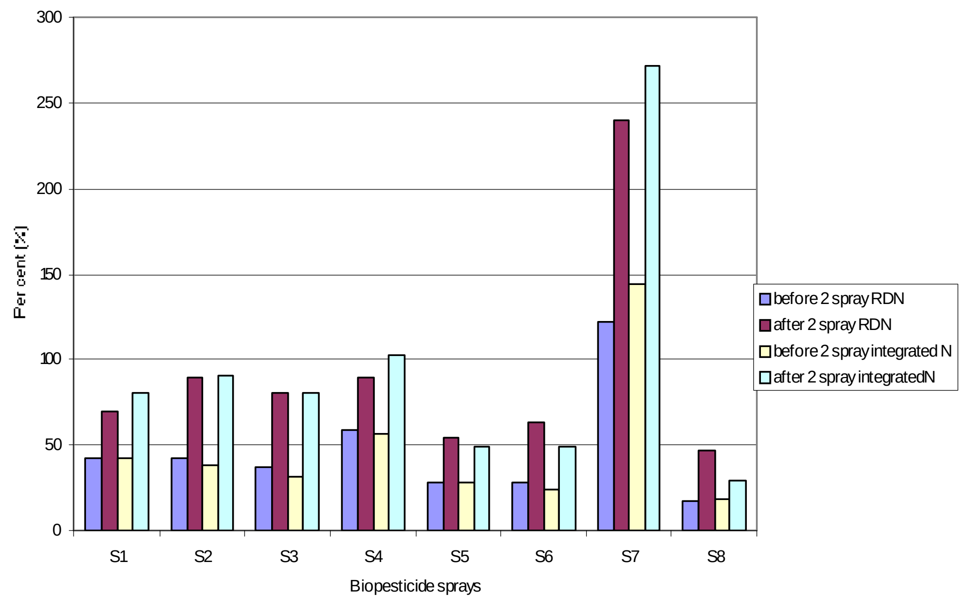
Treatments	Before fifth spray			After 1 week of fifth spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.96 ^{a} (1.40)	0.42 ^{a} (1.19)	0.70 ^{a} (1.30)	0.54 ^{a} (1.24)	0.37 ^{a} (1.17)	0.45 ^{a} (1.20)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.82 ^{b} (1.35)	0.33 ^{b} (1.15)	0.57 ^{b} (1.25)	0.42 ^{b} (1.19)	0.27 ^{b} (1.13)	0.35 ^{b} (1.16)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.04	0.04	0.03	0.04	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.90 ^{b} (1.38)	0.36 ^{b} (1.17)	0.62 ^{bc} (1.27)	0.45 ^{b} (1.20)	0.30 ^{b} (1.14)	0.37 ^{bcd} (1.17)
S_2: Nimbecidine – Leaf extract	0.80 ^{b} (1.34)	0.36 ^{b} (1.17)	0.58 ^{bc} (1.26)	0.40 ^{b} (1.18)	0.34 ^{b} (1.16)	0.37 ^{bcd} (1.17)
S_3: Nimbecidine - Panchgavya	0.96 ^{b} (1.40)	0.40 ^{b} (1.18)	0.66 ^{bc} (1.29)	0.45 ^{b} (1.20)	0.34 ^{b} (1.16)	0.41 ^{bcd} (1.18)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.80 ^{b} (1.34)	0.32 ^{b} (1.15)	0.54 ^{c} (1.24)	0.40 ^{b} (1.18)	0.27 ^{b} (1.13)	0.33 ^{d} (1.15)
S_5: Nimbecidine - Silica spray	1.00 ^{b} (1.41)	0.40 ^{b} (1.18)	0.68 ^{bc} (1.29)	0.57 ^{b} (1.25)	0.34 ^{b} (1.16)	0.46 ^{bc} (1.21)
S_6: Nimbecidine - Action 100 spray	0.96 ^{b} (1.40)	0.42 ^{ab} (1.19)	0.68 ^{bc} (1.29)	0.60 ^{ab} (1.26)	0.37 ^{b} (1.17)	0.48 ^{b} (1.22)
S_7: Abamectin (1.9 EC) - Perfect	0.43 ^{c} (1.19)	0.20 ^{b} (1.10)	0.30 ^{d} (1.14)	0.13 ^{c} (1.06)	0.08 ^{c} (1.04)	0.11 ^{e} (1.05)
S_8: Silica	1.05 ^{ab} (1.43)	0.42 ^{ab} (1.19)	0.72 ^{b} (1.31)	0.63 ^{ab} (1.27)	0.37 ^{b} (1.17)	0.50 ^{b} (1.22)
S_9: RPP	0.85 ^{b} (1.36)	0.33 ^{b} (1.15)	0.58 ^{bc} (1.25)	0.41 ^{b} (1.19)	0.27 ^{b} (1.13)	0.35 ^{cd} (1.16)
S_{10}: Control	1.25 ^{a} (1.50)	0.61 ^{a} (1.27)	0.91 ^{a} (1.38)	0.80 ^{a} (1.34)	0.57 ^{a} (1.25)	0.68 ^{a} (1.30)
S.Em.±	0.03	0.03	0.02	0.03	0.02	0.02
C.D at 5%	0.08	0.08	0.06	0.08	0.06	0.05
Interaction						
T_1S_1	0.96 ^{abc} (1.40)	0.40 ^{ab} (1.18)	0.67 $^{b-e}$ (1.29)	0.50 ^{bc} (1.22)	0.33 ^{bcd} (1.15)	0.42 $^{b-e}$ (1.19)
T_1S_2	0.82 ^{bc} (1.35)	0.42 ^{ab} (1.19)	0.60 $^{b-e}$ (1.27)	0.45 ^{bcd} (1.20)	0.37 ^{bcd} (1.17)	0.40 $^{b-e}$ (1.18)
T_1S_3	1.05 ^{abc} (1.43)	0.45 ^{ab} (1.20)	0.72 $^{b-e}$ (1.31)	0.47 ^{bcd} (1.21)	0.40 ^{bcd} (1.18)	0.45 $^{b-e}$ (1.20)
T_1S_4	0.87 ^{bc} (1.37)	0.35 ^{b} (1.16)	0.58 $^{b-e}$ (1.26)	0.45 ^{bcd} (1.20)	0.33 ^{bcd} (1.15)	0.40 $^{b-e}$ (1.18)
T_1S_5	1.05 ^{abc} (1.43)	0.45 ^{ab} (1.20)	0.75 ^{bcd} (1.32)	0.63 ^{abc} (1.28)	0.40 ^{bcd} (1.18)	0.52 ^{bcd} (1.23)
T_1S_6	1.03 ^{abc} (1.42)	0.50 ^{ab} (1.22)	0.75 ^{bcd} (1.32)	0.67 ^{ab} (1.29)	0.45 ^{abc} (1.20)	0.54 ^{bc} (1.24)
T_1S_7	0.47 ^{de} (1.21)	0.23 ^{b} (1.11)	0.35 ^{fg} (1.16)	0.17 ^{de} (1.08)	0.17 ^{de} (1.08)	0.17 ^{fg} (1.08)
T_1S_8	1.13 ^{ab} (1.46)	0.45 ^{ab} (1.20)	0.77 ^{bc} (1.33)	0.70 ^{ab} (1.30)	0.40 ^{bcd} (1.18)	0.54 ^{bc} (1.24)
T_1S_9	0.85 ^{bc} (1.36)	0.35 ^{b} (1.16)	0.58 $^{b-e}$ (1.26)	0.45 ^{bcd} (1.20)	0.33 ^{bcd} (1.15)	0.40 $^{b-e}$ (1.18)

T_1S_{10}	1.33 [a] (1.53)	0.72 [a] (1.31)	1.02 [a] (1.42)	0.90 [a] (1.38)	0.65 [a] (1.28)	0.77 [a] (1.33)
T_2S_1	0.83 [bc] (1.35)	0.33 [b] (1.15)	0.57 [b-f] (1.25)	0.40 [b-e] (1.18)	0.27 [bcd] (1.13)	0.33 [def] (1.15)
T_2S_2	0.78 [bcd] (1.33)	0.33 [b] (1.15)	0.55 [b-f] (1.24)	0.33 [cde] (1.15)	0.30 [bcd] (1.14)	0.32 [def] (1.15)
T_2S_3	0.89 [bc] (1.37)	0.35 [b] (1.16)	0.58 [b-e] (1.26)	0.45 [bcd] (1.20)	0.30 [bcd] (1.14)	0.37 [cde] (1.17)
T_2S_4	0.70 [cd] (1.30)	0.28 [b] (1.13)	0.50 [ef] (1.22)	0.33 [cde] (1.15)	0.20 [cd] (1.10)	0.27 [ef] (1.13)
T_2S_5	0.90 [bc] (1.38)	0.35 [b] (1.16)	0.62 [b-e] (1.27)	0.52 [bc] (1.23)	0.30 [bcd] (1.14)	0.40 [b-e] (1.18)
T_2S_6	0.90 [bc] (1.38)	0.35 [b] (1.16)	0.60 [b-e] (1.27)	0.53 [bc] (1.24)	0.30 [bcd] (1.14)	0.42 [b-e] (1.19)
T_2S_7	0.37 [e] (1.17)	0.17 [b] (1.08)	0.25 [g] (1.12)	0.10 [e] (1.05)	0.00 [e] (1.00)	0.05 [g] (1.02)
T_2S_8	0.96 [abc] (1.40)	0.38 [b] (1.17)	0.67 [b-e] (1.29)	0.57 [abc] (1.25)	0.33 [bcd] (1.15)	0.45 [b-e] (1.20)
T_2S_9	0.77 [bcd] (1.33)	0.30 [b] (1.14)	0.52 [def] (1.23)	0.37 [b-e] (1.17)	0.20 [cd] (1.10)	0.30 [ef] (1.14)
T_2S_{10}	1.13 [ab] (1.46)	0.50 [ab] (1.22)	0.80 [ab] (1.34)	0.70 [ab] (1.30)	0.50 [ab] (1.22)	0.60 [ab] (1.26)
S.Em.±	0.04	0.04	0.03	0.04	0.03	0.03
C.D at 5%	0.12	0.12	0.08	0.12	0.09	0.07
C.V. (%)	5.4	5.9	5.6	5.6	4.8	5.2

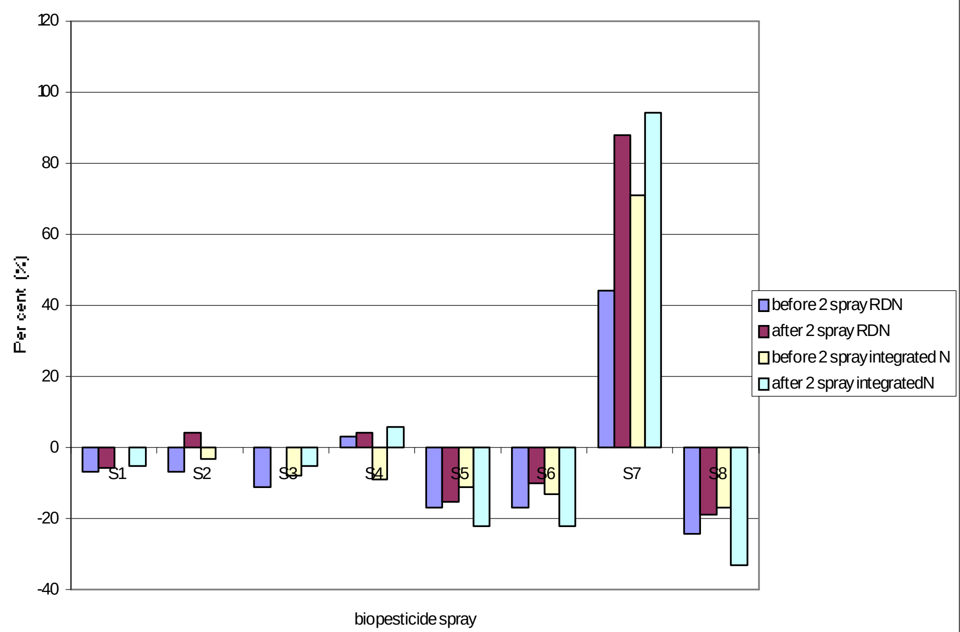
* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbicidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimonia mexicana* and NSKE,) abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate √x+1 transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Coccinellid population before third spray was the highest (0.52 plant^{-1}) with N supplied through inorganic source (Table 76). No spray (control) treatment recorded the highest coccinellid population (0.74 plant^{-1}). While, the chemical sprayed (RPP) treatment recorded the lowest coccinellid population (0.20 plant^{-1}). Among the treatment combinations, inorganic N nutritioned crop without any sprays (T_1S_{10}) for sucking pests recorded significantly higher coccinellid population (0.80 plant^{-1}). T_1 S_5, T_1S_6 and T_2S_{10} were on par with the former treatment combination (T_1S_{10}). While, RPP sprayed treatment coupled with integrated N supply through organic and inorganic sources (T_2S_9) recorded significantly lower coccinellid population (0.19 plant^{-1}).

After third spray the coccinellid population was the highest (0.42 plant^{-1}) with N supplied through inorganic sources (Table 76) and no spray (S_{10}) registered the highest population of coccinellids (0.65 plant^{-1}). While, chemical sprayed (S_9) treatment (Dimethoate, Dicofal and Carbaryl) recorded the lowest coccinellid count (0.18 plant^{-1}). Among the treatment combinations, N nutritioned through inorganic without any sprays (T_1S_{10}) against the sucking pests registered significantly higher coccinellid population (0.70 plant^{-1}). T_1S_5, T_1S_6 and T_2S_{10} treatment combinations were on par with the former treatment combination (T_1S_{10}). While, RPP with integrated N supply recorded significantly lower coccinellid population (0.16 plant^{-1}).



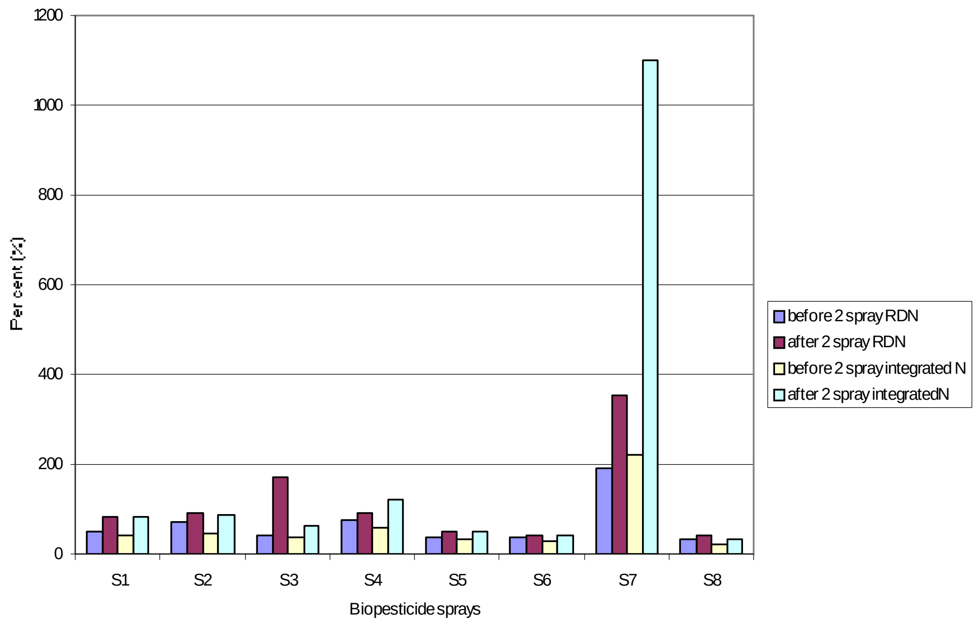
A. Per cent reduction in mites population over control before and after a week of fourth spray of biopesticides under recommended dose of nitrogen and integrated N supply



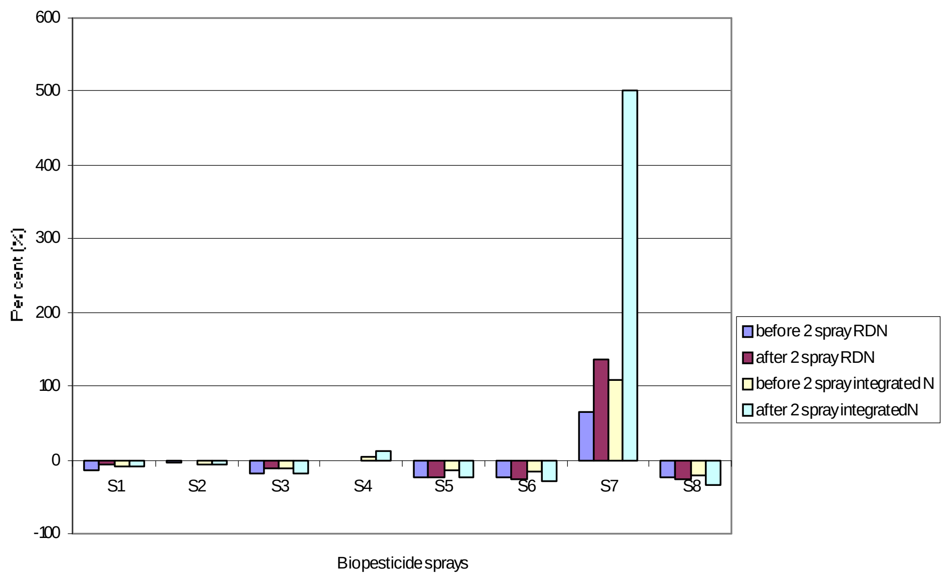
B.Per cent variation in mites population over RPP before and after a week of fourth spray of biopesticides under RDN and integrated N supply

LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

Fig.20: Percent variation in mites population over control and RPP (Recommended plant protection) before and after a week of fourth spray of different biopesticides under RDN and integrated supply



A. Per cent reduction in mites population over control before and after a week of fifth spray of different biopesticides under RDN and integrated N supply



B. Per cent variation in mites population over RPP before and after a week of fifth spray of different biopesticides under RDN and integrated N supply

LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

Fig. 21. Percent variation in mites population over control and RPP before and after a week of fifth spray of different biopesticides under RDN and integrated N supply

Table 75. Coccinellids population plant^{-1} before second spray (5 WAT) and after 1 week of second spray (6 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before second spray			After 1 week of second spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.72 ^{a} (1.31)	0.64 ^{a} (1.28)	0.67 ^{a} (1.29)	0.64 ^{a} (1.28)	0.60 ^{a} (1.26)	0.62 ^{a} (1.27)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.62 ^{b} (1.27)	0.44 ^{b} (1.20)	0.54 ^{b} (1.24)	0.54 ^{b} (1.24)	0.44 ^{b} (1.20)	0.50 ^{b} (1.22)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.04	0.04	0.03	0.03	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.66 ^{bcd} (1.29)	0.55 ^{ab} (1.24)	0.60 ^{bcd} (1.26)	0.60 ^{bcd} (1.26)	0.51 ^{b} (1.23)	0.55 $^{b-e}$ (1.24)
S_2: Nimbecidine – Leaf extract	0.56 ^{cde} (1.25)	0.53 ^{ab} (1.23)	0.54 ^{cde} (1.24)	0.55 $^{b-e}$ (1.24)	0.51 ^{b} (1.23)	0.52 ^{cde} (1.23)
S_3: Nimbecidine - Panchgavya	0.75 ^{abc} (1.32)	0.53 ^{ab} (1.23)	0.64 ^{bc} (1.28)	0.58 $^{b-e}$ (1.25)	0.55 ^{b} (1.24)	0.56 $^{b-e}$ (1.25)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.46 ^{de} (1.21)	0.50 ^{ab} (1.22)	0.48 ^{de} (1.21)	0.45 ^{de} (1.20)	0.45 ^{bc} (1.20)	0.45 ^{de} (1.21)
S_5: Nimbecidine - Silica spray	0.84 ^{ab} (1.36)	0.60 ^{ab} (1.26)	0.72 ^{abc} (1.31)	0.73 ^{ab} (1.31)	0.56 ^{b} (1.25)	0.64 ^{bc} (1.28)
S_6: Nimbecidine - Action 100 spray	0.82 ^{ab} (1.35)	0.52 ^{ab} (1.23)	0.67 ^{abc} (1.29)	0.76 ^{ab} (1.32)	0.56 ^{b} (1.25)	0.66 ^{b} (1.29)
S_7: Abamectin (1.9 EC) - Perfect	0.51 ^{de} (1.23)	0.52 ^{ab} (1.23)	0.52 ^{cde} (1.23)	0.47 ^{cde} (1.21)	0.45 ^{bc} (1.20)	0.46 ^{de} (1.21)
S_8: Silica	0.79 ^{ab} (1.34)	0.55 ^{ab} (1.24)	0.65 ^{abc} (1.29)	0.68 ^{abc} (1.29)	0.53 ^{b} (1.23)	0.60 ^{bcd} (1.26)
S_9: RPP	0.43 ^{e} (1.19)	0.42 ^{b} (1.19)	0.43 ^{e} (1.19)	0.36 ^{e} (1.17)	0.29 ^{c} (1.14)	0.33 ^{f} (1.15)
S_{10}: Control	0.94 ^{a} (1.39)	0.73 ^{a} (1.31)	0.82 ^{a} (1.35)	0.87 ^{a} (1.37)	0.83 ^{a} (1.35)	0.85 ^{a} (1.36)
S.Em.±	0.03	0.03	0.02	0.03	0.03	0.02
C.D at 5%	0.08	0.09	0.06	0.07	0.07	0.05
Interaction						
T_1S_1	0.72 $^{a-e}$ (1.31)	0.62 ^{ab} (1.27)	0.67 $^{a-e}$ (1.29)	0.65 $^{a-d}$ (1.28)	0.62 ^{abc} (1.27)	0.64 ^{abc} (1.28)
T_1S_2	0.60 $^{b-e}$ (1.26)	0.62 ^{ab} (1.27)	0.61 $^{a-f}$ (1.27)	0.60 $^{a-e}$ (1.26)	0.60 ^{abc} (1.26)	0.60 ^{bcd} (1.26)
T_1S_3	0.80 $^{a-d}$ (1.34)	0.67 ^{ab} (1.29)	0.74 $^{a-d}$ (1.31)	0.57 $^{a-e}$ (1.25)	0.60 ^{abc} (1.26)	0.58 $^{b-e}$ (1.25)
T_1S_4	0.50 ^{de} (1.22)	0.60 ^{ab} (1.26)	0.55 $^{c-g}$ (1.24)	0.50 ^{cde} (1.22)	0.53 ^{bc} (1.23)	0.54 $^{b-e}$ (1.24)
T_1S_5	0.87 ^{ab} (1.37)	0.68 ^{ab} (1.30)	0.79 ^{ab} (1.34)	0.80 ^{abc} (1.34)	0.63 ^{abc} (1.28)	0.72 ^{ab} (1.31)
T_1S_6	0.85 ^{abc} (1.36)	0.62 ^{ab} (1.27)	0.73 $^{a-d}$ (1.32)	0.83 ^{ab} (1.35)	0.62 ^{abc} (1.27)	0.72 ^{ab} (1.31)
T_1S_7	0.52 ^{cde} (1.23)	0.60 ^{ab} (1.26)	0.57 $^{b-g}$ (1.25)	0.52 $^{b-e}$ (1.23)	0.52 ^{bc} (1.23)	0.52 $^{b-e}$ (1.23)
T_1S_8	0.85 ^{abc} (1.36)	0.67 ^{ab} (1.29)	0.76 $^{a-d}$ (1.32)	0.77 ^{abc} (1.33)	0.60 ^{abc} (1.26)	0.68 ^{abc} (1.29)
T_1S_9	0.47 ^{de} (1.21)	0.46 ^{ab} (1.21)	0.47 ^{efg} (1.21)	0.42 ^{de} (1.19)	0.40 ^{cd} (1.18)	0.41 ^{def} (1.19)

T_1S_{10}	0.97^{a} (1.40)	0.78^{a} (1.33)	0.86^{a} (1.36)	0.87^{a} (1.37)	0.80^{ab} (1.34)	0.85^{a} (1.36)
T_2S_1	0.60^{b-e} (1.26)	0.47^{ab} (1.21)	0.52^{d-g} (1.23)	0.52^{b-e} (1.23)	0.40^{cd} (1.18)	0.47^{cde} (1.21)
T_2S_2	0.52^{cde} (1.23)	0.43^{ab} (1.19)	0.46^{efg} (1.21)	0.50^{cde} (1.22)	0.41^{cd} (1.19)	0.47^{cde} (1.21)
T_2S_3	0.70^{a-e} (1.30)	0.40^{ab} (1.18)	0.54^{c-g} (1.24)	0.60^{a-e} (1.26)	0.50^{bc} (1.22)	0.54^{b-e} (1.24)
T_2S_4	0.42^{e} (1.19)	0.40^{ab} (1.18)	0.41^{fg} (1.19)	0.40^{de} (1.18)	0.37^{cd} (1.17)	0.38^{ef} (1.17)
T_2S_5	0.80^{a-d} (1.34)	0.50^{ab} (1.22)	0.64^{a-f} (1.28)	0.67^{a-d} (1.29)	0.47^{cd} (1.21)	0.57^{b-e} (1.25)
T_2S_6	0.78^{a-d} (1.33)	0.40^{ab} (1.18)	0.60^{a-g} (1.26)	0.70^{a-d} (1.30)	0.50^{bc} (1.22)	0.60^{bcd} (1.26)
T_2S_7	0.50^{de} (1.22)	0.43^{ab} (1.19)	0.47^{efg} (1.21)	0.42^{de} (1.19)	0.37^{cd} (1.17)	0.40^{def} (1.18)
T_2S_8	0.72^{a-e} (1.31)	0.43^{ab} (1.19)	0.57^{b-g} (1.25)	0.60^{a-e} (1.26)	0.47^{cd} (1.21)	0.52^{b-e} (1.23)
T_2S_9	0.40^{e} (1.18)	0.37^{b} (1.17)	0.38^{g} (1.17)	0.30^{e} (1.14)	0.18^{d} (1.09)	0.26^{f} (1.12)
T_2S_{10}	0.90^{ab} (1.38)	0.67^{ab} (1.29)	0.78^{abc} (1.33)	0.86^{a} (1.36)	0.85^{a} (1.36)	0.85^{a} (1.36)
S.Em.±	0.04	0.05	0.03	0.04	0.04	0.03
C.D at 5%	0.12	0.13	0.08	0.10	0.10	0.07
C.V. (%)	5.3	6.2	5.7	5.0	5.1	5.0

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate $\sqrt{x+1}$ transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Before fourth spray, inorganic N applied plot recorded the highest coccinellid population (0.49 plant^{-1}) (Table 77). While, no spray (control) treatment registered the highest coccinellid population (0.66 plant^{-1}). On the other hand, RPP treatment recorded significantly lower coccinellid population (0.21 plant^{-1}). Among the treatment combinations, N nutritioned through inorganic source without any sprays (T_1S_{10}) recorded significantly higher coccinellid population (0.72 plant^{-1}). T_1S_5, T_1S_6, T_1S_8 and T_2S_{10} were on par with the former treatment combination (T_1S_{10}). While, RPP with equal quantity of N through organics and inorganic sources recorded significantly lower coccinellid population (0.20 plant^{-1}).

Further, the highest population of coccinellid (0.45 plant^{-1}) after fourth spray was recorded with N supplied through inorganic source (Table 77). While, no spray (control) treatment recorded significantly higher coccinellid population per plant (0.63). On the other hand, RPP registered the lowest coccinellid population (0.19 plant^{-1}). Among the treatment combinations, T_1S_{10} recorded significantly higher coccinellid population (0.69 plant^{-1}). T_1S_5, T_1S_6, T_1S_8, T_1S_{10} and T_2S_{10} treatment combinations were on par with the former treatment combination (T_1S_{10}). While, coccinellid population was significantly lower (0.19 plant^{-1}) with T_2S_9 treatment combination.

Before fifth spray (Table 78), inorganic N applied plot recorded the highest coccinellid population (0.47 plant^{-1}). While, no spray (control) treatment registered the highest coccinellid population (0.70 plant^{-1}), among the spray treatments. On the other hand, RPP treatment recorded the lowest coccinellid population (0.13 plant^{-1}). Among the treatment combinations, N nutritioned through inorganic source without any sprays (T_1S_{10}) recorded significantly higher coccinellid population (0.78 plant^{-1}). T_2S_{10} treatment combination was on par with the former treatment combination (T_1S_{10}). While, RPP with equal quantity of N through organics and inorganic sources recorded significantly lower coccinellid population (0.07 plant^{-1}).

Table 76. Coccinellids population (no. plant^{-1}) before third spray (7 WAT) and after 1 week of third spray (8 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before third spray			After 1 week of third spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.60 ^{a} (1.26)	0.47 ^{a} (1.21)	0.52 ^{a} (1.23)	0.50 ^{a} (1.22)	0.38 ^{a} (1.17)	0.42 ^{a} (1.19)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.47 ^{b} (1.21)	0.35 ^{b} (1.16)	0.42 ^{b} (1.19)	0.38 ^{b} (1.17)	0.28 ^{b} (1.13)	0.33 ^{b} (1.15)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.04	0.03	0.02	0.03	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.50 ^{b} (1.22)	0.37 ^{bc} (1.17)	0.43 ^{c} (1.19)	0.38 ^{bcd} (1.17)	0.28 ^{bcd} (1.13)	0.32 ^{c} (1.15)
S_2: Nimbecidine – Leaf extract	0.43 ^{bc} (1.19)	0.35 ^{bc} (1.16)	0.40 ^{c} (1.18)	0.35 ^{cd} (1.16)	0.25 ^{cd} (1.12)	0.31 ^{c} (1.14)
S_3: Nimbecidine - Panchgavya	0.58 ^{b} (1.25)	0.42 ^{bc} (1.19)	0.49 ^{bc} (1.22)	0.50 ^{bc} (1.22)	0.28 ^{bcd} (1.13)	0.40 ^{bc} (1.18)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.58 ^{b} (1.25)	0.42 ^{bc} (1.19)	0.49 ^{bc} (1.22)	0.47 ^{bc} (1.21)	0.33 ^{bc} (1.15)	0.40 ^{bc} (1.18)
S_5: Nimbecidine - Silica spray	0.65 ^{ab} (1.28)	0.51 ^{ab} (1.23)	0.57 ^{b} (1.25)	0.57 ^{ab} (1.25)	0.40 ^{ab} (1.20)	0.51 ^{ab} (1.22)
S_6: Nimbecidine - Action 100 spray	0.62 ^{ab} (1.27)	0.53 ^{ab} (1.23)	0.57 ^{b} (1.25)	0.47 ^{bc} (1.21)	0.38 ^{abc} (1.17)	0.42 ^{bc} (1.19)
S_7: Abamectin (1.9 EC) - Perfect	0.45 ^{bc} (1.20)	0.33 ^{c} (1.15)	0.39 ^{c} (1.18)	0.38 ^{bcd} (1.17)	0.27 ^{a} (1.23)	0.31 ^{c} (1.15)
S_8: Silica	0.58 ^{b} (1.25)	0.42 ^{bc} (1.19)	0.51 ^{bc} (1.22)	0.47 ^{bc} (1.21)	0.35 ^{abc} (1.16)	0.40 ^{bc} (1.18)
S_9: RPP	0.25 ^{c} (1.12)	0.16 ^{b} (1.07)	0.20 ^{d} (1.10)	0.19 ^{d} (1.09)	0.16 ^{d} (1.07)	0.18 ^{d} (1.08)
S_{10}: Control	0.84 ^{a} (1.36)	0.63 ^{a} (1.27)	0.74 ^{a} (1.31)	0.70 ^{a} (1.30)	0.55 ^{a} (1.23)	0.65 ^{a} (1.29)
S.Em.±	0.03	0.02	0.02	0.03	0.02	0.02
C.D at 5%	0.09	0.06	0.05	0.07	0.06	0.05
Interaction						
T_1S_1	0.52 $^{a-e}$ (1.23)	0.40 $^{c-f}$ (1.18)	0.47 $^{b-e}$ (1.21)	0.42 $^{b-f}$ (1.19)	0.30 ^{cde} (1.14)	0.37 ^{cde} (1.17)
T_1S_2	0.47 $^{b-e}$ (1.21)	0.37 $^{c-g}$ (1.17)	0.42 ^{de} (1.19)	0.40 $^{b-f}$ (1.18)	0.27 ^{cde} (1.13)	0.33 $^{c-f}$ (1.15)
T_1S_3	0.60 $^{a-e}$ (1.26)	0.47 $^{a-e}$ (1.21)	0.54 $^{b-e}$ (1.24)	0.52 $^{a-d}$ (1.23)	0.30 ^{cde} (1.14)	0.42 ^{bcd} (1.19)
T_1S_4	0.65 $^{a-d}$ (1.28)	0.50 $^{a-e}$ (1.22)	0.57 ^{bcd} (1.25)	0.52 $^{a-d}$ (1.23)	0.33 $^{b-e}$ (1.15)	0.42 ^{bcd} (1.19)
T_1S_5	0.70 ^{abc} (1.30)	0.60 ^{abc} (1.26)	0.64 ^{abc} (1.28)	0.67 ^{ab} (1.29)	0.57 ^{ab} (1.25)	0.62 ^{ab} (1.27)
T_1S_6	0.65 $^{a-d}$ (1.28)	0.67 ^{ab} (1.29)	0.67 ^{ab} (1.29)	0.62 ^{abc} (1.27)	0.42 ^{abc} (1.19)	0.51 ^{abc} (1.23)
T_1S_7	0.50 $^{a-e}$ (1.22)	0.37 $^{c-g}$ (1.17)	0.43 ^{de} (1.19)	0.40 $^{b-f}$ (1.18)	0.30 ^{cde} (1.14)	0.35 $^{c-f}$ (1.16)
T_1S_8	0.60 $^{a-e}$ (1.26)	0.50 $^{a-e}$ (1.22)	0.55 $^{b-e}$ (1.24)	0.50 ^{bcd} (1.22)	0.40 $^{a-d}$ (1.18)	0.45 ^{bcd} (1.20)
T_1S_9	0.27 ^{de} (1.13)	0.17 ^{fg} (1.08)	0.21 ^{fg} (1.10)	0.19 ^{ef} (1.09)	0.17 ^{de} (1.08)	0.18 ^{ef} (1.09)
T_1S_{10}	0.88 ^{a} (1.37)	0.70 ^{a} (1.30)	0.80 ^{a} (1.34)	0.80 ^{a} (1.34)	0.60 ^{a} (1.26)	0.70 ^{a} (1.30)
T_2S_1	0.47 $^{b-e}$ (1.21)	0.32 $^{d-g}$ (1.15)	0.40 ^{de} (1.18)	0.30 ^{def} (1.14)	0.27 ^{cde} (1.13)	0.28 ^{def} (1.13)

T_2S_2	0.40 ^{cde} (1.18)	0.32 $^{d-g}$ (1.15)	0.37 ^{def} (1.17)	0.30 ^{def} (1.14)	0.24 ^{cde} (1.11)	0.28 ^{def} (1.13)
T_2S_3	0.52 $^{a-e}$ (1.23)	0.37 $^{c-g}$ (1.17)	0.45 ^{cde} (1.20)	0.47 $^{b-e}$ (1.21)	0.28 ^{cde} (1.13)	0.38 ^{cde} (1.17)
T_2S_4	0.50 $^{a-e}$ (1.22)	0.32 $^{d-g}$ (1.15)	0.42 ^{de} (1.19)	0.42 $^{b-f}$ (1.19)	0.30 ^{cde} (1.14)	0.36 ^{cde} (1.17)
T_2S_5	0.60 $^{a-e}$ (1.26)	0.42 $^{b-e}$ (1.19)	0.52 $^{b-e}$ (1.23)	0.47 $^{b-e}$ (1.21)	0.33 $^{b-e}$ (1.15)	0.40 ^{cd} (1.18)
T_2S_6	0.58 $^{a-e}$ (1.25)	0.40 $^{c-f}$ (1.18)	0.47 $^{b-e}$ (1.21)	0.30 ^{def} (1.14)	0.33 $^{b-e}$ (1.15)	0.32 $^{c-f}$ (1.15)
T_2S_7	0.40 ^{cde} (1.18)	0.30 ^{efg} (1.14)	0.34 ^{efg} (1.16)	0.33 $^{c-f}$ (1.15)	0.24 ^{cde} (1.11)	0.28 ^{def} (1.13)
T_2S_8	0.58 $^{a-e}$ (1.25)	0.37 $^{c-g}$ (1.17)	0.47 $^{b-e}$ (1.21)	0.42 $^{b-f}$ (1.19)	0.30 ^{cde} (1.14)	0.37 ^{cde} (1.17)
T_2S_9	0.23 ^{e} (1.11)	0.15 ^{g} (1.07)	0.19 ^{g} (1.09)	0.17 ^{f} (1.08)	0.16 ^{e} (1.07)	0.16 ^{f} (1.07)
T_2S_{10}	0.80 ^{ab} (1.34)	0.57 ^{ab} (1.25)	0.67 ^{ab} (1.29)	0.60 ^{a} (1.26)	0.44 ^{abc} (1.20)	0.65 ^{ab} (1.24)
S.Em.±	0.04	0.03	0.03	0.04	0.03	0.03
C.D at 5%	0.13	0.09	0.07	0.10	0.09	0.07
C.V. (%)	6.4	4.4	5.5	5.4	4.7	5.1

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate $\sqrt{x+1}$ transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Further, the highest population (0.40 $plant^{-1}$) of coccinellid after fifth spray was recorded with N supplied through inorganic source (Table 78). Among the spray treatments, no spray (control) treatment recorded significantly higher coccinellid population per plant (0.62). On the other hand, RPP registered the lowest coccinellid population (0.06 $plant^{-1}$). Among the treatment combinations, T_1S_{10} recorded significantly higher coccinellid population (0.70 $plant^{-1}$). While, no coccinellid population was observed with T_2S_9 treatment combination.

4.3.3.4 Spider population (no. $plant^{-1}$)

The effects of sources of N, biopesticides sprays and their interaction were significant with regard to spider population per plant during the periodical observations (Table 79, 80 and 81).

Before third spray the highest spider population was recorded (0.40 $plant^{-1}$) with crop supplied with inorganic sources of N (Table 79). Amongst spray treatments control plot having no sprays recorded the highest spider population (0.51 $plant^{-1}$). The inorganic chemical sprayed treatment (RPP) recorded the lowest spider population (0.16 $plant^{-1}$). Among the treatment combinations, chilli supplied with RDF without any sprays (T_1S_{10}) recorded significantly higher spider population (0.57 $plant^{-1}$). T_1S_2, T_1S_3, T_1S_4, T_1S_5, T_1S_6, T_1S_7, T_1S_8 and T_2S_{10} were next in the order. On the other hand, significantly lower spider population (0.15 $plant^{-1}$) was registered with T_2S_9 treatment combination.

A week after third spray, N application through inorganics recorded the highest spider population (0.27 $plant^{-1}$) (Table 79). The treatment having no sprays recorded significantly higher spider population (0.38 $plant^{-1}$). While, the lowest spider population was recorded in the chemical spray (RPP) treatment (0.07 $plant^{-1}$). Among the combinations, inorganic N nutritioned crop without any sprays (T_1S_{10}) recorded significantly higher spider population (0.42 $plant^{-1}$). T_1S_1, T_2S_2, T_1S_3, T_1S_4, T_1S_5, T_1S_6, T_2S_5, T_2S_8 and T_2S_{10} were on par with the former treatment combination. While, significantly lower spider population (0.04 $plant^{-1}$) was recorded with T_2S_9.

Table 77. Coccinellids population (no.plant^{-1}) before fourth spray (9 WAT) and after 1 week of fourth spray (10 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before fourth spray			After 1 week of fourth spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.57 ^{a} (1.25)	0.40 ^{a} (1.18)	0.49 ^{a} (1.22)	0.51 ^{a} (1.23)	0.38 ^{a} (1.17)	0.45 ^{a} (1.20)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.45 ^{b} (1.20)	0.30 ^{b} (1.14)	0.37 ^{b} (1.17)	0.40 ^{b} (1.18)	0.28 ^{b} (1.13)	0.33 ^{b} (1.15)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.04	0.03	0.03	0.04	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.42 ^{bc} (1.19)	0.30 ^{bcd} (1.14)	0.36 ^{cd} (1.16)	0.37 ^{bc} (1.17)	0.25 ^{bcd} (1.12)	0.32 ^{d} (1.15)
S_2: Nimbecidine – Leaf extract	0.45 ^{bc} (1.20)	0.25 ^{cd} (1.12)	0.35 ^{cd} (1.16)	0.42 ^{bc} (1.19)	0.22 ^{cd} (1.10)	0.33 ^{d} (1.15)
S_3: Nimbecidine - Panchgavya	0.55 ^{ab} (1.24)	0.32 ^{bcd} (1.15)	0.42 ^{bc} (1.19)	0.47 ^{bc} (1.21)	0.28 ^{bcd} (1.13)	0.37 ^{bcd} (1.17)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.42 ^{bc} (1.19)	0.39 ^{abc} (1.17)	0.40 ^{bc} (1.18)	0.36 ^{bc} (1.17)	0.33 ^{abc} (1.15)	0.35 ^{cd} (1.16)
S_5: Nimbecidine - Silica spray	0.62 ^{ab} (1.27)	0.43 ^{abc} (1.19)	0.52 ^{ab} (1.23)	0.55 ^{ab} (1.24)	0.40 ^{ab} (1.18)	0.48 ^{bc} (1.21)
S_6: Nimbecidine - Action 100 spray	0.57 ^{a} (1.25)	0.45 ^{abc} (1.20)	0.52 ^{ab} (1.23)	0.51 ^{b} (1.23)	0.46 ^{a} (1.21)	0.49 ^{ab} (1.22)
S_7: Abamectin (1.9 EC) - Perfect	0.42 ^{bc} (1.19)	0.29 ^{bcd} (1.13)	0.35 ^{cd} (1.16)	0.33 ^{bc} (1.15)	0.27 ^{bcd} (1.13)	0.30 ^{de} (1.14)
S_8: Silica	0.61 ^{ab} (1.27)	0.46 ^{ab} (1.21)	0.54 ^{ab} (1.24)	0.55 ^{ab} (1.24)	0.37 ^{abc} (1.17)	0.47 ^{bc} (1.21)
S_9: RPP	0.28 ^{c} (1.13)	0.16 ^{d} (1.07)	0.21 ^{d} (1.10)	0.25 ^{c} (1.12)	0.15 ^{d} (1.07)	0.19 ^{e} (1.09)
S_{10}: Control	0.79 ^{a} (1.33)	0.55 ^{a} (1.24)	0.66 ^{a} (1.29)	0.81 ^{a} (1.35)	0.48 ^{a} (1.22)	0.63 ^{a} (1.27)
S.Em.±	0.03	0.03	0.02	0.03	0.02	0.02
C.D at 5%	0.09	0.07	0.06	0.08	0.06	0.05
Interaction						
T_1S_1	0.47 ^{bcd} (1.21)	0.37 $^{a-d}$ (1.17)	0.42 $^{b-f}$ (1.19)	0.42 ^{bcd} (1.19)	0.30 $^{b-e}$ (1.14)	0.37 $^{b-f}$ (1.17)
T_1S_2	0.50 $^{a-d}$ (1.22)	0.31 $^{a-d}$ (1.14)	0.40 $^{b-f}$ (1.18)	0.47 ^{bcd} (1.21)	0.27 $^{b-e}$ (1.13)	0.37 $^{b-f}$ (1.17)
T_1S_3	0.60 $^{a-d}$ (1.26)	0.37 $^{a-d}$ (1.17)	0.47 ^{bcd} (1.21)	0.52 $^{a-d}$ (1.23)	0.33 $^{a-e}$ (1.15)	0.42 ^{bcd} (1.19)
T_1S_4	0.47 ^{bcd} (1.21)	0.47 ^{abc} (1.21)	0.47 ^{bcd} (1.21)	0.42 ^{bcd} (1.19)	0.42 $^{a-d}$ (1.19)	0.42 ^{bcd} (1.19)
T_1S_5	0.67 ^{abc} (1.29)	0.50 ^{abc} (1.22)	0.57 ^{abc} (1.25)	0.63 ^{abc} (1.27)	0.47 ^{abc} (1.21)	0.55 ^{ab} (1.24)
T_1S_6	0.62 $^{a-d}$ (1.27)	0.52 ^{ab} (1.23)	0.57 ^{abc} (1.25)	0.60 ^{abc} (1.26)	0.50 ^{ab} (1.22)	0.55 ^{ab} (1.24)
T_1S_7	0.47 ^{bcd} (1.21)	0.31 $^{a-d}$ (1.14)	0.38 $^{c-f}$ (1.17)	0.37 ^{bcd} (1.17)	0.30 $^{b-e}$ (1.14)	0.33 $^{c-f}$ (1.15)
T_1S_8	0.70 ^{ab} (1.30)	0.52 ^{ab} (1.23)	0.62 ^{ab} (1.27)	0.60 ^{abc} (1.26)	0.42 $^{a-d}$ (1.19)	0.52 ^{abc} (1.23)
T_1S_9	0.30 ^{cd} (1.14)	0.17 ^{d} (1.08)	0.23 ^{ef} (1.11)	0.27 ^{cd} (1.13)	0.15 ^{e} (1.07)	0.20 ^{ef} (1.10)
T_1S_{10}	0.88 ^{a} (1.37)	0.60 ^{a} (1.26)	0.72 ^{a} (1.31)	0.83 ^{a} (1.35)	0.57 ^{a} (1.26)	0.69 ^{a} (1.30)

T_2S_1	0.37 bcd (1.17)	0.23 bcd (1.11)	0.30 def (1.14)	0.33 bcd (1.15)	0.19 de (1.09)	0.27 def (1.12)
T_2S_2	0.40 bcd (1.18)	0.20 cd (1.10)	0.30 def (1.14)	0.37 bcd (1.17)	0.17 e (1.08)	0.27 def (1.12)
T_2S_3	0.50 a-d (1.22)	0.27 bcd (1.13)	0.37 c-f (1.17)	0.42 bcd (1.19)	0.23 cde (1.11)	0.33 c-f (1.15)
T_2S_4	0.37 bcd (1.17)	0.30 a-d (1.14)	0.33 def (1.15)	0.30 cd (1.14)	0.23 cde (1.11)	0.27 def (1.13)
T_2S_5	0.57 a-d (1.25)	0.37 a-d (1.17)	0.47 bcd (1.21)	0.47 bcd (1.21)	0.33 a-e (1.15)	0.40 b-e (1.18)
T_2S_6	0.52 a-d (1.23)	0.37 a-d (1.17)	0.45 b-e (1.20)	0.42 bcd (1.19)	0.42 a-d (1.19)	0.43 bcd (1.19)
T_2S_7	0.37 bcd (1.17)	0.27 bcd (1.13)	0.33 def (1.15)	0.30 cd (1.14)	0.23 cde (1.11)	0.27 def (1.13)
T_2S_8	0.52 a-d (1.23)	0.40 a-d (1.18)	0.46 bcd (1.21)	0.50 a-d (1.22)	0.33 a-e (1.15)	0.42 bcd (1.19)
T_2S_9	0.27 d (1.13)	0.15 d (1.07)	0.20 f (1.10)	0.23 d (1.11)	0.15 e (1.07)	0.19 f (1.09)
T_2S_{10}	0.70 ab (1.30)	0.50 abc (1.22)	0.60 abc (1.26)	0.67 ab (1.29)	0.42 a-d (1.19)	0.55 ab (1.24)
S.Em.±	0.05	0.03	0.03	0.04	0.03	0.03
C.D at 5%	0.13	0.10	0.08	0.12	0.09	0..07
C.V. (%)	6.1	5.5	5.9	6.1	4.7	5.5

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate $\sqrt{x+1}$ transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Further, spider population before fourth spray was the highest (0.42 plant^{-1}) where N was supplied through inorganics only (Table 80). No spray treatment (S_{10}) also recorded the highest spider population (0.60 plant^{-1}). While, the lowest spider population (0.13 plant^{-1}) was recorded in the chemical pesticide sprayed treatment (S_9). Among the treatment combinations, inorganic N nutritioned crop without any sprays (T_1S_{10}) for sucking pests control recorded significantly higher spider population (0.70 plant^{-1}). T_2S_{10} treatment combination was on par with the former treatment combination (T_1S_{10}). While, RPP sprayed treatment coupled with integrated N supply through organic and inorganic sources (T_2S_9) recorded significantly lower spider population (0.11 plant^{-1}).

After fourth spray, the spider population was the highest (0.35 plant^{-1}) with entire N supplied through inorganics (Table 80), and no spray also registered the highest population of spiders (0.53 plant^{-1}). The recommended plant protection treatment (S_9) recorded significantly lower spider count per plant (0.13 plant^{-1}). Among the treatment combinations, N nutritioned through inorganic source without any sprays for the sucking pests (T_1S_{10}) registered significantly higher spider population (0.62 plant^{-1}). T_2S_{10} was on par with the former treatment combination (T_1S_{10}). While, RPP with integrated N supply recorded significantly lower spider population (0.11 plant^{-1}).

Spider population before fifth spray was the highest population (0.40 plant^{-1}) with inorganic N applied plot (Table 81). While, no spray (control) treatment also recorded significantly higher spider population (0.48 plant^{-1}) among spray treatments, On the other hand RPP treatment recorded significantly lower spider population (0.19 plant^{-1}). Among the treatment combinations, RDF with no spray (T_1S_{10}) recorded significantly higher spider population (0.55 plant^{-1}). While, RPP with equal quantity of N through organics and inorganic sources recorded (T_1S_9) significantly lower spider population (0.16 plant^{-1}).

Table 78. Coccinellids population (no. plant^{-1}) before fifth spray (11 WAT) and after 1 week of fifth spray (12 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before fifth spray			After 1 week of fifth spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.52 ^{a} (1.23)	0.41 ^{a} (1.19)	0.47 ^{a} (1.21)	0.45 ^{a} (1.20)	0.37 ^{a} (1.17)	0.40 ^{a} (1.18)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.40 ^{b} (1.18)	0.30 ^{b} (1.14)	0.35 ^{b} (1.16)	0.35 ^{b} (1.16)	0.28 ^{b} (1.13)	0.30 ^{b} (1.14)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.04	0.03	0.02	0.03	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.46 ^{bc} (1.21)	0.35 ^{b} (1.16)	0.40 ^{bcd} (1.18)	0.35 ^{b} (1.16)	0.30 ^{b} (1.14)	0.33 ^{b} (1.15)
S_2: Nimbecidine – Leaf extract	0.38 ^{bc} (1.17)	0.32 ^{b} (1.15)	0.35 ^{cd} (1.16)	0.35 ^{b} (1.16)	0.33 ^{b} (1.15)	0.33 ^{b} (1.15)
S_3: Nimbecidine - Panchgavya	0.52 ^{bc} (1.23)	0.41 ^{ab} (1.19)	0.46 ^{bc} (1.21)	0.42 ^{b} (1.19)	0.33 ^{b} (1.15)	0.37 ^{b} (1.17)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.50 ^{bc} (1.22)	0.36 ^{ab} (1.17)	0.43 ^{bc} (1.19)	0.45 ^{b} (1.20)	0.37 ^{ab} (1.17)	0.42 ^{b} (1.19)
S_5: Nimbecidine - Silica spray	0.57 ^{b} (1.25)	0.45 ^{ab} (1.20)	0.51 ^{b} (1.23)	0.47 ^{b} (1.21)	0.37 ^{ab} (1.17)	0.42 ^{b} (1.19)
S_6: Nimbecidine - Action 100 spray	0.50 ^{bc} (1.22)	0.45 ^{ab} (1.20)	0.47 ^{bc} (1.21)	0.48 ^{b} (1.21)	0.35 ^{ab} (1.16)	0.42 ^{b} (1.19)
S_7: Abamectin (1.9 EC) - Perfect	0.30 ^{cd} (1.14)	0.27 ^{b} (1.13)	0.27 ^{d} (1.13)	0.33 ^{b} (1.15)	0.25 ^{b} (1.12)	0.30 ^{b} (1.14)
S_8: Silica	0.41 ^{bc} (1.19)	0.40 ^{ab} (1.18)	0.40 ^{bcd} (1.18)	0.38 ^{b} (1.17)	0.37 ^{ab} (1.17)	0.37 ^{b} (1.17)
S_9: RPP	0.14 ^{d} (1.07)	0.11 ^{c} (1.05)	0.13 ^{e} (1.06)	0.07 ^{c} (1.03)	0.05 ^{c} (1.02)	0.06 ^{c} (1.03)
S_{10}: Control	0.84 ^{a} (1.35)	0.55 ^{a} (1.24)	0.70 ^{a} (1.30)	0.70 ^{a} (1.30)	0.53 ^{a} (1.23)	0.62 ^{a} (1.27)
S.Em.±	0.03	0.02	0.02	0.03	0.02	0.02
C.D at 5%	0.08	0.06	0.05	0.07	0.06	0.05
Interaction						
T_1S_1	0.52 ^{bcd} (1.23)	0.40 ^{abc} (1.18)	0.47 $^{b-f}$ (1.21)	0.33 ^{bc} (1.15)	0.37 ^{abc} (1.17)	0.35 ^{bcd} (1.16)
T_1S_2	0.40 ^{bcd} (1.18)	0.33 ^{bcd} (1.15)	0.37 $^{c-g}$ (1.17)	0.40 ^{bc} (1.18)	0.33 ^{bc} (1.15)	0.36 ^{bcd} (1.16)
T_1S_3	0.62 ^{bcd} (1.27)	0.52 ^{ab} (1.23)	0.57 ^{bc} (1.25)	0.47 ^{b} (1.21)	0.37 ^{abc} (1.17)	0.42 ^{bcd} (1.19)
T_1S_4	0.57 ^{bcd} (1.25)	0.42 ^{abc} (1.19)	0.50 $^{b-e}$ (1.22)	0.50 ^{b} (1.22)	0.42 ^{abc} (1.19)	0.47 ^{bc} (1.21)
T_1S_5	0.64 ^{abc} (1.28)	0.50 ^{ab} (1.22)	0.57 ^{bc} (1.25)	0.52 ^{ab} (1.23)	0.40 ^{abc} (1.18)	0.47 ^{bc} (1.21)
T_1S_6	0.57 ^{bcd} (1.25)	0.52 ^{ab} (1.23)	0.54 ^{bcd} (1.24)	0.57 ^{ab} (1.25)	0.40 ^{abc} (1.18)	0.47 ^{bc} (1.21)
T_1S_7	0.27 ^{de} (1.13)	0.30 ^{bcd} (1.14)	0.28 ^{fg} (1.13)	0.37 ^{bc} (1.17)	0.30 ^{bc} (1.14)	0.33 ^{cd} (1.15)
T_1S_8	0.42 ^{bcd} (1.19)	0.47 ^{abc} (1.21)	0.45 $^{b-f}$ (1.20)	0.40 ^{bc} (1.18)	0.42 ^{abc} (1.19)	0.42 ^{bcd} (1.19)
T_1S_9	0.20 ^{de} (1.10)	0.15 ^{de} (1.07)	0.18 ^{gh} (1.09)	0.15 ^{cd} (1.07)	0.07 ^{de} (1.03)	0.11 ^{e} (1.05)
T_1S_{10}	0.98 ^{a} (1.40)	0.60 ^{a} (1.26)	0.78 ^{a} (1.33)	0.80 ^{a} (1.34)	0.60 ^{a} (1.26)	0.70 ^{a} (1.30)

T_2S_1	0.40 ^{bcd} (1.18)	0.30 ^{bcd} (1.14)	0.35 $^{d-g}$ (1.16)	0.37 ^{bc} (1.17)	0.23 ^{bcd} (1.11)	0.30 ^{cd} (1.14)
T_2S_2	0.37 ^{bcd} (1.17)	0.30 ^{bcd} (1.14)	0.33 ^{efg} (1.15)	0.30 ^{bc} (1.14)	0.30 ^{bc} (1.14)	0.30 ^{cd} (1.14)
T_2S_3	0.40 ^{bcd} (1.18)	0.30 ^{bcd} (1.14)	0.35 $^{d-g}$ (1.16)	0.37 ^{bc} (1.17)	0.30 ^{bc} (1.14)	0.33 ^{cd} (1.15)
T_2S_4	0.42 ^{bcd} (1.19)	0.30 ^{bcd} (1.14)	0.37 $^{c-g}$ (1.17)	0.40 ^{bc} (1.18)	0.33 ^{bc} (1.15)	0.37 ^{bcd} (1.17)
T_2S_5	0.50 ^{bcd} (1.22)	0.40 ^{abc} (1.18)	0.45 $^{b-f}$ (1.20)	0.42 ^{bc} (1.19)	0.37 ^{abc} (1.17)	0.40 ^{bcd} (1.18)
T_2S_6	0.42 ^{bcd} (1.19)	0.37 ^{abc} (1.17)	0.40 $^{b-g}$ (1.18)	0.40 ^{bc} (1.18)	0.30 ^{bc} (1.14)	0.35 ^{bcd} (1.16)
T_2S_7	0.33 ^{cde} (1.15)	0.23 ^{cde} (1.11)	0.27 ^{fg} (1.13)	0.30 ^{bc} (1.14)	0.19 ^{cde} (1.09)	0.25 ^{d} (1.12)
T_2S_8	0.40 ^{bcd} (1.18)	0.33 ^{bcd} (1.15)	0.37 $^{c-g}$ (1.17)	0.37 ^{bc} (1.17)	0.30 ^{bc} (1.14)	0.33 ^{d} (1.15)
T_2S_9	0.07 ^{e} (1.03)	0.07 ^{e} (1.03)	0.07 ^{f} (1.03)	0.00 ^{d} (1.00)	0.00 ^{e} (1.00)	0.00 ^{e} (1.00)
T_2S_{10}	0.70 ^{ab} (1.30)	0.50 ^{ab} (1.22)	0.60 ^{ab} (1.26)	0.60 ^{ab} (1.26)	0.47 ^{ab} (1.21)	0.53 ^{b} (1.23)
S.Em.±	0.04	0.03	0.03	0.04	0.03	0.02
C.D at 5%	0.12	0.09	0.07	0.10	0.09	0.06
C.V. (%)	5.6	4.4	5.1	5.1	4.8	5.0

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate $\sqrt{x+1}$ transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

The highest population (0.31 plant^{-1}) of spider after fifth spray was recorded with N supplied through inorganic source (Table 81). Among the spray treatments, no spray (control) treatment recorded significantly higher spider population per plant (0.40). On the other hand, RPP registered the lowest spider population (0.06 plant^{-1}). Among the treatment combinations, T_1S_{10} recorded significantly higher spider population (0.45 plant^{-1}). While, no spider population was observed with T_2S_9 treatment combination.

4.3.4 Leaf curl index (LCI)

Leaf curl index varied significantly due to sources of nitrogen, biopesticide sprays and their interaction (Table 82, 83, 84 and 85) at all the stages of observations starting from second spray.

The LCI before the second spray (5 WAT) was the lowest (0.70) with integrated supply of N through urea, vermicompost and neem cake (Table 82). Among the biopesticide sprays alternate sprays of Abamectin and Perfect recorded the lowest LCI. Sprays consisting of Nimbecidine alternated with other biopesticides except GCK extract, silica and Action 100 were next in the order and were comparable to RPP and infact S_4 was superior to the recommended practice. While, the highest LCI was observed with no spray treatment (1.20). Among the treatment combinations, chilli crop nutritioned with equal quantities of organic and inorganic sources of N coupled with Abamectin and Perfect spray (T_2S_7) alternatively recorded the lowest LCI (0.28). T_1S_4 and T_2S_4 were next in the order. While, the highest LCI was recorded with T_1S_{10} treatment combination (1.42).

LCI a week after second spray revealed the lowest value (0.51) with integrated supply of N through organic and inorganic sources (Table 82). Among the biopesticide sprays, the lowest LCI (0.31) was recorded with alternate sprays of Abamectin and Perfect treatment

Table 79. Spider population (no. plant^{-1}) before third spray (7 WAT) and after 1 week of third spray (8 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before third spray			After 1 week of third spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.45 ^{a} (1.20)	0.35 ^{a} (1.16)	0.40 ^{a} (1.18)	0.30 ^{a} (1.14)	0.25 ^{a} (1.12)	0.27 ^{a} (1.13)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.33 ^{b} (1.15)	0.23 ^{b} (1.11)	0.27 ^{b} (1.13)	0.20 ^{b} (1.10)	0.17 ^{b} (1.08)	0.19 ^{b} (1.09)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.04	0.03	0.03	0.03	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.33 ^{bc} (1.15)	0.27 ^{ab} (1.13)	0.30 ^{b} (1.45)	0.21 ^{bc} (1.10)	0.17 ^{ab} (1.08)	0.19 ^{b} (1.09)
S_2: Nimbecidine – Leaf extract	0.33 ^{bc} (1.15)	0.26 ^{ab} (1.12)	0.30 ^{b} (1.14)	0.21 ^{bc} (1.10)	0.19 ^{ab} (1.09)	0.20 ^{b} (1.10)
S_3: Nimbecidine - Panchgavya	0.36 ^{bc} (1.17)	0.30 ^{ab} (1.14)	0.33 ^{b} (1.15)	0.25 ^{abc} (1.12)	0.22 ^{ab} (1.10)	0.23 ^{b} (1.11)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.36 ^{bc} (1.17)	0.28 ^{ab} (1.13)	0.32 ^{bc} (1.15)	0.25 ^{abc} (1.12)	0.22 ^{ab} (1.10)	0.23 ^{b} (1.11)
S_5: Nimbecidine - Silica spray	0.43 ^{ab} (1.19)	0.33 ^{ab} (1.15)	0.38 ^{ab} (1.17)	0.33 ^{ab} (1.15)	0.26 ^{a} (1.12)	0.29 ^{ab} (1.14)
S_6: Nimbecidine - Action 100 spray	0.43 ^{ab} (1.19)	0.33 ^{ab} (1.15)	0.38 ^{ab} (1.17)	0.30 ^{ab} (1.14)	0.26 ^{a} (1.12)	0.28 ^{ab} (1.13)
S_7: Abamectin (1.9 EC) - Perfect	0.35 ^{bc} (1.16)	0.25 ^{ab} (1.12)	0.30 ^{b} (1.14)	0.19^{bc} (1.09)	0.17 ^{ab} (1.08)	0.18 ^{b} (1.09)
S_8: Silica	0.47 ^{ab} (1.21)	0.30 ^{ab} (1.14)	0.37 ^{b} (1.17)	0.29 ^{ab} (1.13)	0.25 ^{a} (1.12)	0.27 ^{ab} (1.13)
S_9: RPP	0.17 ^{c} (1.08)	0.15 ^{b} (1.07)	0.16 ^{c} (1.07)	0.11 ^{c} (1.05)	0.04 ^{b} (1.02)	0.07 ^{c} (1.03)
S_{10}: Control	0.61 ^{a} (1.27)	0.42 ^{a} (1.19)	0.51 ^{a} (1.23)	0.40 ^{a} (1.18)	0.35 ^{a} (1.16)	0.38 ^{a} (1.17)
S.Em.±	0.03	0.03	0.02	0.02	0.02	0.01
C.D at 5%	0.08	0.07	0.06	0.06	0.07	0.05
Interaction						
T_1S_1	0.37 $^{a-d}$ (1.17)	0.30 ^{ab} (1.14)	0.33 $^{b-c}$ (1.15)	0.27 ^{abc} (1.13)	0.20^{abc} (1.10)	0.23 $^{a-d}$ (1.11)
T_1S_2	0.40 $^{a-d}$ (1.18)	0.33 ^{ab} (1.15)	0.37 $^{a-d}$ (1.17)	0.27 ^{abc} (1.13)	0.23 ^{abc} (1.11)	0.25 $^{a-d}$ (1.12)
T_1S_3	0.42 $^{a-d}$ (1.19)	0.37 ^{ab} (1.17)	0.40 ^{abc} (1.18)	0.30 ^{ab} (1.14)	0.27 ^{ab} (1.13)	0.28 $^{a-d}$ (1.13)
T_1S_4	0.40 $^{a-d}$ (1.18)	0.37^{ab} (1.17)	0.37 $^{a-d}$ (1.17)	0.33 ^{ab} (1.15)	0.27 ^{ab} (1.13)	0.30 ^{abc} (1.14)
T_1S_5	0.47 $^{a-d}$ (1.21)	0.40 ^{ab} (1.18)	0.43 ^{abc} (1.19)	0.37 ^{ab} (1.17)	0.33 ^{ab} (1.15)	0.35 ^{ab} (1.16)
T_1S_6	0.50 ^{abc} (1.22)	0.42 ^{ab} (1.19)	0.47 ^{ab} (1.21)	0.37 ^{ab} (1.17)	0.33 ^{ab} (1.15)	0.35 ^{ab} (1.16)
T_1S_7	0.40 $^{a-d}$ (1.18)	0.30 ^{ab} (1.14)	0.35 $^{a-e}$ (1.16)	0.23^{abc} (1.11)	0.19 ^{abc} (1.09)	0.20 $^{b-e}$ (1.10)
T_1S_8	0.57 ^{ab} (1.25)	0.37 ^{ab} (1.17)	0.47 ^{ab} (1.21)	0.30 ^{ab} (1.14)	0.27 ^{ab} (1.13)	0.28 $^{a-d}$ (1.13)
T_1S_9	0.19 ^{cd} (1.09)	0.15 ^{b} (1.07)	0.17 ^{de} (1.08)	0.15 ^{bc} (1.07)	0.07 ^{bc} (1.03)	0.11 ^{de} (1.05)
T_1S_{10}	0.64 ^{a} (1.28)	0.50 ^{a} (1.22)	0.57 ^{a} (1.25)	042 ^{a} (1.19)	0.40 ^{a} (1.18)	0.42 ^{a} (1.19)

T_2S_1	0.30 [a-d] (1.14)	0.23 [ab] (1.11)	0.27 [b-e] (1.13)	0.17 [bc] (1.08)	0.15 [abc] (1.07)	0.16 [cde] (1.07)
T_2S_2	0.27 [bcd] (1.13)	0.19 [b] (1.09)	0.23 [cde] (1.11)	0.17 [bc] (1.08)	0.15 [abc] (1.07)	0.16 [cde] (1.07)
T_2S_3	0.30 [a-d] (1.14)	0.23 [ab] (1.11)	0.27 [b-e] (1.13)	0.19 [bc] (1.09)	0.17 [abc] (1.08)	0.18 [b-e] (1.09)
T_2S_4	0.33 [a-d] (1.15)	0.19 [b] (1.09)	0.26 [b-e] (1.12)	0.17 [bc] (1.08)	0.15 [abc] (1.07)	0.16 [cde] (1.07)
T_2S_5	0.37 [a-d] (1.17)	0.27 [ab] (1.13)	0.33 [b-e] (1.15)	0.27 [abc] (1.13)	0.19 [abc] (1.09)	0.23 [a-d] (1.11)
T_2S_6	0.37 [a-d] (1.17)	0.23 [ab] (1.11)	0.30 [b-e] (1.14)	0.23 [abc] (1.11)	0.19 [abc] (1.09)	0.20 [b-e] (1.10)
T_2S_7	0.30 [a-d] (1.14)	0.20 [ab] (1.10)	0.26 [b-e] (1.12)	0.15[bc] (1.07)	0.15[abc] (1.07)	0.15 [cde] (1.07)
T_2S_8	0.37 [a-d] (1.17)	0.23 [ab] (1.11)	0.30 [b-e] (1.14)	0.27 [abc] (1.13)	0.23 [abc] (1.11)	0.25 [a-d] (1.12)
T_2S_9	0.15 [d] (1.07)	0.15 [e] (1.07)	0.15 [e] (1.07)	0.07 [c] (1.03)	0.00 [c] (1.00)	0.04 [e] (1.02)
T_2S_{10}	0.57 [ab] (1.25)	0.33 [ab] (1.15)	0.45 [ab] (1.20)	0.37 [ab] (1.17)	0.30 [ab] (1.14)	0.33 [abc] (1.15)
S.Em.±	0.04	0.04	0.03	0.03	0.04	0.03
C.D at 5%	0.12	0.10	0.08	0.09	0.10	0.07
C.V. (%)	6.3	5.3	5.8	4.9	6.1	5.5

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate $\sqrt{x+1}$ transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 79. Spider population (no. plant^{-1}) before third spray (7 WAT) and after 1 week of third spray (8 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before third spray			After 1 week of third spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.45 ^{a} (1.20)	0.35 ^{a} (1.16)	0.40 ^{a} (1.18)	0.30 ^{a} (1.14)	0.25 ^{a} (1.12)	0.27 ^{a} (1.13)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.33 ^{b} (1.15)	0.23 ^{b} (1.11)	0.27 ^{b} (1.13)	0.20 ^{b} (1.10)	0.17 ^{b} (1.08)	0.19 ^{b} (1.09)
S.Em.± C.D at5%	0.01 0.04	0.01 0.03	0.01 0.03	0.01 0.03	0.01 0.03	0.01 0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.33 ^{bc} (1.15)	0.27 ^{ab} (1.13)	0.30 ^{b} (1.45)	0.21 ^{bc} (1.10)	0.17 ^{ab} (1.08)	0.19 ^{b} (1.09)
S_2: Nimbecidine – Leaf extract	0.33 ^{bc} (1.15)	0.26 ^{ab} (1.12)	0.30 ^{b} (1.14)	0.21 ^{bc} (1.10)	0.19 ^{ab} (1.09)	0.20 ^{b} (1.10)
S_3: Nimbecidine - Panchgavya	0.36 ^{bc} (1.17)	0.30 ^{ab} (1.14)	0.33 ^{b} (1.15)	0.25 ^{abc} (1.12)	0.22 ^{ab} (1.10)	0.23 ^{b} (1.11)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.36 ^{bc} (1.17)	0.28 ^{ab} (1.13)	0.32 ^{bc} (1.15)	0.25 ^{abc} (1.12)	0.22 ^{ab} (1.10)	0.23 ^{b} (1.11)
S_5: Nimbecidine - Silica spray	0.43 ^{ab} (1.19)	0.33 ^{ab} (1.15)	0.38 ^{ab} (1.17)	0.33 ^{ab} (1.15)	0.26 ^{a} (1.12)	0.29 ^{ab} (1.14)
S_6: Nimbecidine - Action 100 spray	0.43 ^{ab} (1.19)	0.33 ^{ab} (1.15)	0.38 ^{ab} (1.17)	0.30 ^{ab} (1.14)	0.26 ^{a} (1.12)	0.28 ^{ab} (1.13)
S_7: Abamectin (1.9 EC) - Perfect	0.35 ^{bc} (1.16)	0.25 ^{ab} (1.12)	0.30 ^{b} (1.14)	0.19^{bc} (1.09)	0.17 ^{ab} (1.08)	0.18 ^{b} (1.09)
S_8: Silica	0.47 ^{ab} (1.21)	0.30 ^{ab} (1.14)	0.37 ^{b} (1.17)	0.29 ^{ab} (1.13)	0.25 ^{a} (1.12)	0.27 ^{ab} (1.13)
S_9: RPP	0.17 ^{c} (1.08)	0.15 ^{b} (1.07)	0.16 ^{c} (1.07)	0.11 ^{c} (1.05)	0.04 ^{b} (1.02)	0.07 ^{c} (1.03)
S_{10}: Control	0.61 ^{a} (1.27)	0.42 ^{a} (1.19)	0.51 ^{a} (1.23)	0.40 ^{a} (1.18)	0.35 ^{a} (1.16)	0.38 ^{a} (1.17)
S.Em.± C.D at 5%	0.03 0.08	0.03 0.07	0.02 0.06	0.02 0.06	0.02 0.07	0.01 0.05
Interaction						
T_1S_1	0.37 $^{a-d}$ (1.17)	0.30 ^{ab} (1.14)	0.33 $^{b-c}$ (1.15)	0.27 ^{abc} (1.13)	0.20^{abc} (1.10)	0.23 $^{a-d}$ (1.11)
T_1S_2	0.40 $^{a-d}$ (1.18)	0.33 ^{ab} (1.15)	0.37 $^{a-d}$ (1.17)	0.27 ^{abc} (1.13)	0.23 ^{abc} (1.11)	0.25 $^{a-d}$ (1.12)
T_1S_3	0.42 $^{a-d}$ (1.19)	0.37 ^{ab} (1.17)	0.40 ^{abc} (1.18)	0.30 ^{ab} (1.14)	0.27 ^{ab} (1.13)	0.28 $^{a-d}$ (1.13)
T_1S_4	0.40 $^{a-d}$ (1.18)	0.37^{ab} (1.17)	0.37 $^{a-d}$ (1.17)	0.33 ^{ab} (1.15)	0.27 ^{ab} (1.13)	0.30 ^{abc} (1.14)
T_1S_5	0.47 $^{a-d}$ (1.21)	0.40 ^{ab} (1.18)	0.43 ^{abc} (1.19)	0.37 ^{ab} (1.17)	0.33 ^{ab} (1.15)	0.35 ^{ab} (1.16)
T_1S_6	0.50 ^{abc} (1.22)	0.42 ^{ab} (1.19)	0.47 ^{ab} (1.21)	0.37 ^{ab} (1.17)	0.33 ^{ab} (1.15)	0.35 ^{ab} (1.16)
T_1S_7	0.40 $^{a-d}$ (1.18)	0.30 ^{ab} (1.14)	0.35 $^{a-e}$ (1.16)	0.23^{abc} (1.11)	0.19 ^{abc} (1.09)	0.20 $^{b-e}$ (1.10)
T_1S_8	0.57 ^{ab} (1.25)	0.37 ^{ab} (1.17)	0.47 ^{ab} (1.21)	0.30 ^{ab} (1.14)	0.27 ^{ab} (1.13)	0.28 $^{a-d}$ (1.13)
T_1S_9	0.19 ^{cd} (1.09)	0.15 ^{b} (1.07)	0.17 ^{de} (1.08)	0.15 ^{bc} (1.07)	0.07 ^{bc} (1.03)	0.11 ^{de} (1.05)
T_1S_{10}	0.64 ^{a} (1.28)	0.50 ^{a} (1.22)	0.57 ^{a} (1.25)	042 ^{a} (1.19)	0.40 ^{a} (1.18)	0.42 ^{a} (1.19)

T_2S_1	0.30 $^{a-d}$ (1.14)	0.23 ^{ab} (1.11)	0.27 $^{b-e}$ (1.13)	0.17 ^{bc} (1.08)	0.15 ^{abc} (1.07)	0.16 ^{cde} (1.07)
T_2S_2	0.27 ^{bcd} (1.13)	0.19 ^{b} (1.09)	0.23 ^{cde} (1.11)	0.17 ^{bc} (1.08)	0.15 ^{abc} (1.07)	0.16 ^{cde} (1.07)
T_2S_3	0.30 $^{a-d}$ (1.14)	0.23 ^{ab} (1.11)	0.27 $^{b-e}$ (1.13)	0.19 ^{bc} (1.09)	0.17 ^{abc} (1.08)	0.18 $^{b-e}$ (1.09)
T_2S_4	0.33 $^{a-d}$ (1.15)	0.19 ^{b} (1.09)	0.26 $^{b-e}$ (1.12)	0.17 ^{bc} (1.08)	0.15 ^{abc} (1.07)	0.16 ^{cde} (1.07)
T_2S_5	0.37 $^{a-d}$ (1.17)	0.27 ^{ab} (1.13)	0.33 $^{b-e}$ (1.15)	0.27 ^{abc} (1.13)	0.19 ^{abc} (1.09)	0.23 $^{a-d}$ (1.11)
T_2S_6	0.37 $^{a-d}$ (1.17)	0.23 ^{ab} (1.11)	0.30 $^{b-e}$ (1.14)	0.23 ^{abc} (1.11)	0.19 ^{abc} (1.09)	0.20 $^{b-e}$ (1.10)
T_2S_7	0.30 $^{a-d}$ (1.14)	0.20 ^{ab} (1.10)	0.26 $^{b-e}$ (1.12)	0.15 ^{bc} (1.07)	0.15 ^{abc} (1.07)	0.15 ^{cde} (1.07)
T_2S_8	0.37 $^{a-d}$ (1.17)	0.23 ^{ab} (1.11)	0.30 $^{b-e}$ (1.14)	0.27 ^{abc} (1.13)	0.23 ^{abc} (1.11)	0.25 $^{a-d}$ (1.12)
T_2S_9	0.15 ^{d} (1.07)	0.15 ^{e} (1.07)	0.15 ^{e} (1.07)	0.07 ^{c} (1.03)	0.00 ^{c} (1.00)	0.04 ^{e} (1.02)
T_2S_{10}	0.57 ^{ab} (1.25)	0.33 ^{ab} (1.15)	0.45 ^{ab} (1.20)	0.37 ^{ab} (1.17)	0.30 ^{ab} (1.14)	0.33 ^{abc} (1.15)
S.Em.±	0.04	0.04	0.03	0.03	0.04	0.03
C.D at 5%	0.12	0.10	0.08	0.09	0.10	0.07
C.V. (%)	6.3	5.3	5.8	4.9	6.1	5.5

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate √x+1 transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

(S_7). While, alternate spray of nimbecidine and leaf extract + panchagavya was next in the order and comparable to RPP. On the other hand, the highest LCI (1.02) was recorded in the treatment having no sprays (S_{10}). Among the treatment combinations, chilli crop nutritioned with integrated N sources coupled with alternate sprays of Abamectin and Perfect (T_2S_7) recorded the lowest LCI (0.27), and T_1S_7, T_2S_3, T_2S_4 and T_2S_9 were on par with the former treatment combination. On the other hand, significantly higher LCI (1.10) was recorded with T_1S_{10}.

LCI before third spray differed significantly due to sources of N nutrition (Table 83). Chilli crop nutritioned with integrated sources of N recorded the lowest LCI (0.66). Among the biopesticide sprays, alternate sprays of Abamectin and Perfect (S_7) recorded the lowest LCI (0.45). Nimbecidine spray treatments alternated with other biopesticides except silica and Action 100 were next in the order and were comparable to RPP, and infact S_4 was superior to the recommended practice. The highest LCI was recorded (S_{10}) with treatment receiving neither chemical nor biopesticide spray (1.11). Among the treatment combinations, T_2S_7 recorded significantly lower LCI (0.37). T_2S_4 was on par with the former treatment T_1S_7, T_2S_2 and T_2S_9 were next in the order. The highest LCI (1.17) was registered with T_1S_{10}.

Integrated sources of N through organic and inorganic sources recorded the lowest LCI (0.50) after third spray (Table 83). Alternate sprays of Abamectin and Perfect also recorded the lowest LCI (0.25). Nimbecidine alternated with other biorationals except GCK extract, silica and Action 100 were next in the order and were comparable to RPP. Among the treatment combinations, T_2S_7 recorded significantly lower LCI (0.23). T_1S_7 was on par with the former treatment combination (T_2S_7). T_1S_2, T_1S_4, T_2S_1, T_2S_2, T_2S_3, T_2S_4, T_2S_5 and T_2S_9 were next in the order. The highest LCI was recorded with T_1S_{10} (1.15).

The LCI before fourth spray revealed lowest LCI (0.50) with integrated sources of N through organic and inorganic sources (Table 84). Among the biopesticide sprays, alternate sprays of Abamectin and Perfect (S_7) recorded significantly lower LCI (0.30). RPP was on par

Table 80. Spider population (no. plant^{-1}) before fourth spray (9 WAT) and after 1 week of fourth spray (10 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before fourth spray			After 1 week of fourth spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.45 [a] (1.20)	0.37 [a] (1.17)	0.42 [a] (1.19)	0.40 [a] (1.18)	0.33 [a] (1.15)	0.35 [a] (1.16)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.35 [b] (1.16)	0.28 [b] (1.13)	0.30 [b] (1.14)	0.30 [b] (1.14)	0.20 [b] (1.10)	0.26 [b] (1.12)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.03	0.03	0.02	0.03	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.36 [b] (1.17)	0.33 [b] (1.15)	0.35 [bc] (1.16)	0.30 [bc] (1.14)	0.28 [abc] (1.13)	0.30 [b] (1.14)
S_2: Nimbecidine – Leaf extract	0.33 [bc] (1.15)	0.28 [b] (1.13)	0.31 [c] (1.14)	0.26 [bc] (1.12)	0.21 [bc] (1.10)	0.25 [bc] (1.11)
S_3: Nimbecidine - Panchgavya	0.40 [b] (1.18)	0.33 [b] (1.15)	0.38 [bc] (1.17)	0.32 [bc] (1.15)	0.26 [abc] (1.12)	0.28 [b] (1.13)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.36 [b] (1.17)	0.30 [b] (1.14)	0.33 [bc] (1.15)	0.32 [bc] (1.15)	0.26 [abc] (1.12)	0.30 [b] (1.14)
S_5: Nimbecidine - Silica spray	0.45 [b] (1.20)	0.37 [ab] (1.17)	0.42 [bc] (1.19)	0.38 [b] (1.17)	0.33 [ab] (1.15)	0.35 [b] (1.16)
S_6: Nimbecidine - Action 100 spray	0.47 [b] (1.21)	0.40 [ab] (1.18)	0.44 [b] (1.20)	0.38 [b] (1.17)	0.33 [ab] (1.15)	0.35 [b] (1.16)
S_7: Abamectin (1.9 EC) - Perfect	0.33 [bc] (1.15)	0.28 [b] (1.13)	0.30 [c] (1.14)	0.28 [bc] (1.13)	0.21 [bc] (1.10)	0.25 [b] (1.12)
S_8: Silica	0.46 [b] (1.21)	0.37 [ab] (1.17)	0.42 [bc] (1.19)	0.40 [b] (1.18)	0.31 [ab] (1.14)	0.35 [b] (1.16)
S_9: RPP	0.15 [c] (1.07)	0.11 [c] (1.05)	0.13 [d] (1.06)	0.16 [c] (1.07)	0.11 [c] (1.05)	0.13 [c] (1.06)
S_{10}: Control	0.70 [a] (1.30)	0.51 [a] (1.23)	0.60 [a] (1.26)	0.62 [a] (1.27)	0.43 [a] (1.19)	0.53 [a] (1.23)
S.Em.±	0.03	0.02	0.02	0.03	0.03	0.02
C.D at 5%	0.08	0.06	0.05	0.07	0.07	0.05
Interaction						
T_1S_1	0.42 [bc] (1.19)	0.37 [abc] (1.17)	0.40 [bcd] (1.18)	0.37 [bc] (1.17)	0.33[abc] (1.15)	0.35 [bcd] (1.16)
T_1S_2	0.40 [bc] (1.18)	0.33 [bc] (1.15)	0.37 [bcd] (1.17)	0.33 [bc] (1.15)	0.30 [abc] (1.14)	0.32 [b-e] (1.15)
T_1S_3	0.47 [ab] (1.21)	0.37 [abc] (1.17)	0.42 [bcd] (1.19)	0.37 [bc] (1.17)	0.33 [abc] (1.15)	0.35 [bcd] (1.16)
T_1S_4	0.42 [bc] (1.19)	0.37[abc] (1.17)	0.40 [bcd] (1.18)	0.37 [bc] (1.17)	0.33 [abc] (1.15)	0.35 [bcd] (1.16)
T_1S_5	0.50 [ab] (1.22)	0.42 [ab] (1.19)	0.47 [bc] (1.21)	0.40 [bc] (1.18)	0.33 [abc] (1.15)	0.37 [bc] (1.17)
T_1S_6	0.52 [ab] (1.23)	0.47 [ab] (1.21)	0.50 [b] (1.22)	0.40 [bc] (1.18)	0.37 [ab] (1.17)	0.38 [bc] (1.17)
T_1S_7	0.37 [bc] (1.17)	0.30 [bc] (1.14)	0.33 [b-e] (1.15)	0.33[bc] (1.15)	0.23 [abc] (1.11)	0.28 [b-f] (1.13)
T_1S_8	0.52 [ab] (1.23)	0.42 [ab] (1.19)	0.46 [bc] (1.21)	0.42 [bc] (1.19)	0.37 [ab] (1.17)	0.40 [bc] (1.18)
T_1S_9	0.15 [c] (1.07)	0.15 [cd] (1.07)	0.15 [ef] (1.07)	0.17 [c] (1.08)	0.15 [bc] (1.07)	0.16 [ef] (1.07)
T_1S_{10}	0.80 [a] (1.34)	0.60 [a] (1.26)	0.70 [a] (1.30)	0.72 [a] (1.31)	0.50 [a] (1.22)	0.62 [a] (1.27)

T_2S_1	0.30^{bc} (1.14)	0.27^{bcd} (1.13)	0.28^{c-f} (1.13)	0.23^{bc} (1.11)	0.23^{abc} (1.11)	0.23^{c-f} (1.11)
T_2S_2	0.27^{bc} (1.13)	0.23^{bcd} (1.11)	0.26^{def} (1.12)	0.19^{c} (1.09)	0.13^{abc} (1.06)	0.16^{def} (1.08)
T_2S_3	0.33^{bc} (1.15)	0.30^{bc} (1.14)	0.32^{b-e} (1.15)	0.27^{bc} (1.13)	0.17^{bc} (1.08)	0.22^{c-f} (1.10)
T_2S_4	0.30^{bc} (1.14)	0.23^{bcd} (1.11)	0.27^{c-f} (1.13)	0.27^{bc} (1.13)	0.19^{bc} (1.09)	0.23^{c-f} (1.11)
T_2S_5	0.40^{bc} (1.18)	0.33^{bc} (1.15)	0.37^{bcd} (1.17)	0.37^{bc} (1.17)	0.30^{abc} (1.14)	0.33^{b-e} (1.15)
T_2S_6	0.42^{bc} (1.19)	0.33^{bc} (1.15)	0.37^{bcd} (1.17)	0.37^{bc} (1.17)	0.27^{abc} (1.13)	0.33^{b-e} (1.15)
T_2S_7	0.30^{bc} (1.14)	0.27^{bcd} (1.13)	0.28^{c-f} (1.13)	0.23^{bc} (1.11)	0.19^{bc} (1.09)	0.21^{c-f} (1.10)
T_2S_8	0.40^{bc} (1.18)	0.33^{bc} (1.15)	0.37^{bcd} (1.17)	0.37^{abc} (1.17)	0.25^{abc} (1.12)	0.30^{b-e} (1.14)
T_2S_9	0.15^{c} (1.07)	0.07^{d} (1.03)	0.11^{f} (1.05)	0.15^{c} (1.07)	0.07^{c} (1.03)	0.11^{f} (1.05)
T_2S_{10}	0.60^{ab} (1.26)	0.42^{ab} (1.19)	0.52^{ab} (1.23)	0.52^{ab} (1.23)	0.37^{ab} (1.17)	0.45^{ab} (1.20)
S.Em.±	0.04	0.03	0.03	0.04	0.04	0.03
C.D at 5%	0.12	0.09	0.07	0.10	0.10	0.07
C.V.	5.8	4.5	5.2	5.8	5.4	5.6

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate √x+1 transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

with the former treatment (S_7). Among treatment combinations, T_2S_7 recorded significantly lower LCI (0.27). T_1S_7, T_1S_9, T_2S_1, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 were on par with the former treatment combination. On the other hand, the highest LCI was recorded with T_1S_{10} (1.32).

LCI after a week of fourth spray followed similar trend observed previously (Table 84). The lowest LCI (0.39) was observed with integrated source of N supplied through organics and inorganic sources. In the biopesticide sprays, Abamectin and Perfect (S_7) recorded the lowest LCI (0.22). Sprays of Nimbecidine alternated with rest of the biopesticides except silica and Action 100 were next in the order and were comparable to RPP. While, no spray (S_{10}) treatment recorded the highest LCI (0.88). Among the treatment combinations, T_2S_7 recorded significantly lower LCI (0.20). T_2S_1, T_2S_2, , T_2S_4 and T_2S_9 were on par with the former treatment. While, the highest LCI (0.95) was recorded with T_1S_{10}.

LCI before fifth spray revealed significantly lower LCI (0.60) with integrated N supply treatment (Table 85). Among the biopesticide sprays, alternate sprays of Abamectin and Perfect (S_7) recorded the lowest LCI (0.35). Nimbecidine alternated with leaf extract + panchagavya was next in the order and comparable to RPP. On the other hand, no spray treatment recorded the highest LCI (1.27). Among the treatment combinations, integrated supply of N coupled with alternate sprays of Abamectin and Perfect (T_2S_7) continued to record significantly lower LCI (0.32). T_1S_7 was on par with the former treatment. T_2S_2 and T_2S_9 were next in the order. While, the highest LCI (1.43) was recorded with N application through inorganic source without any sprays (T_1S_{10}) against the sucking pests.

The LCI after fifth spray recorded significantly lower value (0.47) with T_2 treatment (Table 85). Abamectin and Perfect spray (S_7) also registered the lowest LCI (0.20), among spray treatments. Nimbecidine sprays alternated with other biopesticides except silica and Action 100 were comparable with RPP and infact, S_2 and S_4 were found superior to the

Table 81. Spider population (no. plant^{-1}) before fifth spray (11WAT) and after 1 week of fifth spray (12 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before fifth spray			After 1 week of fifth spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.42 ^{a} (1.19)	0.37 ^{a} (1.17)	0.40 ^{a} (1.18)	0.35 ^{a} (1.16)	0.27 ^{a} (1.13)	0.31 ^{a} (1.14)
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1}V.C + 500 kg ha^{-1} neem cake**	0.33 ^{b} (1.15)	0.27 ^{b} (1.13)	0.30 ^{b} (1.14)	0.23 ^{b} (1.11)	0.19 ^{b} (1.09)	0.20 ^{b} (1.10)
S.Em.±	0.01	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.03	0.03	0.02	0.03	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.32 ^{bcd} (1.15)	0.27 ^{ab} (1.13)	0.30 ^{bc} (1.14)	0.25 ^{ab} (1.12)	0.19 ^{a} (1.09)	0.21 ^{d} (1.10)
S_2: Nimbecidine – Leaf extract	0.35 $^{a-d}$ (1.16)	0.30 ^{ab} (1.14)	0.33 ^{c} (1.15)	0.28 ^{ab} (1.13)	0.19 ^{a} (1.09)	0.23 ^{cd} (1.11)
S_3: Nimbecidine - Panchgavya	0.38 $^{a-d}$ (1.17)	0.33 ^{ab} (1.15)	0.35 ^{abc} (1.16)	0.33 ^{ab} (1.15)	0.21 ^{a} (1.10)	0.28 $^{a-d}$ (1.13)
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.40 ^{abc} (1.18)	0.36 ^{a} (1.17)	0.38 ^{abc} (1.17)	0.31 ^{ab} (1.14)	0.21 ^{a} (1.10)	0.27 ^{bcd} (1.12)
S_5: Nimbecidine - Silica spray	0.43 ^{abc} (1.19)	0.36 ^{a} (1.17)	0.40 ^{ab} (1.18)	0.35 ^{ab} (1.16)	0.33 ^{a} (1.15)	0.34 ^{abc} (1.16)
S_6: Nimbecidine - Action 100 spray	0.45 ^{ab} (1.20)	0.36 ^{a} (1.17)	0.40 ^{ab} (1.18)	0.37 ^{ab} (1.17)	0.35 ^{a} (1.16)	0.36 ^{ab} (1.17)
S_7: Abamectin (1.9 EC) - Perfect	0.23 ^{cd} (1.11)	0.27 ^{ab} (1.13)	0.25 ^{cd} (1.12)	0.17 ^{bc} (1.08)	0.19 ^{a} (1.09)	0.18 ^{d} (1.09)
S_8: Silica	0.40 ^{b} (1.18)	0.36 ^{a} (1.17)	0.38 ^{abc} (1.17)	0.31 ^{ab} (1.14)	0.26 ^{a} (1.12)	0.28 $^{a-d}$ (1.13)
S_9: RPP	0.19 ^{c} (1.09)	0.19 ^{b} (1.09)	0.19 ^{d} (1.09)	0.07 ^{c} (1.03)	0.04 ^{b} (1.02)	0.06 ^{e} (1.03)
S_{10}: Control	0.55 ^{a} (1.24)	0.42 ^{a} (1.19)	0.48 ^{a} (1.21)	0.47 ^{a} (1.21)	0.33 ^{a} (1.15)	0.40 ^{a} (1.18)
S.Em.±	0.03	0.02	0.02	0.03	0.02	0.02
C.D at 5%	0.07	0.06	0.06	0.08	0.06	0.05
Interaction						
T_1S_1	0.37 ^{abc} (1.17)	0.34 ^{abc} (1.15)	0.37 ^{bcd} (1.18)	0.30 ^{ab} (1.14)	0.23^{ab} (1.11)	0.27 $^{a-e}$ (1.13)
T_1S_2	0.40 ^{abc} (1.18)	0.37 ^{abc} (1.17)	0.37 ^{bcd} (1.17)	0.33 ^{ab} (1.15)	0.23 ^{ab} (1.11)	0.27 $^{a-e}$ (1.13)
T_1S_3	0.42 ^{abc} (1.19)	0.37 ^{abc} (1.17)	0.40 ^{bcd} (1.18)	0.37 ^{ab} (1.17)	0.27 ^{ab} (1.13)	0.32 $^{a-d}$ (1.15)
T_1S_4	0.42 ^{abc} (1.19)	0.42 ^{ab} (1.19)	0.42 ^{bcd} (1.19)	0.37 ^{ab} (1.17)	0.27 ^{ab} (1.13)	0.32 $^{a-d}$ (1.15)
T_1S_5	0.47 ^{ab} (1.21)	0.42 ^{ab} (1.19)	0.45 ^{bc} (1.21)	0.40 ^{ab} (1.18)	0.37 ^{a} (1.17)	0.38 ^{abc} (1.17)

T_1S_6	0.50 [ab] (1.22)	0.40 [abc] (1.18)	0.45 [bc] (1.21)	0.42 [ab] (1.19)	0.37 [a] (1.17)	0.40 [ab] (1.18)
T_1S_7	0.23 [bc] (1.11)	0.30 [abc] (1.14)	0.27 [c-f] (1.15)	0.15 [bc] (1.07)	0.19 [abc] (1.09)	0.17 [de] (1.08)
T_1S_8	0.47 [ab] (1.21)	0.40 [abc] (1.18)	0.44 [bc] (1.20)	0.40 [ab] (1.18)	0.33 [a] (1.15)	0.37 [abc] (1.17)
T_1S_9	0.23 [bc] (1.11)	0.20 [bc] (1.10)	0.21 [ef] (1.10)	0.15 [bc] (1.07)	0.07 [bc] (1.03)	0.11 [ef] (1.05)
T_1S_{10}	0.62 [a] (1.27)	0.47 [a] (1.21)	0.55 [a] (1.25)	0.52 [a] (1.23)	0.37 [a] (1.17)	0.45 [a] (1.20)
T_2S_1	0.27 [bc] (1.13)	0.20 [bc] (1.10)	0.24 [c-f] (1.12)	0.19 [abc] (1.09)	0.15 [abc] (1.07)	0.17 [de] (1.08)
T_2S_2	0.30 [bc] (1.14)	0.23 [abc] (1.11)	0.26 [def] (1.12)	0.23 [abc] (1.11)	0.15 [abc] (1.07)	0.19 [cde] (1.09)
T_2S_3	0.33 [abc] (1.15)	0.30 [abc] (1.14)	0.32 [b-e] (1.15)	0.27 [abc] (1.13)	0.17 [abc] (1.08)	0.22 [b-e] (1.10)
T_2S_4	0.37 [abc] (1.17)	0.30 [abc] (1.14)	0.34 [c-f] (1.15)	0.26 [abc] (1.12)	0.17 [abc] (1.08)	0.22 [b-e] (1.10)
T_2S_5	0.40 [abc] (1.18)	0.30 [abc] (1.14)	0.37 [bcd] (1.17)	0.30 [ab] (1.14)	0.30 [a] (1.14)	0.30 [a-d] (1.14)
T_2S_6	0.40 [abc] (1.18)	0.33 [abc] (1.15)	0.37 [bcd] (1.17)	0.33 [ab] (1.15)	0.33 [a] (1.15)	0.33 [a-d] (1.15)
T_2S_7	0.23 [bc] (1.11)	0.23 [abc] (1.11)	0.23 [c-f] (1.11)	0.20 [abc] (1.10)	0.17 [abc] (1.08)	0.19 [cde] (1.09)
T_2S_8	0.33 [abc] (1.15)	0.33 [abc] (1.15)	0.33 [bcd] (1.15)	0.23 [abc] (1.11)	0.19 [abc] (1.09)	0.20 [b-e] (1.10)
T_2S_9	0.15 [c] (1.07)	0.17 [c] (1.08)	0.16 [f] (1.07)	0.00 [c] (1.00)	0.00 [c] (1.00)	0.00 [f] (1.00)
T_2S_{10}	0.47 [ab] (1.21)	0.37 [abc] (1.17)	0.42 [ab] (1.20)	0.40 [ab] (1.18)	0.27 [ab] (1.13)	0.33 [a-d] (1.15)
S.Em.±	0.04	0.03	0.03	0.04	0.03	0.03
C.D at 5%	0.10	0.09	0.07	0.12	0.09	0.07
C.V. (%)	5.1	4.5	5.2	6.1	4.9	5.5

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate √x+1 transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 82. Leaf curl index (LCI) before second spray (5 WAT) and after 1 week of second spray (6 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before second spray			After 1 week of second spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.93 [a]	0.70 [a]	0.82 [a]	0.73 [a]	0.56 [a]	0.65 [a]
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	0.81 [b]	0.59 [b]	0.70 [b]	0.58 [b]	0.45 [b]	0.51 [b]
S.Em.±	0.02	0.02	0.01	0.02	0.01	0.01
C.D at5%	0.06	0.05	0.04	0.05	0.07	0.03
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.87 [c]	0.70 [bc]	0.78 [d]	0.57 [c]	0.40 [d]	0.48 [c]
S_2: Nimbecidine – Leaf extract	0.78 [cd]	0.53 [d]	0.66 [e]	0.57 [c]	0.40 [d]	0.48 [c]
S_3: Nimbecidine - Panchgavya	0.77 [cde]	0.50 [d]	0.63 [e]	0.57 [c]	0.40 [d]	0.48 [c]
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.63 [e]	0.37 [e]	0.50 [f]	0.47 [cd]	0.32 [d]	0.39 [d]
S_5: Nimbecidine - Silica spray	1.07 [b]	0.77 [b]	0.92 [c]	0.83 [b]	0.63 [c]	0.73 [b]
S_6: Nimbecidine - Action 100 spray	0.88 [c]	0.70 [bc]	0.79 [d]	0.77 [b]	0.67 [bc]	0.72 [b]
S_7: Abamectin (1.9 EC) - Perfect	0.43 [f]	0.32 [e]	0.38 [g]	0.40 [d]	0.22 [e]	0.31 [e]
S_8: Silica	1.15 [b]	0.93 [a]	1.04 [b]	0.85 [b]	0.73 [b]	0.79 [b]
S_9: RPP	0.72 [de]	0.65 [c]	0.68 [e]	0.43 [d]	0.33 [d]	0.38 [d]
S_{10}: Control	1.40 [a]	1.00 [a]	1.20 [a]	1.10 [a]	0.93 [a]	1.02 [a]
S.Em.±	0.05	0.04	0.03	0.04	0.03	0.02
C.D at 5%	0.13	0.11	0.09	0.11	0.07	0.07
Interaction						
T_1S_1	0.93 [cde]	0.73 [cde]	0.83 [efg]	0.63 [def]	0.47 [ef]	0.55 [d]
T_1S_2	0.80 [c-f]	0.60 [efg]	0.70 [gh]	0.67 [de]	0.47 [ef]	0.57 [d]
T_1S_3	0.73 [ef]	0.53 [fgh]	0.63 [hi]	0.67 [de]	0.47 [ef]	0.57 [d]
T_1S_4	0.67 [fg]	0.40 [hi]	0.53 [ij]	0.53 [efg]	0.37 [fgh]	0.45 [e]
T_1S_5	1.20 [b]	0.80 [cd]	1.00 [cd]	0.90 [bc]	0.73 [cd]	0.82 [c]
T_1S_6	0.97 [cd]	0.73 [cde]	0.85 [ef]	0.87 [bc]	0.80 [bc]	0.83 [c]
T_1S_7	0.50 [gh]	0.43 [hi]	0.47 [j]	0.47 [fgh]	0.23 [ij]	0.35 [efg]
T_1S_8	1.30 [b]	1.00 [b]	1.15 [b]	0.90 [bc]	0.67 [d]	0.78 [c]
T_1S_9	0.73 [ef]	0.63 [d-g]	0.68 [h]	0.50 [efg]	0.40 [fg]	0.45 [e]
T_1S_{10}	1.50 [a]	1.33 [a]	1.42 [a]	1.20 [a]	1.00 [a]	1.10 [a]
T_2S_1	0.80 [c-f]	0.67 [def]	0.73 [fgh]	0.50 [e-h]	0.33 [ghi]	0.42 [ef]
T_2S_2	0.77 [def]	0.47 [ghi]	0.62 [hi]	0.47 [fgh]	0.33 [ghi]	0.40 [ef]
T_2S_3	0.80 [c-f]	0.47 [ghi]	0.63 [hi]	0.47 [fgh]	0.33 [ghi]	0.40 [ef]
T_2S_4	0.60 [fg]	0.33 [ij]	0.47 [j]	0.40 [gh]	0.27 [hij]	0.33 [fg]
T_2S_5	0.93 [cde]	0.73 [cde]	0.83 [efg]	0.77 [cd]	0.53 [e]	0.65 [d]
T_2S_6	0.80 [c-f]	0.67 [def]	0.73 [fgh]	0.67 [de]	0.53 [e]	0.60 [d]
T_2S_7	0.37 [h]	0.20 [j]	0.28 [k]	0.33 [h]	0.20 [j]	0.27 [g]
T_2S_8	1.00 [fg]	0.87 [bc]	0.93 [de]	0.80 [cd]	0.80 [bc]	0.80 [c]
T_2S_9	0.70 [fg]	0.67 [def]	0.68 [h]	0.37 [gh]	0.27 [hij]	0.32 [fg]
T_2S_{10}	1.30 [b]	0.87 [bc]	1.08 [bc]	1.00 [b]	0.87 [b]	0.93 [b]
S.Em.±	0.07	0.05	0.04	0.05	0.04	0.03
C.D at 5%	0.19	0.15	0.12	0.16	0.10	0.10
C.V. (%)	13.3	14.1	13.7	14.4	12.8	13.9

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively, Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata*, *Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), Figures in parenthesis indicate √x+1 transformation values, , In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 83. Leaf curl index (LCI) before third spray (7 WAT) and after 1 week of third spray (8 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before third spray			After 1 week of third spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.93^{a}	0.69^{a}	0.81^{a}	0.69^{a}	0.58^{a}	0.64^{a}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	0.79^{b}	0.53^{b}	0.66^{b}	0.56^{b}	0.44^{b}	0.50^{b}
S.Em.±	0.02	0.02	0.01	0.02	0.01	0.01
C.D at5%	0.05	0.05	0.04	0.05	0.04	0.03
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.77^{cde}	0.58^{c}	0.68^{c}	0.58^{cd}	0.47^{de}	0.53^{d}
S_2: Nimbecidine – Leaf extract	0.82^{cd}	0.45^{de}	0.63^{c}	0.53^{d}	0.42^{e}	0.48^{de}
S_3: Nimbecidine - Panchgavya	0.87^{bc}	0.47^{cde}	0.67^{c}	0.60^{cd}	0.45^{e}	0.53^{d}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.65^{ef}	0.42^{de}	0.53^{d}	0.50^{d}	0.38^{e}	0.44^{e}
S_5: Nimbecidine - Silica spray	0.97^{b}	0.75^{b}	0.86^{b}	0.67^{c}	0.58^{c}	0.63^{c}
S_6: Nimbecidine - Action 100 spray	0.98^{b}	0.75^{b}	0.87^{b}	0.67^{c}	0.55^{cd}	0.61^{c}
S_7: Abamectin (1.9 EC) - Perfect	0.55^{f}	0.35^{e}	0.45^{d}	0.28^{e}	0.22^{f}	0.25^{f}
S_8: Silica	1.00^{b}	0.80^{b}	0.90^{b}	0.80^{b}	0.68^{b}	0.74^{b}
S_9: RPP	0.73^{de}	0.53^{cd}	0.63^{c}	0.58^{cd}	0.40^{e}	0.49^{de}
S_{10}: Control	1.25^{a}	0.97^{a}	1.11^{a}	1.07^{a}	0.95^{a}	1.00^{a}
S.Em.±	0.04	0.04	0.03	0.04	0.03	0.02
C.D at 5%	0.12	0.12	0.08	0.11	0.09	0.07
Interaction						
T_1S_1	0.83^{def}	0.63^{def}	0.73^{ef}	0.63^{c-f}	0.57^{c-f}	0.60^{def}
T_1S_2	0.90^{def}	0.57^{d-g}	0.73^{ef}	0.57^{c-f}	0.43^{fg}	0.50^{fgh}
T_1S_3	0.93^{cde}	0.57^{d-g}	0.75^{e}	0.67^{cde}	0.50^{d-g}	0.58^{def}
T_1S_4	0.73^{e-h}	0.50^{e-i}	0.62^{fg}	0.53^{def}	0.40^{g}	0.47^{gh}
T_1S_5	1.00^{cd}	0.83^{bc}	0.92^{cd}	0.73^{c}	0.70^{bc}	0.72^{c}
T_1S_6	1.00^{cd}	0.83^{bc}	0.92^{cd}	0.70^{cd}	0.63^{cd}	0.67^{cd}
T_1S_7	0.63^{ghi}	0.43^{g-j}	0.53^{gh}	0.30^{g}	0.23^{h}	0.27^{i}
T_1S_8	1.10^{bc}	0.87^{ab}	0.98^{bc}	0.93^{b}	0.77^{b}	0.85^{b}
T_1S_9	0.83^{def}	0.60^{d-g}	0.72^{ef}	0.67^{cde}	0.43^{fg}	0.55^{efg}
T_1S_{10}	1.30^{a}	1.03^{a}	1.17^{a}	1.20^{a}	1.10^{a}	1.15^{a}
T_2S_1	0.70^{fgh}	0.53^{e-i}	0.62^{fg}	0.53^{def}	0.37^{g}	0.45^{gh}
T_2S_2	0.73^{e-h}	0.33^{ij}	0.53^{gh}	0.50^{ef}	0.40^{g}	0.45^{gh}
T_2S_3	0.80^{d-g}	0.37^{hij}	0.58^{g}	0.53^{def}	0.40^{g}	0.47^{gh}
T_2S_4	0.57^{hi}	0.33^{ij}	0.45^{hi}	0.47^{f}	0.37^{g}	0.42^{h}
T_2S_5	0.93^{cde}	0.67^{cde}	0.80^{de}	0.60^{c-f}	0.47^{efg}	0.53^{e-h}
T_2S_6	0.97^{cd}	0.67^{cde}	0.82^{de}	0.63^{c-f}	0.47^{efg}	0.55^{efg}
T_2S_7	0.47^{i}	0.27^{j}	0.37^{i}	0.27^{g}	0.20^{h}	0.23^{i}
T_2S_8	0.90^{def}	0.73^{bcd}	0.82^{de}	0.67^{cde}	0.60^{cde}	0.63^{cde}
T_2S_9	0.63^{ghi}	0.47^{f-i}	0.55^{gh}	0.50^{ef}	0.37^{g}	0.43^{h}
T_2S_{10}	1.20^{ab}	0.90^{ab}	1.05^{b}	0.93^{b}	0.80^{b}	0.87^{b}
S.Em.±	0.06	0.06	0.04	0.06	0.04	0.03
C.D at 5%	0.17	0.17	0.12	0.16	0.13	0.10
C.V. (%)	12.0	16.3	13.8	14.9	15.0	15.0

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively

Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 84. Leaf curl index (LCI) before fourth spray (9 WAT) and after 1 week of fourth spray (10 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before fourth spray			After 1 week of fourth spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.64 [a]	0.56 [a]	0.60 [a]	0.50 [a]	0.43 [a]	0.47 [a]
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	0.52 [b]	0.49 [b]	0.50 [b]	0.41 [b]	0.37 [b]	0.39 [b]
S.Em.±	0.03	0.02	0.01	0.01	0.01	0.01
C.D at5%	0.05	0.05	0.03	0.03	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.47 [de]	0.35 [ef]	0.41 [d]	0.35 [d]	0.32 [ef]	0.33 [de]
S_2: Nimbecidine – Leaf extract	0.45 [e]	0.42 [de]	0.43 [d]	0.38 [d]	0.30 [efg]	0.34 [de]
S_3: Nimbecidine - Panchgavya	0.48 [de]	0.38 [e]	0.43 [d]	0.37 [d]	0.37 [de]	0.37 [d]
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.38 [ef]	0.35 [ef]	0.37 [d]	0.32 [d]	0.28 [fg]	0.30 [e]
S_5: Nimbecidine - Silica spray	0.57 [cd]	0.52 [cd]	0.54 [c]	0.48 [c]	0.42 [cd]	0.45 [c]
S_6: Nimbecidine - Action 100 spray	0.60 [c]	0.62 [c]	0.61 [c]	0.52 [c]	0.45 [bc]	0.48 [c]
S_7: Abamectin (1.9 EC) - Perfect	0.33 [f]	0.25 [f]	0.30 [e]	0.22 [e]	0.22 [g]	0.22 [f]
S_8: Silica	0.87 [b]	0.83 [b]	0.85 [b]	0.70 [b]	0.50 [b]	0.60 [b]
S_9: RPP	0.40 [ef]	0.32 [ef]	0.36 [de]	0.33 [d]	0.28 [fg]	0.31 [e]
S_{10}: Control	1.25 [a]	1.23 [a]	1.24 [a]	0.90 [a]	0.85 [a]	0.88 [a]
S.Em.±	0.04	0.04	0.03	0.03	0.03	0.02
C.D at 5%	0.10	0.10	0.07	0.07	0.07	0.05
Interaction						
T_1S_1	0.57 [def]	0.40 [ghi]	0.48 [fg]	0.43 [def]	0.37 [c-f]	0.40 [f-i]
T_1S_2	0.53 [d-g]	0.50 [fg]	0.52 [ef]	0.47 [cde]	0.33 [d-g]	0.40 [f-i]
T_1S_3	0.57 [def]	0.40 [ghi]	0.48 [fg]	0.40 [d-g]	0.37 [c-f]	0.38 [ghi]
T_1S_4	0.43 [f-i]	0.37 [ghi]	0.40 [gh]	0.33 [f-i]	0.30 [e-h]	0.32 [ij]
T_1S_5	0.63 [de]	0.57 [ef]	0.60 [e]	0.50 [cd]	0.43 [cd]	0.47 [ef]
T_1S_6	0.67 [cd]	0.57 [ef]	0.62 [e]	0.57 [c]	0.47 [cd]	0.52 [de]
T_1S_7	0.37 [ghi]	0.27 [i]	0.32 [hi]	0.23 [ij]	0.23 [gh]	0.23 [k]
T_1S_8	0.93 [b]	0.90 [c]	0.92 [c]	0.70 [b]	0.60 [b]	0.65 [c]
T_1S_9	0.43 [f-i]	0.33 [hi]	0.38 [ghi]	0.37 [e-h]	0.30 [e-h]	0.33 [ij]
T_1S_{10}	1.30 [a]	1.33 [a]	1.32 [a]	1.00 [a]	0.90 [a]	0.95 [a]
T_2S_1	0.37 [ghi]	0.30 [hi]	0.33 [hi]	0.27 [hij]	0.27 [fgh]	0.27 [jk]
T_2S_2	0.37 [ghi]	0.33 [hi]	0.35 [hi]	0.30 [g-j]	0.27 [fgh]	0.28 [jk]
T_2S_3	0.40 [ghi]	0.37 [ghi]	0.38 [ghi]	0.33 [f-i]	0.37 [c-f]	0.35 [hij]
T_2S_4	0.33 [hi]	0.33 [hi]	0.33 [hi]	0.30 [g-j]	0.27 [fgh]	0.28 [jk]
T_2S_5	0.50 [e-h]	0.47 [fgh]	0.48 [fg]	0.47 [cde]	0.40 [cde]	0.43 [fgh]
T_2S_6	0.53 [d-g]	0.67 [de]	0.60 [e]	0.47 [cde]	0.43 [cd]	0.45 [efg]
T_2S_7	0.30 [i]	0.23 [i]	0.27 [i]	0.20 [j]	0.20 [h]	0.20 [k]
T_2S_8	0.80 [bc]	0.77 [cd]	0.78 [d]	0.70 [b]	0.40[cde]	0.55 [d]
T_2S_9	0.37 [ghi]	0.30 [hi]	0.33 [hi]	0.30 [g-j]	0.27 [fgh]	0.28 [jk]
T_2S_{10}	1.20 [a]	1.13 [b]	1.17 [b]	0.80 [b]	0.80 [a]	0.80 [b]
S.Em.±	0.05	0.05	0.04	0.04	0.04	0.03
C.D at 5%	0.15	0.15	0.10	0.10	0.11	0.07
C.V. (%)	15.5	17.5	16.5	13.4	16.5	14.8

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

recommended practice. On other hand, highest LCI was recorded with no spray treatment (1.08). Among the treatment combinations, T_2S_7 recorded significantly lower LCI (0.17). T_1S_7 was on par with the former treatment. T_1S_4, T_2S_1, T_2S_2 and T_2S_9 were next in the order. While, the highest LCI (1.20) was recorded with T_1S_{10}.

4.3.5 Quality parameters

4.3.5.1 Ascorbic acid content (mg 100 g^{-1})

Ascorbic acid content differed significantly with sources of nitrogen, various biopesticide sprays and their interactions (Table 86).

Among sources of nutrition, integrated nutrition of N 50 per cent each through organics and inorganics recorded the highest ascorbic acid content (178.9 mg 100 g^{-1}). Among the biorational sprays, alternate sprays of nimbecidine and leaf extract + panchagavya combination spray resulted in highest ascorbic acid content in the fruits (216.4 mg 100 g^{-1}). While, no spray (S_{10}) treatment registered the lower ascorbic acid content (125.1 mg 100 g^{-1}).

Among the treatment combinations, integrated N nutrition to chilli crop with nimbicidine and mixture of panchagavya and leaf extract spray (T_2S_4) recorded the highest ascorbic acid in the green chilli fruit (234.2 mg 100 g^{-1}). While, the lowest ascorbic acid content (116.3 mg 100 g^{-1}) was recorded with chilli supplied with entire N in the inorganic form coupled with no control measure against sucking pests was taken up (T_1S_{10}).

4.3.5.2 Capsaicin content (%)

The capsaicin content of dry chilli fruit varied significantly with sources of nitrogen, biopesticide sprays and their interaction (Table 86).

Among the fertilizer treatments, integrated N supply equally through organic and inorganic sources recorded significantly higher capsaicin content (0.15%) compared to only inorganic source of N nutrition (0.12%).

Among biopesticide sprays alternate sprays of nimbecidine (5 ml l^{-1}) and mixture of leaf extract and panchagavya registered highest capsaicin content (0.22%) of all the spray schedules. However, lowest capsaicin content was recorded with the control treatment (0.07%) consisted of no sprays.

Among the treatment combinations, integrated sources of nitrogen application along with alternate sprays of nimbecidine and leaf extract + panchagavya (T_2S_4) recorded higher capsaicin content (0.23%) followed by T_1S_4. However, the lowest capsaicin content (0.07%) was recorded with the treatment receiving N through inorganic source without any sprays (T_1S_{10}).

4.3.5.3 Scovielle heat units (SHU)

Data revealed significant differences in the SHU due to sources of nitrogen, biopesticide sprays and their interaction (Table 87).

Among sources of nitrogen, significantly higher SHU was recorded with integrated sources of N through both organic and inorganic sources in equal proportion (22250) compared to only inorganic source of N nutrition (18025).

Among the spray schedules, alternate spray of nimbecidine (5 ml l^{-1}) and mixture of panchagavya + leaf extract recorded the highest SHU (32250). While, lowest SHU were recorded in the control treatment having no sprays (10625).

The highest SHU (34500) were registered with the treatment combination of integrated sources of N equally through organic and inorganic sources to chilli crop coupled with alternate sprays of nimbecidine and panchagavya + leaf extract combination (T_2S_4) compared to the rest of the treatment combinations. While, significantly lower SHU were registered with T_1S_{10} (10000).

4.3.5.4 Per cent discoloured fruits

The variations in per cent discoloured fruits due to sources of nitrogen, biorational sprays and their interaction were significant (Table 88).

Table 85. Leaf curl index (LCI) before fifth spray (11 WAT) and after 1 week of fifth spray (12 WAT) as influenced by different sources of nutrition and biopesticides spray

Treatments	Before fifth spray			After 1 week of fifth spray		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	0.84 [a]	0.69 [a]	0.76 [a]	0.67 [a]	0.47 [a]	0.57 [a]
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	0.63 [b]	0.56 [b]	0.60 [b]	0.57 [b]	0.38 [b]	0.47 [b]
S.Em.±	0.02	0.01	0.01	0.01	0.01	0.01
C.D at5%	0.06	0.02	0.03	0.03	0.03	0.02
Biopesticides sprays***						
S_1: Nimbecidine – GCK	0.58 [de]	0.52 [de]	0.55 [de]	0.43 [de]	0.33 [e]	0.38 [fg]
S_2: Nimbecidine – Leaf extract	0.60 [de]	0.52 [de]	0.56 [de]	0.45 [cd]	0.35 [e]	0.40 [ef]
S_3: Nimbecidine - Panchgavya	0.63 [d]	0.55 [d]	0.59 [d]	0.50 [c]	0.37 [e]	0.43 [e]
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	0.48 [ef]	0.47 [e]	0.48 [f]	0.38 [e]	0.30 [e]	0.34 [g]
S_5: Nimbecidine - Silica spray	0.80 [c]	0.70 [c]	0.75 [c]	0.75 [b]	0.45 [d]	0.60 [d]
S_6: Nimbecidine - Action 100 spray	0.83 [c]	0.72 [c]	0.78 [c]	0.80 [b]	0.52 [c]	0.66 [c]
S_7: Abamectin (1.9 EC) - Perfect	0.37 [f]	0.33 [f]	0.35 [g]	0.22 [f]	0.18 [f]	0.20 [h]
S_8: Silica	1.07 [b]	0.87 [b]	0.97 [b]	0.80 [b]	0.62 [b]	0.71 [b]
S_9: RPP	0.55 [de]	0.47 [e]	0.51 [ef]	0.50 [c]	0.32 [e]	0.41 [ef]
S_{10}: Control	1.43 [a]	1.10 [a]	1.27 [a]	1.35 [a]	0.80 [a]	1.08 [a]
S.Em.±	0.04	0.02	0.02	0.02	0.02	0.02
C.D at 5%	0.12	0.05	0.06	0.06	0.06	0.05
Interaction						
T_1S_1	0.67 [e]	0.57 [fgh]	0.62 [def]	0.47 [fg]	0.37 [fg]	0.42 [hij]
T_1S_2	0.70 [de]	0.63 [ef]	0.67 [d]	0.47 [fg]	0.37 [fg]	0.42 [hij]
T_1S_3	0.67 [e]	0.60 [efg]	0.63 [def]	0.53 [f]	0.40 [ef]	0.47 [gh]
T_1S_4	0.53 [ef]	0.50 [hij]	0.52 [gh]	0.40 [g]	0.33 [fgh]	0.37 [ijk]
T_1S_5	0.90 [c]	0.73 [cd]	0.82 [c]	0.80 [cd]	0.53 [cd]	0.68 [de]
T_1S_6	1.00 [c]	0.80 [c]	0.90 [c]	0.87 [c]	0.57 [c]	0.72 [cd]
T_1S_7	0.40 [fg]	0.37 [lm]	0.38 [ij]	0.23 [h]	0.23 [h]	0.23 [l]
T_1S_8	1.27 [b]	0.93 [b]	1.10 [b]	0.87 [c]	0.67 [b]	0.77 [c]
T_1S_9	0.60 [ef]	0.53 [ghi]	0.57 [efg]	0.53 [f]	0.33 [fgh]	0.43 [hi]
T_1S_{10}	1.67 [a]	1.20 [a]	1.43 [a]	1.5 [a]	0.90 [a]	1.20 [a]
T_2S_1	0.50 [efg]	0.47 [ijk]	0.48 [gh]	0.40 [g]	0.30 [fgh]	0.35 [jk]
T_2S_2	0.50 [efg]	0.40 [kl]	0.45 [hi]	0.43 [fg]	0.33 [fgh]	0.38 [ijk]
T_2S_3	0.60 [ef]	0.50 [hij]	0.55 [fg]	0.47 [fg]	0.33 [fgh]	0.40 [hij]
T_2S_4	0.43 [fg]	0.43 [jkl]	0.43 [hi]	0.37 [g]	0.27 [gh]	0.32 [k]
T_2S_5	0.70 [de]	0.67 [de]	0.68 [d]	0.70 [e]	0.37 [fg]	0.53 [g]
T_2S_6	0.67 [e]	0.63 [ef]	0.65 [de]	0.73 [de]	0.47 [de]	0.60 [f]
T_2S_7	0.33 [g]	0.30 [m]	0.32 [j]	0.20 [h]	0.13 [i]	0.17 [l]
T_2S_8	0.87 [cd]	0.80 [c]	0.83 [c]	0.73 [de]	0.57 [c]	0.65 [ef]
T_2S_9	0.50 [efg]	0.40 [kl]	0.45 [hi]	0.47 [fg]	0.30 [fgh]	0.38 [ijk]
T_2S_{10}	1.20 [b]	1.00 [b]	1.10 [b]	1.20 [b]	0.70 [b]	0.95 [b]
S.Em.±	0.06	0.03	0.03	0.03	0.03	0.02
C.D at 5%	0.63	0.07	0.09	0.09	0.09	0.06
C.V. (%)	14.4	6.8	11.9	9.3	12.8	10.7

Table 86. Ascorbic acid content (mg 100 g^{-1}) and capsaicin content (%) as influenced by different sources of nutrition and biopesticides spray

Treatments	Ascorbic acid content (mg 100 g^{-1})			Capsaicin content (%)		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	150.7 ^{b}	172.4 ^{b}	161.5 ^{b}	0.11 ^{b}	0.13 ^{b}	01.2 ^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	165.6 ^{a}	192.3 ^{a}	178.9 ^{a}	0.13 ^{a}	0.17 ^{a}	0.15 ^{a}
S.Em.±	2.3	3.0	1.9	0.006	0.006	0.004
C.D at5%	6.6	8.6	5.3	0.017	0.017	0.012
Biopesticides sprays***						
S_1: Nimbecidine – GCK	168.3 ^{b}	186.3 ^{cd}	177.3 ^{c}	0.12 ^{bc}	0.18 ^{b}	0.15 ^{bc}
S_2: Nimbecidine – Leaf extract	176.4 ^{b}	205.2 ^{bc}	190.8 ^{b}	0.12 ^{bc}	0.17 ^{b}	0.14 ^{cd}
S_3: Nimbecidine - Panchgavya	181.7 ^{b}	209.8 ^{b}	195.7 ^{b}	0.14 ^{b}	0.19 ^{b}	0.17 ^{b}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	200.1 ^{a}	232.7 ^{a}	216.4 ^{a}	0.19 ^{a}	0.25 ^{a}	0.22 ^{a}
S_5: Nimbecidine - Silica spray	138.1 ^{cd}	150.6 ^{efg}	144.7 ^{ef}	0.11 ^{bcd}	0.13 ^{c}	0.12 ^{de}
S_6: Nimbecidine - Action 100 spray	150.7 ^{c}	170.7 ^{de}	160.8 ^{d}	0.10 ^{bcd}	0.12 ^{cd}	0.11 ^{e}
S_7: Abamectin (1.9 EC) - Perfect	183.3 ^{b}	221.6 ^{ab}	202.4 ^{b}	0.14 ^{b}	0.19 ^{b}	0.17 ^{b}
S_8: Silica	124.9 ^{de}	146.5 ^{fg}	135.7 ^{fg}	0.10 ^{bcd}	0.12 ^{cd}	0.11 ^{e}
S_9: RPP	141.4 ^{c}	165.9 ^{ef}	153.6 ^{de}	0.09 ^{cd}	0.11 ^{cd}	0.10 ^{e}
S_{10}: Control	116.1 ^{e}	134.1 ^{g}	125.1 ^{g}	0.07 ^{d}	0.08 ^{d}	0.07 ^{f}
S.Em.±	5.1	6.7	4.2	0.01	0.01	0.01
C.D at 5%	14.7	19.3	11.9	0.04	0.037	0.03
Interaction						
T_1S_1	167.8 ^{cde}	187.4 ^{de}	177.6 ^{def}	0.12 $^{b-e}$	0.15 ^{cde}	0.14 ^{cde}
T_1S_2	166.3 ^{def}	189.6 ^{de}	177.9 ^{def}	0.10 ^{cde}	0.13 $^{d-g}$	0.12 $^{d-g}$
T_1S_3	172.8 ^{bcd}	193.6 ^{cde}	183.2 ^{cde}	0.13 ^{bcd}	0.18 ^{bcd}	0.16 ^{cd}
T_1S_4	184.7 ^{bcd}	212.2 ^{bcd}	198.5 ^{bc}	0.17 ^{ab}	0.23 ^{ab}	0.20 ^{ab}
T_1S_5	132.0 ^{ghi}	145.9 ^{hij}	138.9 ^{ijk}	0.10 ^{cde}	0.10 ^{efg}	0.10 $^{e-h}$
T_1S_6	138.5 ^{gh}	167.5 $^{e-i}$	153.0 ^{ghi}	0.08 ^{de}	0.10 ^{efg}	0.09 ^{fgh}
T_1S_7	174.4 ^{bcd}	212.2 ^{bcd}	193.3 ^{bcd}	0.13 ^{bcd}	0.18 ^{bcd}	0.16 ^{cd}
T_1S_8	121.4 ^{hi}	139.9 ^{ij}	130.7 ^{kl}	0.09 ^{cde}	0.10 ^{efg}	0.10 $^{e-h}$
T_1S_9	138.5 ^{gh}	153.2 ^{ghi}	145.9 $^{h-k}$	0.08 ^{de}	0.10 ^{efg}	0.09 ^{fgh}
T_1S_{10}	110.4 ^{i}	122.1 ^{j}	116.3 ^{l}	0.06 ^{e}	0.07 ^{g}	0.07 ^{h}
T_2S_1	168.8 ^{bcd}	185.3 ^{def}	177.1 ^{def}	0.13 ^{bcd}	0.20 ^{bc}	0.16 ^{cd}
T_2S_2	186.4 ^{bcd}	220.8 ^{bc}	203.6 ^{b}	0.13 ^{bcd}	0.19 ^{bc}	0.16 ^{cd}
T_2S_3	190.5 ^{bc}	225.9 ^{ab}	208.2 ^{b}	0.15 ^{abc}	0.20 ^{bc}	0.18 ^{bc}
T_2S_4	215.4 ^{a}	253.1 ^{a}	234.2 ^{a}	0.20 ^{a}	0.26 ^{a}	0.23 ^{a}
T_2S_5	145.6 ^{efg}	155.2 $^{f-i}$	150.4 $^{g-j}$	0.12 $^{b-e}$	0.16 ^{cd}	0.14 ^{cde}
T_2S_6	162.8 ^{def}	173.9 $^{e-h}$	168.3 ^{efg}	0.12 $^{b-e}$	0.14 $^{c-f}$	0.13 ^{def}
T_2S_7	192.1 ^{b}	231.0 ^{ab}	211.6 ^{b}	0.15 ^{abc}	0.20 ^{bc}	0.18 ^{bc}
T_2S_8	128.4 ^{ghi}	153.0 ^{ghi}	140.7 ^{ijk}	0.11 $^{b-e}$	0.13 $^{d-g}$	0.12 $^{d-g}$
T_2S_9	144.2 ^{fgh}	178.5 ^{efg}	161.4 ^{fgh}	0.10 ^{cde}	0.12 $^{d-g}$	0.11 $^{e-h}$
T_2S_{10}	121.8 ^{hi}	146.1 ^{hij}	133.9 ^{jkl}	0.07 ^{de}	0.08 ^{fg}	0.08 ^{gh}
S.Em.±	7.2	9.5	6.0	0.02	0.02	0.01
C.D at 5%	20.8	27.3	16.9	0.05	0.05	0.04
C.V. (%)	7.9	9.1	8.6	15.6	16.6	17.2

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 86. Ascorbic acid content (mg 100 g^{-1}) and capsaicin content (%) as influenced by different sources of nutrition and biopesticides spray

Treatments	Ascorbic acid content (mg 100 g^{-1})			Capsaicin content (%)		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	150.7 ^{b}	172.4 ^{b}	161.5 ^{b}	0.11 ^{b}	0.13 ^{b}	01.2 ^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	165.6 ^{a}	192.3 ^{a}	178.9 ^{a}	0.13 ^{a}	0.17 ^{a}	0.15 ^{a}
S.Em.±	2.3	3.0	1.9	0.006	0.006	0.004
C.D at5%	6.6	8.6	5.3	0.017	0.017	0.012
Biopesticides sprays***						
S_1: Nimbecidine – GCK	168.3 ^{b}	186.3 ^{cd}	177.3 ^{c}	0.12 ^{bc}	0.18 ^{b}	0.15 ^{bc}
S_2: Nimbecidine – Leaf extract	176.4 ^{b}	205.2 ^{bc}	190.8 ^{b}	0.12 ^{bc}	0.17 ^{b}	0.14 ^{cd}
S_3: Nimbecidine - Panchgavya	181.7 ^{b}	209.8 ^{b}	195.7 ^{b}	0.14 ^{b}	0.19 ^{b}	0.17 ^{b}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	200.1 ^{a}	232.7 ^{a}	216.4 ^{a}	0.19 ^{a}	0.25 ^{a}	0.22 ^{a}
S_5: Nimbecidine - Silica spray	138.1 ^{cd}	150.6 ^{efg}	144.7 ^{ef}	0.11 ^{bcd}	0.13 ^{c}	0.12 ^{de}
S_6: Nimbecidine - Action 100 spray	150.7 ^{c}	170.7 ^{de}	160.8 ^{d}	0.10 ^{bcd}	0.12 ^{cd}	0.11 ^{e}
S_7: Abamectin (1.9 EC) - Perfect	183.3 ^{b}	221.6 ^{ab}	202.4 ^{b}	0.14 ^{b}	0.19 ^{b}	0.17 ^{b}
S_8: Silica	124.9 ^{de}	146.5 ^{fg}	135.7 ^{fg}	0.10 ^{bcd}	0.12 ^{cd}	0.11 ^{e}
S_9: RPP	141.4 ^{c}	165.9 ^{ef}	153.6 ^{de}	0.09 ^{cd}	0.11 ^{cd}	0.10 ^{e}
S_{10}: Control	116.1 ^{e}	134.1 ^{g}	125.1 ^{g}	0.07 ^{d}	0.08 ^{d}	0.07 ^{f}
S.Em.±	5.1	6.7	4.2	0.01	0.01	0.01
C.D at 5%	14.7	19.3	11.9	0.04	0.037	0.03
Interaction						
T_1S_1	167.8 ^{cde}	187.4 ^{de}	177.6 ^{def}	0.12 $^{b-e}$	0.15 ^{cde}	0.14 ^{cde}
T_1S_2	166.3 ^{def}	189.6 ^{de}	177.9 ^{def}	0.10 ^{cde}	0.13 $^{d-g}$	0.12 $^{d-g}$
T_1S_3	172.8 ^{bcd}	193.6 ^{cde}	183.2 ^{cde}	0.13 ^{bcd}	0.18 ^{bcd}	0.16 ^{cd}
T_1S_4	184.7 ^{bcd}	212.2 ^{bcd}	198.5 ^{bc}	0.17 ^{ab}	0.23 ^{ab}	0.20 ^{ab}
T_1S_5	132.0 ^{ghi}	145.9 ^{hij}	138.9 ^{ijk}	0.10 ^{cde}	0.10 ^{efg}	0.10 $^{e-h}$
T_1S_6	138.5 ^{gh}	167.5 $^{e-i}$	153.0 ^{ghi}	0.08 ^{de}	0.10 ^{efg}	0.09 ^{fgh}
T_1S_7	174.4 ^{bcd}	212.2 ^{bcd}	193.3 ^{bcd}	0.13 ^{bcd}	0.18 ^{bcd}	0.16 ^{cd}
T_1S_8	121.4 ^{hi}	139.9 ^{ij}	130.7 ^{kl}	0.09 ^{cde}	0.10 ^{efg}	0.10 $^{e-h}$
T_1S_9	138.5 ^{gh}	153.2 ^{ghi}	145.9 $^{h-k}$	0.08 ^{de}	0.10 ^{efg}	0.09 ^{fgh}
T_1S_{10}	110.4 ^{i}	122.1 ^{j}	116.3 ^{l}	0.06 ^{e}	0.07 ^{g}	0.07 ^{h}
T_2S_1	168.8 ^{bcd}	185.3 ^{def}	177.1 ^{def}	0.13 ^{bcd}	0.20 ^{bc}	0.16 ^{cd}
T_2S_2	186.4 ^{bcd}	220.8 ^{bc}	203.6 ^{b}	0.13 ^{bcd}	0.19 ^{bc}	0.16 ^{cd}
T_2S_3	190.5 ^{bc}	225.9 ^{ab}	208.2 ^{b}	0.15 ^{abc}	0.20 ^{bc}	0.18 ^{bc}
T_2S_4	215.4 ^{a}	253.1 ^{a}	234.2 ^{a}	0.20 ^{a}	0.26 ^{a}	0.23 ^{a}
T_2S_5	145.6 ^{efg}	155.2 $^{f-i}$	150.4 $^{g-j}$	0.12 $^{b-e}$	0.16 ^{cd}	0.14 ^{cde}
T_2S_6	162.8 ^{def}	173.9 $^{e-h}$	168.3 ^{efg}	0.12 $^{b-e}$	0.14 $^{c-f}$	0.13 ^{def}
T_2S_7	192.1 ^{b}	231.0 ^{ab}	211.6 ^{b}	0.15 ^{abc}	0.20 ^{bc}	0.18 ^{bc}
T_2S_8	128.4 ^{ghi}	153.0 ^{ghi}	140.7 ^{ijk}	0.11 $^{b-e}$	0.13 $^{d-g}$	0.12 $^{d-g}$
T_2S_9	144.2 ^{fgh}	178.5 ^{efg}	161.4 ^{fgh}	0.10 ^{cde}	0.12 $^{d-g}$	0.11 $^{e-h}$
T_2S_{10}	121.8 ^{hi}	146.1 ^{hij}	133.9 ^{jkl}	0.07 ^{de}	0.08 ^{fg}	0.08 ^{gh}
S.Em.±	7.2	9.5	6.0	0.02	0.02	0.01
C.D at 5%	20.8	27.3	16.9	0.05	0.05	0.04
C.V. (%)	7.9	9.1	8.6	15.6	16.6	17.2

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively

Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 87. Scoville heat units as influenced by different sources of nutrition and biopesticides spray

Treatments	Scoville heat units		
	2005-06	2006-07	Pooled
Sources of nitrogen			
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	15950 [b]	20100 [b]	18025 [b]
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	19200 [a]	25300 [a]	22250 [a]
S.Em.±	570.5	694.3	449.3
C.D at5%	1636	1991	1267
Biopesticides sprays***			
S_1: Nimbecidine – GCK	18750 [bc]	26250 [b]	22500 [bc]
S_2: Nimbecidine – Leaf extract	17250 [bcd]	24000 [bc]	20625 [cd]
S_3: Nimbecidine - Panchgavya	21000 [b]	28750 [b]	24875 [b]
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	27750 [a]	36750 [a]	32250 [a]
S_5: Nimbecidine - Silica spray	16500 [cd]	19750 [cd]	18125 [de]
S_6: Nimbecidine - Action 100 spray	15000 [cd]	18000 [d]	16500 [ef]
S_7: Abamectin (1.9 EC) - Perfect	21000 [b]	28500 [b]	24750 [b]
S_8: Silica	15000 [cd]	17250 [d]	16125 [ef]
S_9: RPP	13500 [de]	16500 [d]	15000 [f]
S_{10}: Control	10000 [e]	11250 [e]	10625 [g]
S.Em.±	1276	1553	1005
C.D at 5%	3659	4453	2832
Interaction			
T_1S_1	18000 [cde]	22500 [def]	20250 [def]
T_1S_2	15000 [def]	19500 [efg]	17250 [fgh]
T_1S_3	19500 [cd]	27000 [cd]	23250 [cde]
T_1S_4	25500 [ab]	34500 [ab]	30000 [b]
T_1S_5	15000 [def]	15500 [f-i]	15250 [ghi]
T_1S_6	12000 [ef]	14500 [ghi]	13250 [hij]
T_1S_7	19000 [cd]	27000 [cd]	23250 [cde]
T_1S_8	13500 [def]	15000 [ghi]	14250 [g-j]
T_1S_9	12000 [ef]	15000 [ghi]	13500 [g-j]
T_1S_{10}	9500 [f]	10500 [i]	10000 [j]
T_2S_1	19500 [cd]	30000 [bc]	24750 [cd]
T_2S_2	19500 [cd]	28500 [bcd]	24000 [cde]
T_2S_3	22500 [bc]	30500 [bc]	26500 [bc]
T_2S_4	30000 [a]	39000 [a]	34500 [a]
T_2S_5	18000 [cde]	24000 [cde]	21000 [def]
T_2S_6	18000 [cde]	21500 [d-g]	19750 [ef]
T_2S_7	22500 [bc]	30000 [bc]	26250 [bc]
T_2S_8	16500 [cde]	19500 [efg]	18000 [fg]
T_2S_9	15000 [def]	18000 [e-h]	16500 [fgh]
T_2S_{10}	10500 [f]	12000 [hi]	11250 [ij]
S.Em.±	1804	2196	1421
C.D at 5%	5174	6297	4006
C.V. (%)	17.8	16.8	17.3

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Among the sources of nitrogen, 50 per cent of nitrogen supplied through organic and inorganic sources registered the lowest per cent discoloured fruits (10.27%). Among the biopesticide sprays, alternate sprays of Abamectin and Perfect (S_7) recorded the lowest per cent of discoloured fruits (8.35%). S_4 treatment was on par with the former treatment (S_7). Nimbecidine alternated with silica, Action 100 and leaf extract spray were next in the order and were comparable to RPP and infact S_3 and S_1 were superior to the recommended sprays. On the other hand, highest per cent of discoloured fruits were observed in the treatment having no sprays for sucking pest control (14.53%).

Among treatment combinations, nimbicidine alternated with leaf extract + panchagavya sprays coupled with N supply equally through organic and inorganic sources (T_2S_4) recorded the lowest per cent of discoloured fruits (7.82%) (Fig. 22). T_1S_4, T_1S_7, T_2S_1, T_2S_3 and T_2S_7 were on par with the former treatment combination (T_2S_4). T_1S_1, T_1S_3, T_1S_7, T_2S_2, T_2S_5, T_2S_6 and T_2S_9 were next in the order. While the highest per cent of discoloured fruits (15.62%) was recorded in the T_1S_{10}.

4.3.5.5 Yield of good quality fruits (kg ha^{-1})

Good quality fruit yield differed significantly due to sources of N, biorational sprays and their interaction (Table 88). Between the two sources of N, the highest yield (715 kg ha^{-1}) of good quality fruits was recorded with 50 per cent recommended N substitution through organics. Among sprays, Abamectin and Perfect (S_7) spray recorded the highest yield of good quality fruits (962 kg ha^{-1}). Nimbecidine sprays alternated with remaining biorationals except silica and Action 100 were next in the order and were comparable to RPP. Among the treatment combinations, chilli nutritioned with the integrated source of N coupled with Abamectin and Perfect (T_2S_7) sprays recorded the highest yield of good quality fruits (1039 kg ha^{-1}) followed by T_1S_7 treatment combination (Fig. 22). T_1S_1, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 were on par with each other. On the other hand lowest yield (361 kg ha^{-1}) of good fruits was recorded with T_1S_{10}.

4.3.5.6 Oleoresin content (%)

The effects due to N sources, pesticide sprays and their interaction were significant with regard to oleoresin per cent (Table 89).

N supply equally through organic and inorganic sources recorded the highest oleoresin per cent (15.56%). Among the biorational sprays, nimbecidine alternated with leaf extract + panchagavya (S_4) registered significantly higher oleoresin per cent (17.48%). S_7 was on per with the former treatment. Nimbecidine sprays alternated with other biorationals were next in the order and comparable with RPP and infact S_1 was found superior to the recommended sprays. While, the lowest per cent of oleoresin was recorded with the control treatment having no sprays (12.47%). Among the treatment combinations, T_2S_4 recorded significantly higher oleoresin per cent (17.87%). T_1S_4, T_2S_1 and T_2S_7 were on par with former treatment combination (T_2S_4). While, significantly lower oleoresin per cent (11.98%) was recorded with T_1S_{10}.

4.3.5.7 Oleoresin yield (kg ha^{-1})

Data revealed significant differences in the oleoresin yield due to sources of N, biopesticide sprays and their interaction (Table 89).

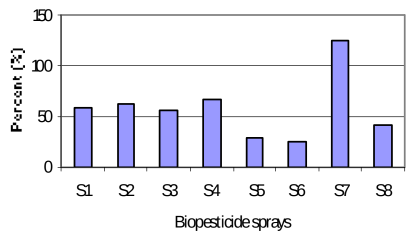
Chilli crop nutritioned with equal doses of organics and inorganic sources of N recorded the highest oleoresin yield (113.9 kg ha^{-1}). Abamectin alternated with Perfect recorded the highest oleoresin yield (159.8 kg ha^{-1}), among the biopesticide sprays. On other hand, lowest oleoresin yield was recorded with no spray treatment (52.8 kg ha^{-1}).

Among the treatment combinations, chilli sprayed with Abamectin and Perfect coupled with integrated N supply (T_2S_7) recorded the highest oleoresin yield (176.6 kg ha^{-1}). T_1S_7 recorded next higher oleoresin yield. On the other hand, the lowest oleoresin yield was registered with T_1S_{10} (43.8 kg ha^{-1}).

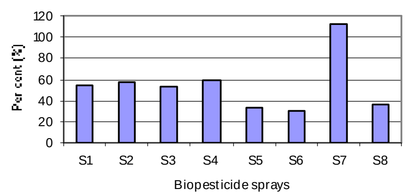
Table 88. Per cent discoloured fruits and yield of good fruits (kg ha^{-1}) as influenced by different sources of nutrition and biopesticides spray

Treatments	Discoloured fruits (%)			Yield of good fruits (kg ha^{-1})		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	12.05 ^{a}	11.38 ^{a}	11.71 ^{a}	486 ^{b}	675 ^{b}	580 ^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	10.47	10.07 ^{b}	10.27 ^{b}	623 ^{a}	808 ^{a}	715 ^{a}
S.Em.±	0.34	0.27	0.22	10.33	13.41	8.47
C.D at5%	0.97	0.76	0.61	29.64	38.47	23.87
Biopesticides sprays***						
S_1: Nimbecidine – GCK	10.20 ^{cd}	9.80 ^{cd}	10.0 ^{c}	564 ^{bc}	787 ^{b}	675 ^{b}
S_2: Nimbecidine – Leaf extract	10.80 ^{bcd}	11.25 ^{bc}	11.0 ^{bc}	577 ^{b}	790 ^{b}	684 ^{b}
S_3: Nimbecidine - Panchgavya	10.72 ^{bcd}	9.62 ^{cde}	10.17 ^{c}	560 ^{bc}	773 ^{b}	667 ^{b}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	8.70 ^{d}	8.52 ^{de}	8.61 ^{d}	613 ^{b}	818 ^{b}	716 ^{b}
S_5: Nimbecidine - Silica spray	11.55 ^{bc}	10.97 ^{bc}	11.26 ^{bc}	466 ^{d}	667 ^{c}	566 ^{c}
S_6: Nimbecidine - Action 100 spray	11.85 ^{bc}	11.50 ^{bc}	11.68 ^{b}	451 ^{d}	637 ^{c}	544 ^{c}
S_7: Abamectin (1.9 EC) - Perfect	8.80 ^{d}	7.9 ^{e}	8.35 ^{d}	912 ^{a}	1012 ^{a}	962 ^{a}
S_8: Silica	12.95 ^{b}	12.05 ^{b}	12.50 ^{b}	501 ^{cd}	666 ^{c}	583 ^{c}
S_9: RPP	11.80 ^{bc}	11.80 ^{b}	11.80 ^{b}	576 ^{b}	763 ^{b}	669 ^{b}
S_{10}: Control	15.25 ^{a}	13.82 ^{a}	14.53 ^{a}	325 ^{e}	498 ^{d}	411 ^{d}
S.Em.±	0.76	0.60	0.48	23.1	29.99	18.93
C.D at 5%	2.17	1.71	1.36	66.27	86.02	53.37
Interaction						
T_1S_1	10.80 $^{b-f}$	10.40 $^{b-g}$	10.60 $^{d-g}$	491 ^{efg}	720 $^{d-g}$	605 ^{de}
T_1S_2	11.20 $^{b-f}$	11.90 ^{bcd}	11.55 $^{b-f}$	499 ^{ef}	731 $^{d-g}$	615 ^{d}
T_1S_3	11.60 $^{b-e}$	9.93 $^{c-h}$	10.77 $^{c-g}$	480 ^{efg}	716 $^{d-g}$	598 ^{de}
T_1S_4	9.80 ^{def}	9.00 $^{e-h}$	9.40 ^{fgh}	533 ^{ef}	757 ^{cde}	645 ^{d}
T_1S_5	12.1 $^{b-e}$	11.30 $^{b-e}$	11.70 $^{b-e}$	394 ^{gh}	593 ^{gh}	494 ^{f}
T_1S_6	12.8 ^{bcd}	12.30 ^{abc}	12.55 ^{bcd}	376 ^{gh}	566 ^{h}	471 ^{f}
T_1S_7	9.00 ^{ef}	8.30 ^{fgh}	8.65 ^{gh}	842 ^{b}	929 ^{b}	886 ^{b}
T_1S_8	13.8 ^{abc}	13.00 ^{ab}	13.40 ^{b}	441 ^{fgh}	607 ^{fgh}	524 ^{ef}
T_1S_9	13.0 ^{bcd}	12.80 ^{ab}	12.90 ^{bc}	513 ^{ef}	695 $^{e-h}$	604 ^{de}
T_1S_{10}	16.4 ^{a}	14.83 ^{a}	15.62 ^{a}	291 ^{i}	432 ^{i}	361 ^{g}
T_2S_1	9.60 ^{def}	9.20 $^{d-h}$	9.40 ^{fgh}	637 ^{cd}	854 ^{bcd}	745 ^{c}
T_2S_2	10.3 $^{c-f}$	10.60 $^{b-g}$	10.45 $^{d-g}$	656 ^{cd}	850 ^{bcd}	753 ^{c}
T_2S_3	9.85 ^{def}	9.30 $^{d-h}$	9.57 $^{c-h}$	640 ^{cd}	831 $^{b-e}$	736 ^{c}
T_2S_4	7.60 ^{f}	8.03 ^{fgh}	7.82 ^{h}	692 ^{c}	879 ^{bc}	786 ^{c}
T_2S_5	11.0 $^{b-f}$	10.63 $^{b-g}$	10.82 $^{c-g}$	535 ^{ef}	740 ^{def}	637 ^{d}
T_2S_6	10.9 $^{b-f}$	10.70 $^{b-g}$	10.8 $^{c-g}$	526 ^{ef}	707 ^{efg}	617 ^{d}
T_2S_7	8.60 ^{ef}	7.50 ^{h}	8.05 ^{h}	982 ^{a}	1095 ^{a}	1039 ^{a}
T_2S_8	12.1 $^{b-e}$	11.10 $^{b-f}$	11.60 $^{b-f}$	560 ^{de}	726 $^{d-g}$	643 ^{d}
T_2S_9	10.6 $^{b-f}$	10.80 $^{b-g}$	10.70 $^{c-g}$	638 ^{cd}	831 $^{b-e}$	735 ^{c}
T_2S_{10}	14.1 ^{ab}	12.80 ^{ab}	13.45 ^{b}	359 ^{hi}	564 ^{h}	461 ^{f}
S.Em.±	1.07	0.84	0.68	32.67	42.41	26.77
C.D at 5%	3.06	2.42	1.92	93.27	121.7	75.47
C.V. (%)	16.4	13.6	15.2	10.2	9.9	10.1

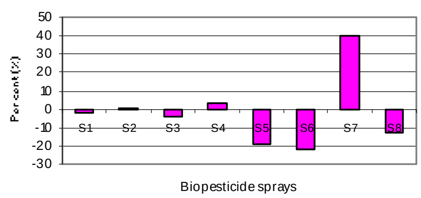
* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)



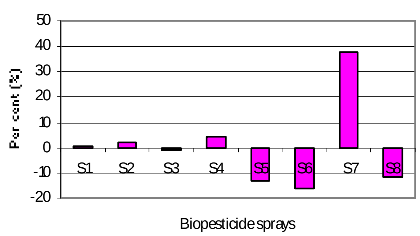
A. Increase in fruit yield under RDN as infuenced by different biopesticides sprays over control



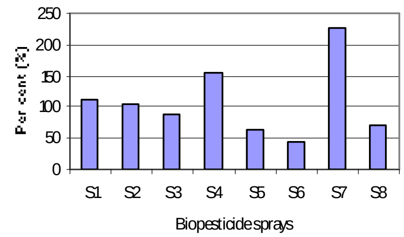
B. Increse in fruit yield under integrated N supply as infuenced by different biopesticide sprays over control



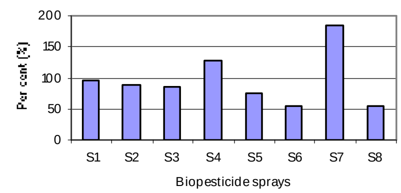
C. Increase/decrease in fruit yield under RDN as influenced by different biopesticide sprays over RPP



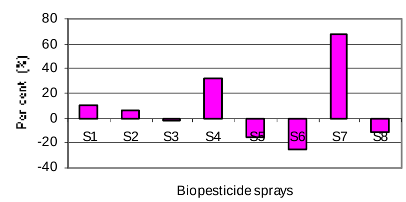
D. Increase/decrease in fruit yield under integrated N supply as infuenced by biopesticide sprays over RPP



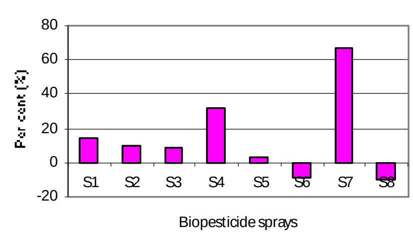
E. Increase in oleoresin yield over control as influenced by different biopesticides sprays under RDN



F. Increase in oleoresin yield over control as influenced by different biopesticide sprays under integrated N supply



G. Per cent increase oleoresin yield of RDN nutrioned chilli as influenced by different biopesticide sprays over RPP



H. Per cent increase in oleoresin yield of integrated N supply as influenced by different biopesticide sprays over RPP

LEGEND: S1 - Nimbencidine + GCK, S2 – Nimbecidine + leaf extract, S3-Nimbecidine +Panchagavya, S4-Nimbecidine + leaf extract +Panchagavya, S5-Nimbecidine +Silica, S4-Nimbecidine + Action 100, S7-Abamectin+ Perfect, S8- Silica

Fig. Percent reduction in discoloured fruits and percent increase in yield of good quality fruits over control and RPP as influenced by different biopesticide sprays under RDN and integrated N supply

4.3.6 Economic analysis

4.3.6.1 Gross return (Rs. ha^{-1})

Significant variations in the total income were recorded due to sources of N, biopesticide spray and their interaction (Table 90).

Between two supply sources of N, chilli crop supplied with equal quantity of organics and inorganic sources of N recorded the highest total income (Rs.39,730 ha^{-1}). Among the spray treatments, alternate sprays of Abamectin and Perfect (S_7) recorded the highest total income (Rs 52480. ha^{-1}). Sprays comprising of Nimbecidine alternated with rest of the biorationals except silica and Action 100 were next in the order and comparable with RPP. On the other hand, lowest gross income was recorded in the no spray treatment (Rs 23980. ha^{-1}). Among the treatment combinations, T_2S_7 recorded the highest total income (Rs.56530. ha^{-1}). T_1S_7 was next in the order, T_1S_1, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 were on par with each other. While, the lowest gross return (Rs. 21360 ha^{-1}) was obtained to the T_1S_{10}.

4.3.6.2 Net return (Rs. ha^{-1})

The highest net return (Rs.20900 ha^{-1}) was recorded in case of integrated nitrogen nutrition to chilli (Table 90). While, alternate sprays of Abamectin and Perfect recorded the highest net income (Rs 32510 ha^{-1}), among the biopesticide treatments. Nimbecidine sprays alternated with other biopesticides except silica and Action 100 were next in the order and comparable with RPP. While, the lowest net income was obtained with no spray treatment (Rs 9580. ha^{-1}). Among the treatment combinations, alternate spray of Abamectin and Perfect and nutritioned with equal quantity of organic and inorganic N sources (T_2S_7) recorded significantly higher net income (34130 Rs. ha^{-1}). T_1S_7 was on par with the former treatment combination. T_1S_1, T_1S_3, T_1S_4, T_1S_9, T_2S_1, T_2S_2, T_2S_3, T_2S_4 and T_2S_9 were next in the order. While significantly lower net return (Rs. 9360 ha^{-1}) was recorded with T_1S_{10}.

4.3.6.3. B:C ratio

The B:C ratio varied significantly due to sources of N to the chilli crop, pesticide sprays and their interaction (Table 91).

Integrated N supply to chilli crop by equal quantity through organic and inorganic sources registered the highest B:C ratio (2.31). Among biopesticide sprays alternate sprays of Abamectin and Perfect registered the highest B:C ratio (2.64). Sprays schedules of Nimbecidine alternated with remaining biorationals except silica and Action 100 were next in the order and comparable with RPP. On the other hand, lowest B:C ratio (1.68) was recorded with no spray treatment.

Among the treatment combinations, chilli nutritioned with equal doses of N through organic and inorganic sources coupled with Abamectin and Perfect (T_2S_7) spray recorded significantly higher B:C ratio (2.75). T_1S_7, T_2S_1, T_2S_2 and T_2S_4 were on par with the former treatment combination (T_2S_7). T_1S_2, T_2S_3 and T_2S_9 were next in the order. On other hand, significantly lower B: C ratio (1.59) was recorded in T_1S_{10}.

4.3.7 Correlation studies

A significant and highly positive correlation was observed between chilli yield (kg ha^{-1}) and yield and quality parameters of chilli (Table 91a).

Highly significant and positive correlation was observed between chilli yield (kg ha^{-1}) and fruit yield hill^{-1} (0.88), fruit length (0.89), 100-fruit weight (0.84) and seed to pod ratio (0.88). Among the quality parameters yield of good quality fruits (0.95), ascorbic acid content (0.68), capsaicin content (0.65), oleoresin per cent (0.73) and oleoresin yield (0.93) were found to be highly significant and positively correlated with chilli yield (kg ha^{-1}), while discoloured fruits was significantly and highly negatively correlated with chilli yield (kg ha^{-1}) (-0.78).

Table 89. Oleoresin content (%) and oleoresin (kg ha^{-1}) as influenced by different sources of nutrition and biopesticides spray

Treatments	Oleoresin content (%)			Oleoresin (kg ha^{-1})		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	14.07 ^{b}	14.86 ^{b}	14.47 ^{b}	70.6 ^{b}	101.8 ^{b}	86.2 ^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	15.00 ^{a}	16.11 ^{a}	15.56 ^{a}	96.5 ^{a}	131.3 ^{a}	113.9 ^{a}
S.Em.±	0.28	0.21	0.17	2.41	2.39	1.70
C.D at5%	0.81	0.59	0.49	6.91	6.84	4.78
Biopesticides sprays***						
S_1: Nimbecidine – GCK	15.35 ^{ab}	16.29 ^{bc}	15.82 ^{bc}	86.9 ^{bc}	128.6 ^{c}	107.8 ^{c}
S_2: Nimbecidine – Leaf extract	14.76 ^{ab}	15.34 ^{cd}	15.05 ^{cd}	86.5 ^{bc}	121.4 ^{cd}	103.9 ^{cd}
S_3: Nimbecidine - Panchgavya	14.48 ^{b}	15.05 ^{cd}	14.76 ^{cd}	82.4 ^{c}	116.9 ^{cde}	99.6 ^{cde}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	16.67 ^{a}	18.29 ^{a}	17.48 ^{a}	101.6 ^{b}	149.6 ^{b}	125.6 ^{b}
S_5: Nimbecidine - Silica spray	14.60 ^{b}	15.41 ^{cd}	15.00 ^{cd}	78.0 ^{cd}	103.2 ^{ef}	90.6 ^{efg}
S_6: Nimbecidine - Action 100 spray	14.09 ^{b}	14.79 ^{d}	14.44 ^{d}	64.6 ^{d}	94.9 ^{f}	79.7 ^{g}
S_7: Abamectin (1.9 EC) - Perfect	15.59 ^{ab}	17.44 ^{ab}	16.51 ^{ab}	143.3 ^{a}	176.3 ^{a}	159.8 ^{a}
S_8: Silica	13.90 ^{b}	14.97 ^{cd}	14.31 ^{d}	70.4 ^{cd}	99.9 ^{f}	85.2 ^{fg}
S_9: RPP	13.94 ^{b}	14.39 ^{d}	14.16 ^{d}	81.0 ^{cd}	110.0 ^{def}	95.5 ^{def}
S_{10}: Control	12.03 ^{c}	12.92 ^{e}	12.47 ^{e}	40.9 ^{e}	64.7 ^{g}	52.8 ^{h}
S.Em.±	0.63	0.46	0.39	5.39	5.33	3.79
C.D at 5%	1.80	1.32	1.10	15.45	15.3	10.69
Interaction						
T_1S_1	14.83 ^{abc}	15.98 $^{b-e}$	15.41 $^{b-f}$	73.3 $^{e-h}$	115.1 ^{efg}	94.2 ^{efg}
T_1S_2	14.21 $^{a-d}$	14.96 $^{c-f}$	14.59 $^{c-h}$	72.5 ^{fgh}	108.9 $^{f-i}$	90.7 ^{fgh}
T_1S_3	13.66 ^{bcd}	13.91 ^{efg}	13.79 ^{fgh}	66.8 $^{f-i}$	99.3 $^{f-j}$	83.1 ^{ghi}
T_1S_4	16.23 ^{ab}	17.94 ^{ab}	17.09 ^{ab}	87.2 ^{def}	135.8 ^{cde}	111.5 ^{cd}
T_1S_5	14.15 $^{a-d}$	14.64 ^{def}	14.4 $^{c-h}$	56.9 $^{g-j}$	87.8 ^{ij}	72.4 ^{ij}
T_1S_6	13.21 ^{bcd}	13.6 ^{fg}	13.41 ^{ghi}	50.7 ^{hij}	76.7 ^{j}	63.7 ^{j}
T_1S_7	15.21 ^{abc}	16.90 ^{abc}	16.06 ^{bcd}	129.2 ^{b}	156.7 ^{bc}	142.9 ^{b}
T_1S_8	13.41 ^{bcd}	14.61 ^{def}	14.01 $^{c-h}$	60.8 ^{ghi}	88.9 ^{hij}	74.8 ^{hij}
T_1S_9	14.01 ^{bcd}	13.90 ^{efg}	13.96 $^{c-h}$	73.5 $^{e-h}$	96.4 $^{g-j}$	84.9 ^{ghi}
T_1S_{10}	11.79 ^{d}	12.16 ^{g}	11.98 ^{i}	35.3 ^{j}	52.3 k	43.8 k
T_2S_1	15.86 ^{ab}	16.60 $^{a-d}$	16.23 ^{abc}	100.6 ^{cd}	142.1 ^{bcd}	121.3 ^{c}
T_2S_2	15.30 ^{abc}	15.72 $^{c-f}$	15.51 $^{b-f}$	100.5 ^{cd}	113.8 ^{efg}	117.1 ^{c}
T_2S_3	15.29 ^{abc}	16.18 ^{bcd}	15.74 $^{b-e}$	98.0 ^{cde}	134.5 ^{cde}	116.2 ^{c}
T_2S_4	17.10 ^{a}	18.64 ^{a}	17.87 ^{a}	116.1 ^{bc}	163.5 ^{b}	139.8 ^{b}
T_2S_5	15.04 ^{abc}	16.18 ^{bcd}	15.61 $^{b-f}$	99.0 ^{cd}	118.6 $^{d-g}$	108.8 ^{cde}
T_2S_6	14.96 ^{abc}	15.97 $^{b-e}$	15.47 $^{b-f}$	78.5 $^{d-g}$	113.0 $^{e-h}$	95.8 $^{d-g}$
T_2S_7	15.97 ^{ab}	17.97 ^{ab}	16.97 ^{ab}	157.4 ^{a}	195.9 ^{a}	176.6 ^{a}
T_2S_8	14.38 $^{a-d}$	15.32 $^{c-f}$	14.85 $^{c-g}$	80.1 $^{d-g}$	110.9 $^{e-i}$	95.5 $^{d-g}$
T_2S_9	13.86 ^{bcd}	14.88 $^{c-f}$	14.37 $^{d-h}$	88.5 ^{def}	123.6 ^{def}	106.1 $^{c-f}$
T_2S_{10}	12.26 ^{cd}	13.68 ^{fg}	12.97 ^{hi}	46.6 ^{ij}	77.2 ^{j}	61.9 ^{j}
S.Em.±	0.89	0.65	0.55	7.62	7.54	5.36
C.D at 5%	2.55	1.87	1.55	21.86	21.64	15.11
C.V. (%)	10.6	7.3	9.0	15.8	11.2	13.1

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively
Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 90. Gross returns and net returns as influenced by different sources of nutrition and biopesticides spray

Treatments	Gross returns (Rs. ha^{-1})			Net returns (Rs. ha^{-1})		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Sources of nitrogen						
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	27490^{b}	37920^{b}	32700^{b}	13490^{b}	23850^{b}	18670^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	34660^{a}	44795^{a}	39730^{a}	15800^{a}	26000^{a}	20900^{a}
S.Em.±	543	707	446	536	703	442
C.D at5%	1558	2029	1257	1538	2016	1268
Biopesticides sprays***						
S_1: Nimbecidine – GCK	31380^{bc}	43600^{b}	37490^{b}	15430^{bc}	27650^{b}	21540^{b}
S_2: Nimbecidine – Leaf extract	32300^{bc}	44500^{b}	38400^{b}	16200^{bc}	28740^{b}	22470^{b}
S_3: Nimbecidine - Panchgavya	31350^{bc}	42730^{b}	37040^{b}	14850^{bc}	26180^{b}	20520^{b}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	33500^{b}	44710^{b}	39100^{b}	17200^{b}	28410^{b}	22800^{b}
S_5: Nimbecidine - Silica spray	26230^{d}	37390^{c}	31810^{c}	9730^{d}	20890^{c}	15310^{c}
S_6: Nimbecidine - Action 100 spray	25530^{d}	35880^{c}	30700^{c}	9430^{d}	19790^{c}	14610^{c}
S_7: Abamectin (1.9 EC) - Perfect	50060^{a}	54910^{a}	52480^{a}	30110^{a}	34910^{a}	32510^{a}
S_8: Silica	28700^{cd}	37830^{c}	32270^{c}	12680^{cd}	21530^{c}	17100^{c}
S_9: RPP	32550^{bc}	43210^{b}	37880^{b}	16080^{bc}	26740^{b}	21410^{b}
S_{10}: Control	19150^{e}	28810^{d}	23980^{d}	4750^{e}	14410^{d}	9580^{d}
S.Em.±	1215	1581	997	1119	1572	989
C.D at 5%	3484	4536	2811	3440	4508	2787
Interaction						
T_1S_1	27520^{efg}	40150^{d-g}	33800^{de}	13970^{bcd}	26600^{b-f}	20280^{b-e}
T_1S_2	28050^{ef}	41450^{c-f}	34750^{d}	14350^{bcd}	27750^{bcd}	21050^{bcd}
T_1S_3	27150^{efg}	39670^{efg}	33410^{de}	13050^{b-e}	25570^{b-g}	19310^{b-e}
T_1S_4	29550^{ef}	41620^{c-f}	35580^{d}	15650^{bcd}	27720^{b-e}	21680^{bc}
T_1S_5	22400^{ghi}	33430^{gh}	27920^{f}	8300^{ef}	19330^{f-i}	13820^{fgh}
T_1S_6	21550^{hi}	32300^{h}	26900^{f}	7810^{ef}	18480^{ghi}	13140^{ghi}
T_1S_7	46270^{b}	50620^{b}	48440^{b}	28770^{a}	33020^{ab}	30890^{a}
T_1S_8	25550^{fgh}	34870^{fgh}	30210^{ef}	12200^{cde}	20970^{e-h}	16580^{d-g}
T_1S_9	29450^{ef}	39870^{efg}	34660^{d}	15380^{bcd}	25800^{b-f}	20590^{b-e}
T_1S_{10}	17400^{i}	25320^{i}	21360^{g}	5400^{f}	13320^{i}	9360^{i}
T_2S_1	35250^{cd}	47050^{b-e}	41150^{c}	16900^{bc}	28700^{bcd}	22800^{b}
T_2S_2	36550^{cd}	47550^{bcd}	42050^{c}	18050^{bc}	29700^{bc}	23890^{b}
T_2S_3	35550^{cd}	45800^{b-e}	40680^{c}	16650^{bcd}	26800^{b-e}	21730^{bc}
T_2S_4	37450^{c}	47800^{bc}	42630^{c}	18750^{bc}	29100^{bcd}	23930^{b}
T_2S_5	30050^{ef}	41350^{c-f}	35700^{d}	11150^{de}	22450^{c-h}	16800^{d-g}
T_2S_6	29500^{ef}	39550^{efg}	34530^{d}	11050^{de}	21100^{d-h}	16080^{efg}
T_2S_7	53850^{a}	59200^{a}	56530^{a}	31450^{a}	36800^{a}	34130^{a}
T_2S_8	31850^{de}	40800^{c-f}	36330^{d}	13150^{b-e}	22100^{c-h}	17630^{c-f}
T_2S_9	35650^{cd}	46550^{b-e}	41100^{c}	16780^{bcd}	27680^{b-e}	22230^{b}
T_2S_{10}	20900^{hi}	32200^{h}	26600^{f}	4100^{f}	15500^{hi}	9800^{hi}
S.Em.±	1718	2237	1410	1718	2223	1398
C.D at 5%	4926	6415	3975	4926	6375	3941
C.V. (%)	9.6	9.4	9.5	18.1	15.5	17.3

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively

Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 91. B:C ratio as influenced by different sources of nutrition and biopesticides spray

Treatments	B:C ratio		
	2005-06	2006-07	Pooled
Sources of nitrogen			
T_1:100:50:50 kg NPK ha^{-1} (RDF)*	1.82 ^{b}	2.37 ^{b}	2.09 ^{b}
T_2:50:50:50 kg ha^{-1} NPK + 50% N by 2.5 t ha^{-1} V.C + 500 kg ha^{-1} neem cake**	1.93 ^{a}	2.68 ^{a}	2.31 ^{a}
S.Em.±	0.04	0.04	0.03
C.D at5%	0.10	0.12	0.08
Biopesticides sprays***			
S_1: Nimbecidine – GCK	1.98 ^{bc}	2.76 ^{a}	2.37 ^{b}
S_2: Nimbecidine – Leaf extract	2.02 ^{b}	2.80 ^{a}	2.40 ^{b}
S_3: Nimbecidine - Panchgavya	1.91 ^{bc}	2.62 ^{a}	2.26 ^{b}
S_4: Nimbecidine – Leaf extract +Panchagavya mixture spray	2.06 ^{b}	2.78 ^{a}	2.42 ^{b}
S_5: Nimbecidine - Silica spray	1.59 ^{d}	2.28 ^{a}	1.93 ^{c}
S_6: Nimbecidine - Action 100 spray	1.58 ^{d}	2.24 ^{a}	1.91 ^{c}
S_7: Abamectin (1.9 EC) - Perfect	2.52 ^{a}	2.76 ^{a}	2.64 ^{a}
S_8: Silica	1.77 ^{cd}	2.34 ^{b}	2.06 ^{c}
S_9: RPP	1.99 ^{bc}	2.65 ^{a}	2.32 ^{b}
S_{10}: Control	1.35 ^{e}	2.02 ^{c}	1.68 ^{d}
S.Em.±	0.08	0.09	0.06
C.D at 5%	0.23	0.03	0.17
Interaction			
T_1S_1	1.92 ^{cde}	2.56 $^{b-f}$	2.24 ^{def}
T_1S_2	1.98 ^{cd}	2.57 $^{b-f}$	2.27 ^{cde}
T_1S_3	1.88 ^{cde}	2.43 $^{c-g}$	2.16 $^{e-h}$
T_1S_4	2.00 ^{cd}	2.58 $^{a-f}$	2.28 $^{b-e}$
T_1S_5	1.59 ^{efg}	2.19 ^{fgh}	1.89 ^{hi}
T_1S_6	1.60 ^{efg}	2.14 ^{fgh}	1.87 ^{i}
T_1S_7	2.40 ^{ab}	2.64 $^{a-e}$	2.52 $^{a-d}$
T_1S_8	1.70 ^{def}	2.18 ^{fgh}	1.94 ^{ghi}
T_1S_9	1.89 ^{cde}	2.47 $^{c-g}$	2.18 ^{efg}
T_1S_{10}	1.25 ^{g}	1.92 ^{h}	1.59 ^{j}
T_2S_1	2.03 ^{cd}	2.96 ^{ab}	2.50 $^{a-d}$
T_2S_2	2.05 ^{cd}	3.02 ^{a}	2.54 ^{abc}
T_2S_3	1.93 ^{cde}	2.81 $^{a-d}$	2.37 $^{b-e}$
T_2S_4	2.12 ^{bc}	3.00 ^{ab}	2.56 ^{ab}
T_2S_5	1.59 ^{efg}	2.37 $^{d-g}$	1.98 ^{ghi}
T_2S_6	1.57 ^{efg}	2.34 $^{e-h}$	1.96 ^{ghi}
T_2S_7	2.63 ^{a}	2.87 ^{abc}	2.75 ^{a}
T_2S_8	1.84 ^{cde}	2.51 $^{c-g}$	2.17 ^{efg}
T_2S_9	2.09 ^{bc}	2.83 ^{abc}	2.46 ^{bcd}
T_2S_{10}	1.45 ^{fg}	2.11 ^{gh}	1.78 ^{ij}
S.Em.±	0.11	0.13	0.09
C.D at 5%	0.32	0.38	0.24
C.V. (%)	10.3	9.1	9.6

* Inorganic N, ** Organic + inorganic N (50:50), *** Chemical sprayed alternatively

Silica (2 ml l^{-1}), nimbecidine (5 ml l^{-1}), GCK (Galic chilli kerosene extract 1%), leaf extract (*Vitex nigundo*, *Azadirachta inidca*, *Adothoda vesica, Pongamia pinnata, Argimone mexicana* and NSKE), abamectin (0.5 ml l^{-1}), perfect (1 ml l^{-1}), panchagavya (3%), In a column means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 91a. Correlation coefficient (r) between chilli yield (kg ha^{-1}) and yield parameters and quality parameters

Parameters	Correlation coefficient (r) pooled data
1. Yield parameters	
Fruit yield $hill^{-1}$ (g $hill^{-1}$)	0.88**
Fruit length (cm)	0.89**
100-fruit weight (g)	0.84**
Seed to pod ratio	0.88**
2. Quality parameters	
Discoloured fruits (%)	-0.78**
Yield of good fruits (kg ha^{-1})	0.95**
Ascorbic acid content (mg 100 g^{-1})	0.68**
Capsaicin content (%)	0.65**
Oleoresin per cent (%)	0.73**
Oleoresin yield (kg ha^{-1})	0.93**

** - Significant at 0.01 level

5. DISCUSSION

Chilli is cultivated on a large area under rainfed situation in Northern Transition tract of Karnataka. Being the main money-spinner its production is popular among the farmers. Dry chilli of bydagi particularly of *dabbi* type has a great demand in the export market. However, chronically production is severely handicapped due to the incidence of leaf curl / *murda* complex (Plate 1), which along with other viral diseases often results in complete failure of the crop. Prophylactic measures followed by the farmers also do not have the desired advantage in the export market because of pesticide residue, which is a matter of concern even in the local market. This warrants development of eco-friendly measures for the management of leaf curl disease in chilli. Accordingly, field studies were carried out to evaluate the efficiency of barrier cropping, intercropping, crop nutrition and use of biorationals in quality chilli production and in the leaf curl management at Agricultural Research Station, Devihosur, Haveri, Karnataka during growing season of 2005-06 and 2006-07. The results of the experiments are discussed in this chapter.

5.1 PERFORMANCE OF CHILLI

Influence of barrier cropping

Performance of chilli due to barrier cropping improved significantly over crop without barriers particularly in the leeward side of the barrier (Table 18). The increase in dry chilli yield was of the order of 150 and 120 per cent in the leeward and windward sides of the barrier, respectively over the crop without barrier (Plate 3). Barrier density (number of rows) with six or more rows of barrier recorded significantly higher yield (1195 and 1138 kg ha^{-1} with nine and six rows, respectively) over barrier having three rows (Plate 4). This could be attributed to the increased effectiveness of barrier crops in wider strips than in three row strip in improving microclimate in chilli crop particularly on the leeward side as indicated by yield and growth components and insect dynamics. Similar to width of the strips, influence of barrier species varied significantly with regard to chilli yield. Chilli with fodder or grain sorghum recorded significantly higher yield (1200 and 1196 kg ha^{-1}, respectively), compared to the crop with fodder or grain maize. The results are in line with the findings of Deol and Ratwal (1978), Handa *et al.* (1995), Ragupathi and Veeraragavatham (1996) and Anandam and Doraiswamy (2007). Though reports from Coimbatore (Nelson and Natarajan, 1994 and Ragupathy and Veeraragavatham, 1996) and Tirupathi (Anandam and Doraiswamy, 2007) indicated the superiority of maize as a barrier, similar response was not obtained in the present study in comparison to sorghum. Superiority of sorghum over maize as barrier could be attributed to prolonged growth/greenness of sorghum cultivars in comparison to maize. Fodder sorghum and grain sorghum (ear head cut at maturity) remained green till first picking of chilli, on the other hand maize started withering by 70 days onwards.

Among the treatment combinations of number of rows and barrier species, significantly higher dry pod yield was obtained with fodder sorghum grown in nine rows followed by grain sorghum in nine rows and fodder and grain sorghum in six rows (1272, 1262, 1234 and 1204 kg ha^{-1}, respectively) (Plate 5 to 8). The yield with these treatments was higher to the extent of 172, 170, 164 and 157 per cent respectively over crop without barrier (Plate 2).

Yield is the cumulative effect of fruit yield per hill, which in turn depends upon yield components *viz.,* number of fruits per plant, length of fruits, 100-fruit weight, 1000-seed weight and seed to pod ratio (Shashidhara, 2000). Even the correlation studies in the present investigation support the statement (Table 33a). Chilli with fodder sorghum as a barrier grown in nine rows recorded significantly higher fruit yield per hill (52.0), fruit length (12.6 cm), 100-fruit weight (127 g), 1000-seed weight (7.9 g) and seed to pod ratio (39.6) followed by chilli grown with grain sorghum in nine rows and fodder or grain sorghum in six rows (Table 15-17). Chilli grown with nine rows of fodder sorghum as a barrier recorded higher fruit yield per hill, fruit length, 100-fruit weight, 1000-seed weight and seed to pod ratio and increment was to the extent of 136, 37, 65 and 52 and 65 per cent, respectively over no barrier. Further, significant positive correlation was observed between fruit yield per hectare and fruit yield per hill ($r = 0.96$ in the leeward side and $r = 0.95$ in the windward side), fruit length ($r = 0.92$ in the leeward side and $r = 0.76$ in windward side), 100-fruit weight ($r = 0.95$ in the leeward side and $r = 0.94$ in windward side) and seed to pod ratio ($r = 0.94$ in the leeward side and $r = 0.90$ in

Thrips

Mites

Plate 1. Typical plant with severe murda incidence and casual agents of murda
(whip tail leaf symptom)

Plate 2. No barrier plot (control) at 90 DAT

Plate 3. General view of barrier crop experiment at DAT


3 rows of barrier crop at 100 DAT


6 rows of barrier crop at 90 DAT


9 rows of barrier crop at 90 DAT

Plate 4. General view of various of barrier species

windward side) (Table 33a). Improvement in yield components could be attributed to better performance of growth components such as total dry matter production per plant (TDMP), plant height and number of secondary branches per plant. Chilli crop grown with nine rows of fodder sorghum recorded 116 and 114 per cent higher dry matter accumulation in the leeward side and windward side, respectively compared to the chilli crop grown without barriers. The improvement in dry matter production in the plant could be achieved with the development of sound photosynthetic area as observed in the leeward side under barriers. This could be attributed to improved micro-climate that is favourable for the crop growth and more importantly due to reduction in the sucking pest complex (By arrangement of the barriers perpendicular to the prevailing wind direction had effect on the movement of vectors) and also increase in the predator population (discussed in detail elsewhere). Similarly Smith and McSorley (2000) found beneficial effect of barriers in reducing the whitefly population in bean fields by arranging corn rows perpendicular to the prevailing winds to avoid passive movement of whitefly adults to the bean field along with the wind currents as 'aerial plankton' and also trapping the insects and avoiding their free movement and acting as non-host for the gravid or hungry whitefly adults.

The plant height and number of secondary branches per plant were increased significantly due to nine and six rows of barriers compared to three rows (Table 9-12). Significantly higher plant height and number of secondary branches were recorded with fodder and grain sorghum compared to fodder and grain maize. Nine rows of fodder sorghum enhanced the plant height to the extent of 69, 108, 120 and 90 per cent and secondary branches to the tune of 83, 129, 140 and 148 per cent compared to no barriers at 30, 60 and 90 DAT and at final picking, respectively.

The leaf area increased significantly with nine and six rows of barrier crops (Table 13). Fodder and grain sorghum recorded significantly higher leaf area (1533 and 1432 cm^2 $hill^{-1}$, respectively) compared to fodder and grain maize. Significantly higher leaf area was recorded with nine rows of fodder sorghum followed by nine rows of grain sorghum and six rows of fodder sorghum (1699, 1608 and 1592 cm^2 $hill^{-1}$, respectively). The leaf area with these treatments was higher to the extent of 236, 218 and 215 per cent, respectively over no barriers.

Overall, the percentage discoloured fruit was the lowest under barrier cropping compared to the crop without barriers. The extent of reduction was to the tune of 50 per cent. Thus, barrier cropping had significant influence on the marketable produce. Consequently, yield of good quality chilli fruits was the highest under barrier cropping than crop without barrier. The enhancement in the quality yield under barrier was by 157 per cent. Barrier crop with wider width (9 rows) recorded lower per cent of discoloured fruits. Nine and six rows of barrier crop reduced the per cent discoloured fruits to the extent of 11.01 and 11.0 per cent respectively over three rows of barriers. Chilli with nine rows of fodder sorghum recorded significantly lower per cent of discoloured fruits (11.5%) compared to no barrier. The reduction in the discoloured fruits was to the extent of 61 per cent compared to no barriers. Unlike the per cent discoloured fruits, the good quality fruit yield followed similar trend as that chilli yield. Barrier crop with nine rows recorded the highest yield of good quality fruits (1054 kg ha^{-1}). Nine rows of barriers enhanced the yield of good quality fruits to the extent of 18 per cent over three rows of barrier strip. Chilli with nine rows of fodder sorghum recorded significantly higher yield of good quality fruits (1126 kg ha^{-1}) compared to no barrier. The increase in the yield of good quality fruits was to the extent of 195 per cent over no barrier. A significant negetive correlation was obtained between chilli yield (kg ha^{-1}) and discoloured fruits per cent ($r = -0.69$) and positive correlation between yield of goods quality fruits ($r = 0.48$) (Table 33a).

The ascorbic acid content, capsaicin content and Scoville heat units (SHU), however, did not vary due to density of the barriers (number of rows) and species of barriers. On the other hand, ascorbic acid content, capsaicin content and SHU were significantly improved and which was in the order of 38, 74 and 72 per cent over crop without barrier. The oleoresin per cent was also increased significantly with nine and six rows of barriers (16.2 and 16.0 per cent, respectively) compared to three rows of barrier (14.8) (Table 30). Interestingly, unlike ascorbic acid content and SHU, oleoresin per cent was significantly higher with fodder maize than the crop with sorghum barriers. Significantly higher oleoresin per cent was recorded with nine and six rows of fodder maize (16.7).

The oleoresin yield increased significantly with nine rows of barrier strip (171 kg ha^{-1}) compared to six and three rows of barrier strip. Increase in the oleoresin yield with nine rows of barriers was to the extent of 6 and 29 per cent over six and three rows of barriers. Unlike oleoresin per cent and oleoresin yield followed the trends in the good quality chilli fruit yield. Significantly higher oleoresin yield was recorded with fodder sorghum in nine rows (187 kg ha^{-1}) followed by fodder sorghum in six rows and grain sorghum in nine rows (178 and 171 kg ha^{-1}, respectively) over no barrier. A significant positive correlation was observed between chilli fruit yield and oleoresin yield (r = 0.87) (Table 33a).

Significantly higher gross return was recorded with six rows of barrier crops (Rs.53,570 ha^{-1}) compared to three rows of barriers (Rs.45, 590 ha^{-1}). While nine rows barrier was on par with six rows. The net return also followed the similar trend realizing significantly higher net return with six and nine rows (Rs.36, 130 and 35,140 ha^{-1} respectively) compared to three rows of barriers, while lowest net return was realized with control plot having no barrier (Rs. 7100 ha^{-1}). The B: C ratio was the highest with six rows of barrier crops (3.09). While the lowest B: C ratio was recorded with control plot having no barriers (1.44). Thus,gross return, net return and B: C ratio were higher under barrier cropping as a consequence of higher chilli yield recorded in these treatments, particularly of good quality chilli.

Among species of barriers, fodder and grain sorghum recorded significantly higher gross return and net return (Rs.56, 260 and Rs.38, 740 with fodder sorghum and Rs.56, 190 and Rs.38, 650 with grain sorghum, respectively), while the lowest gross and net return were recorded with fodder and grain maize used as barriers. Similarly, fodder and grain sorghum recorded the highest B: C ratio (3.22 and 3.21,respectively). In the instant case, higher monitory benefit with sorghum both fodder and grain could be attributed to higher chilli yield.

Among the treatment combinations of rows and species of barriers, significantly higher gross and net returns were realized with six rows of fodder sorghum (Rs.58,180 and Rs.40,680 ha^{-1}, respectively), while it was on par with six rows of grain sorghum and nine rows of grain and fodder sorghum. The lowest gross and net returns were recorded with control plot having no barriers (Rs.23,400 and Rs.7,100 ha^{-1}, respectively). The net returns were higher by Rs.33,580, Rs.32,680, Rs.32,530 and Rs.32,360 ha^{-1} respectively with six and nine rows of fodder and grain sorghum, compared to chilli crop having no barriers. Similar trend was observed with B: C ratio also. Fodder sorghum in six rows recorded significantly higher B: C ratio (3.43). While, it was on par with grain sorghum in six rows and fodder and grain sorghum with nine rows (3.28, 3.19 and 3.18 respectively). While, the lowest B: C ratio was recorded with chilli crop grown without barriers.

Influence of intercrop

In the present investigation garlic intercropped with chilli recorded significantly higher dry fruit yield (890 kg ha^{-1}) compared to sole chilli and chilli+coriander intercropping system. Increase in the dry chilli yield was to the extent of 11.1 and 30.0 per cent over sole chilli and chilli + coriander intercropping system, respectively (Table 40). Similarly, increase in yield due to intercropping of chilli with tomato was reported by Manjunath *et al.* (2001). Among the two intercrops garlic intercrop recorded the highest bulb yield (450 kg ha^{-1}) compared to coriander (246 kg ha^{-1}) (Table 41). The increment in the yield was to the extent of 89 per cent. However, former being the bulb and latter being capsules, the comparison is inconsequential here. The point of interest nevertheless, is the chilli yield equivalent which is the indicative of the performance of overall system (Table 40).

The chilli + garlic cropping system recorded the highest chilli equivalent yield (1260 kg ha^{-1}) compared to sole chilli and chilli + coriander cropping systems (Table 40). The increase in equivalent yield in the chilli + garlic cropping system was to the tune of 57 and 48 per cent over coriander intercropped under chilli and sole chilli system respectively (Plate 9 to 14). Similar results of increase in chilli equivalent yield with growing of chilli and onion as mixed crop along with cotton and without any reduction in the yield of intercrop (cotton) as compared to that of sole Varalaxmi cotton were reported earlier by Kumaraswamy and Hosamani, 1978. Elangovan *et al.* (1982) reported the highest chilli yield with solid row planting of chilli with one/three rows of onion.

Fruit yield is mainly governed by yield attributing characters *viz.,* number of fruits hill^{-1}, fruit length, 100-fruit weight, 1000-seed weight and seed to pod ratio (Shashidhara, 2000).

Plate 5. Chilli with six rows of fodder sorghum as a barrier at 120 DAT

Plate 6: Chilli with six rows of grain sorghum as a barrier at 120 DAT

Plate 7: Chilli with 9 rows of fodder sorghum as a barrier at 120 DAT

Plate 8: Chilli with 9 rows of grain sorghum as a barrier at 120 DAT

Garlic intercropped with chilli recorded significantly higher fruit yield $hill^{-1}$ (34.4), fruit length (10.9 cm), 100-fruit weight (119.6 g), 1000-seed weight (7.3 g) and seed to pod ratio (36.5). Garlic grown with chilli recorded 38, 15, 13, 14 and 25 per cent, respectively higher fruit yield, fruit length, 100-fruit weight 1000-seed weight and seed to pod ratio compared to chilli + coriander intercropping system (Table 38-39).

The differences in yield components could be traced back to variation in physiological characters *viz.,* total dry matter production per plant, leaf area and growth components such as plant height, number of secondary branches per hill *etc.* Improved chilli growth in terms of height, branches and photosynthetic area with garlic intercrop can be attributed to the improved micro-climate that is favourable for the crop growth more importantly due to reduction in the sucking pest complex and also increase in the predator population (discussed in detail subsequently). Similarly reduction in pest population by intercropping through encouraging crop diversity and reducing oviposition and feeding by pests to avoid population explosion of pests was reported by Shelton and Badenes (2006). The accumulation of dry matter in the plant is very important for improving the crop yield. Chilli + garlic recorded significantly higher total dry matter production (11.0, 43.9 and 83.0 g at 60 and 90 DAT and at final picking, respectively) to the extent of 43, 46 and 40 per cent compared to chilli + coriander cropping system at 60 and 90 DAT at final picking, respectively (Table 37). Further¸ plant height and number of secondary branches were also significantly higher with chilli and garlic intercropping system compared to chilli + coriander intercropping system (Table 34-35).

The improved dry matter production in the plant can be achieved by the sound photosynthetic structure of the crop. Photosynthetic capacity of the plant depends upon the leaf area of the plant. This is the consequence of larger canopy as indicated by leaf area. Chilli + garlic intercropping system recorded significantly higher leaf area from flowering onwards (915 and 1176 cm^2 $hill^{-1}$ at 90 DAT and final picking, respectively) (Table 36).

The lowest per cent of discoloured fruits was recorded with chilli + garlic intercropping system. The decrease in per cent discoloured fruits due to chilli + garlic system was to the tune of 13 per cent compared to sole chilli (Table 51). Consequently, yield of good quality fruits was also the highest with chilli under garlic intercropping system and the yield increment was of the order of 29 and 14 per cent over coriander intercropping and sole chilli systems, respectively (Table 51).

Apart from yield performance, quality of chilli also recorded significant improvement under garlic intercropping system. The ascorbic acid content and capsaicin content did not vary due to intercropping with different crops (Table 50). However, scovielle heat unit (SHU) was significantly higher with chilli + garlic intercropping system (22650) compared to sole chilli and chilli + coriander intercropping systems (Table 50). Improvement in the SHU was to the extent of 20 and 9 per cent over sole chilli and chilli + coriander intercropping system, respectively. Significantly higher oleoresin per cent was recorded with chilli + garlic intercropping system compared to sole chilli and chilli + coriander intercropping system (Table 52). The betterment in the oleoresin per cent with chilli + garlic intercropping was to the tune of 6 and 5 per cent compared to chilli + coriander intercropping and sole chilli systems, respectively. Oleoresin yield also followed the variation in the oleoresin per cent and highest oleoresin yield was obtained with chilli + garlic system and it was higher by 19 and 36 per cent over chilli + coriander and sole crop systems, respectively.

The highest gross return, net return and B: C ratio was recorded with garlic intercropped with chilli (63,000, 42,250 Rs. ha^{-1} and 3.08, respectively) over other systems. The higher return from the system was due to higher chilli dry pod yield besides bonus yield of garlic. Similar results of higher gross income from chilli based intercrop with bhendi was reported by Natarajan (1992). Kagi (1994) reported highest net return (15239 Rs ha^{-1}) and B: C ratio (1.8) with chilli + soybean (1:1) + cotton.

Influence of graded levels of fertilizer N and K

Among N and K nutritional treatments, the crop receiving N equally through organic (poultry manure) and inorganic (urea) and inorganic P and K in equal proportion (N_{50+50}:P_{50}:K_{50}) recorded maximum dry chilli yield (947 kg ha^{-1}) compared to no inorganic N and 100 kg ha^{-1} K and only inorganic N and no K treatments (706 and 650 kg ha^{-1} respectively) (Table 65). The increase in dry chilli yield with N_{50}+P_{50}+K_{50} treatment was to the extent of 34 and 46 per cent compared to $N_0P_{50}K_{100}$ and $N_{100}P_{50}K_0$ nutrient combinations,

Plate 9: Chilli + Garlic + N_{50} $P_{50}K_{50}$ at 75 DAT

Plate 10: Chilli + Garlic + $N_{25}P_{50}K_{75}$ at 75 DAT

Plate 11: Chilli + Coriander + $N_{50}P_{50}K_{50}$ at 70 DAT

Plate 12: Chilli + Coriander + $N_{25}P_{50}K_{75}$ at 70 DAT

respectively. Similar results of increase in yield with 50 / 75 kg K_2O with recommended N application was reported by Jeyraman and Balasubramanian (1988) and Ukey *et al*.(1998) and Mallapur *et al.* (2003).

These improvements in yield in the above treatments are the result of improvement in the yield and growth components such as number of fruits per hill (Table 38), fruit length (Table 38), 100-fruit weight (Table 38), 1000-seed weight (Table 39), seed to pod ratio (Table 39), TDMP (Table 37), plant height (Table 34), number of secondary branches (Table 35) and leaf area (Table 36). All these attributes recorded significantly higher values with chilli crop applied with 100 kg N (equally through fertilizer and poultry manure), 50 kg P and 50 kg K_2O.

As far quality was concerned percentage discoloured fruits was the lowest with zero inorganic nitrogen and maximum K and similar was the variation in ascorbic acid content, capsaicin content, SHU and oleoresin per cent. Nevertheless, yield of good quality fruits as well as oleoresin yield was the highest with N_{50} (organic) + N_{50} (inorganic) + P_{50} and K_{50}. The variation in percentage concentration of different quality parameters unlike yield is on the expected line as ascorbic acid, capsaicin per cent, SHU and oleoresin per cent are negatively correlated with the supply of levels of inorganic nitrogen (Finch, 1945 and Popokaya, 1957).

The maximum uptake of potassium was recorded with N_{50}+P_{50}+K_{50} which was, however, comparable with 25:50:75 kg ha^{-1} N, P_2O_5 and K_2O. The latter treatments recorded numerically higher values. The uptake was higher by 67 per cent over no potassium. Better growth and yield performance with nitrogen and potassium could also be attributed to increased uptake of nitrogen and phosphorus with the above treatments which helped in developing a good architect of the plant, that is evident from the plant height, number of secondary branches and plant canopy. The significant positive correlation obtained between chilli yield (kg ha^{-1}) and uptake of N (r = 0.40) and K uptake (r = 0.82) also substantiate the above findings (Table 53a).

When the intercropped chilli supplied with graded levels and sources of nitrogen and graded levels of K, chilli fruit yield was significantly higher with chilli intercropped with garlic supplied with equal quantities of nitrogen through poultry manure and fertilizer besides supply of 50 kg each of P and K (1125 kg ha^{-1}) (Plate 9). The yield improvement was to the extent of 94 per cent over chilli + coriander intercropping system nutritioned with 100 per cent inorganic nitrogen coupled with no potassium application (N_{100}+P_{50}+K_0) and 22 per cent over sole chilli receiving similar doses of N and K.

Superior performance of chilli with regard to yield under above treatment combination could be ascribed to better performance of yield attributes namely number of fruits per hill, fruit length, 100-fruit weight, 1000-seed weight and seed to pod ratio. Garlic intercropped with chilli nutritioned with equal doses of major nutrients through organic and inorganic sources recorded 139, 46, 46, 53 and 56 per cent, respectively, higher number of matured fruits, fruit length, 100-fruit weight, 1000-seed weight and seed to pod ratio over chilli + coriander intercropping system nutritioned with zero potassium application and 94, 33, 38, 48 and 35 per cent respectively over sole chilli receiving similar nutrition. Further, the significant and positive correlations were obtained between chilli yield (kg ha^{-1}) and fruit yield $hill^{-1}$ (r = 0.98), fruit length (r = 0.97), 100-fruit weight (r = 0.94) and seed to pod ratio (r=0.93) in the present investigation (Table 53a).

The differences in yield components could be traced back to variation in the physiological characters *viz.,* total dry matter production per plant (TDMP), leaf area and growth components such as plant height and number of secondary branches per hill. Improved chilli growth in terms of height, branches and photosynthetic area due to equal quantities N through organic and inorganic and graded levels of K could be attributed to the improved micro-climate that was favourable for the crop growth and more importantly due to reduction in the sucking pest complex and also increase in the predator population (discussed in detail separately).

The dry matter accumulation in the plant is a very important physiological phenomenon, which decides the crop yield. Garlic intercropped with chilli nutritioned with equal quantities of all the nutrients recorded 100, 97 and 102 per cent higher dry matter over chilli+coriander intercropping system nutritioned with 100 per cent inorganic N without any potassium nutrition at 60 and 90 DAT at final picking, respectively.

The plant height and number of secondary branches per plant increased significantly due to chilli + garlic system nutritioned with equal quantities of all the three major nutrients. The increase in the above two growth parameters was to the extent of 25, 45 and 32 per cent with respect to plant height and 30, 46 and 46 per cent with respect to secondary branches over chilli crop nutritioned with 100 per cent inorganic N but without any potassium application at 60 and 90 DAT and at final picking, respectively. Significantly higher leaf area was recorded at the later stages of plant growth with chilli + garlic intercropping system nutritioned with equal doses of all the major nutrients (1031 and 1403 cm^2 $hill^{-1}$ at 90 DAT and at final picking, respectively) compared to chilli + coriander intercropping system nutritioned with 100 per cent inorganic N but with zero level of potassium application. The increase in leaf area was to the extent of 61 and 98 per cent compared to coriander intercropped with chilli nutritioned with 100 per cent inorganic N but with zero level of potassium at 90 DAT and at final picking, respectively.

Nutrient uptake also plays an important role and it is a key factor in the determination of yield potential of chilli. Chilli + garlic intercropping system with 100 kg ha^{-1} potassium application recorded significantly higher potassium uptake and the improvement in the uptake was to the extent of 180 per cent over chilli + coriander system nutritioned with zero potassium.

Unlike yield components and growth parameters, the undesirable character like per cent discoloured fruits was significantly lower with chilli + garlic cropping system supplied with 100 per cent N through organic sources and with highest level of K application. The reduction in the per cent discoloured fruits with the above treatment combination was to the extent of 53 per cent over sole chilli nutritioned with highest level of potassium application but with no inorganic source of N fertilization.

The yield of good quality fruits was significantly higher with chilli + garlic intercropping system nutritioned with equal doses of all the three major nutrients (993 kg ha^{-1}) compared to chilli + coriander cropping system nutritioned with only inorganic N coupled with no potassium. The former treatment combination (chilli + garlic cropping system nutritioned with equal doses of all the major nutrients) enhanced the yield of good quality traits to the extent of 100 per cent over 100 per cent inorganic N and without any potassium application.

Besides growth and yield parameters, the quality parameters were also greatly influenced by chilli + garlic intercropping system nutritioned with equal quantities of all the three major nutrients. The ascorbic acid content of chilli was significantly higher with chilli + garlic intercropping system nutritioned with 100 per cent N through organics along with 100 kg potassium application. The increase in the ascorbic acid content of the above treatment combination was to the extent of 49 per cent over chilli + coriander intercropping system nutritioned with zero level of potassium application but along with 100 per cent inorganic N application. The capsaicin content and SHU followed the similar trend of ascorbic acid content. The chilli + garlic intercropping system with zero level of inorganic N with highest level of K nutrition improved the above mentioned quality parameters to the extent of 111 per cent over sole chilli nutritioned with only inorganic source of N coupled with zero level of potassium application (Table 50). Similar results of increase in ascorbic acid content and other quality parameters with lower level of inorganic N coupled with higher level of organic sources of N was reported by Popokaya (1957). Sinha (1975) in Kashmir variety of chilli and Uddin and Begum (1990) in capsicum reported that inorganic N given alone or in combination with other nutrients had negative effect on vitamin C / ascorbic acid content of the chilli.

The oleoresin per cent was significantly higher (14.48) with chilli + garlic cropping system nutritioned with 100 per cent organic N coupled with highest level of potassium application. The above treatment increased the oleoresin per cent to the extent of 41 per cent over chilli + coriander intercropping system nutritioned with equal doses of all the three major nutrients. The same treatment recorded significantly higher oleoresin yield (130.4 kg ha^{-1}) and the increment in the oleoresin yield was to the extent of 147 per cent over chilli + coriander cropping system nutritioned with 100 per cent inorganic N but without potassium application (Table52). Further, there was significant positive correlation between chilli yield and oleoresin yield ($r = 0.89$) (Table 53a) in the present investigation.

Similarly, among the graded levels of N and K, equal doses of all the three major nutrients along with 50 per cent of N through organics (poultry manure) recorded significantly higher gross and net returns (Rs.56,880 and Rs.39,130 ha^{-1}, respectively). While, it was on par with 75 per cent N through organics along with the application of 75 kg ha^{-1} K_2O. On the other hand, the highest B: C ratio was recorded with application of equal doses of all the three nutrients through inorganics and 50 per cent N substitution through organic source (3.16). While, the lowest gross return, net return and B: C were recorded with 100 per cent N supply through only inorganics coupled with no potassium application or no inorganic source of N application along with 100 kg potassium application.

Among the treatment combinations of cropping system with graded level of N and K, chilli + garlic intercropping system with equal doses of all the three major nutrients with 50 per cent of N substitution through organics recorded significantly higher gross return, net return and B:C ratio (Rs.76,230, Rs.55,660 ha^{-1} and 3.71, respectively). It was on par with 75 per cent N substitution through organic along with 75 kg ha^{-1} K_2O. On the other hand, significantly lower gross return, net return and B: C ratio were recorded with chilli + coriander intercropping system nutritioned with 100 per cent inorganic N application but without K nutrition.

Effect of sources of nitrogen

The Experiment II clearly revealed the advantages of substitution of recommended N through organics (poultry manure) atleast to the extent of 50 per cent (discussed already). Further, in Experiment III also substituting 50 per cent of RDN equally through 2.5 t ha^{-1} vermicompost + 500 kg ha^{-1} neem cake (25 kg ha^{-1} N each) recorded the highest yield of chilli (795 kg ha^{-1}). The improvement in the yield due to the integrated N supply was to the extent of 22 per cent over complete inorganic source of N application. Increase in chilli yield by 32 per cent due to organics along with inorganics was reported by Narasappa *et al.* (1985). Similar results of increased yield due to application of organics in combination with inorganics (RDF) was reported by Hangarge *et al.* (2002) and Dange *et al.* (2002). Sharu and Meerabai (2001) reported that 1:1 ratio of organics to inorganic fertilizer was the best in increasing chilli yield. Higher yields particularly through the use of vermicompost were also reported by Varma and Supare (1997) and Shashidhara (2000) and with the use of neem cake by Giraddi and Smitha (2002), Smitha (2004), Ravikumar (2004) and Gundannavar (2007).

Chilli yield mainly depends upon the yield attributing characters *viz.,* number of fruits per hill, fruit length, 100-fruit weight, 1000-seed weight and seed to pod ratio. Of the two sources of nitrogen, combined application of 50 per cent N equally through organic and inorganic sources increased the number of fruits per hill by 11 per cent, fruit length by 3 per cent, 100-fruit weight by 5 per cent, 1000-seed weight by 11 per cent and seed to pod ratio by 9 per cent over crop supplied with inorganic source of N only (Table 65). The significant and positive correlation was observed between chilli yield (kg ha^{-1}) and number of fruits per hill (r = 0.88), fruit length (r = 0.89) and 100-fruit weight (r = 0.88) (Table 91a). The results are in line with Shashidhara (2000), Sharu and Meerabai (2001), Dange *et al.* (2002), Hangarge *et al.* (2002) and Yadav *et al.* (2003), Sharu and Meerabai (2001) found significant increase in the yield components with the combination of organic and inorganic sources of nutrients (N) to chilli crop.

The superiority of yield components can be traced back to improvements in growth components such as total dry matter production per plant (TDMP), plant height and number of secondary branches per plant. Narasappa *et al*. (1985) and Natarajan (1990) observed significant increase in the number of fruits per hill with combined application of organic and inorganic sources of nutrition.

The total dry matter accumulation in the plant is a very important parameter in deciding the crop yield. At 30, 60 and 90 DAT and at final picking combined application of nutrients through organic and inorganic sources recorded 11, 17, 16 and 17 per cent, respectively higher dry matter over inorganic sources of N nutrition (Table 60-61). These results are also in conformity with the findings of Chavan *et al.* (1997) and Shashidhara (2000).

Further, besides dry matter improvement, plant height and number of secondary branches helped in attaining better plant architecture particularly the plant canopy as evidenced from leaf area (Table 54-57). Further in addition to the development of greater photosynthetic area, the reduction in crop sucking pests (discussed separately) under the treatment helped in the realization of greater photosynthetic efficiency as realized through TDMP (discussed above).

Unlike the growth and yield parameters, the per cent discoloured fruits was the highest with inorganic sources of nitrogen (11.7%) compared to the integrated sources of supply and per cent discoloured fruits was decreased by 14 per cent under integrated sources N supply (Table 88). The yield of good quality fruits followed the similar trend of dry chilli yield. The integrated N supply through organic and inorganic sources recorded 23 per cent higher yield of good quality fruits compared to only inorganic sources of N supply (Table 88). A significant and negative correlation was observed between chilli yield (kg ha^{-1}) and per cent discoloured fruits (r = -0.78) and positive correlation between yield of good fruits (kg ha^{-1}) (r = 0.95) in the present investigation (Table 91a).

Apart from yield and growth parameters the quality of chilli was greatly influenced by application of integrated sources of N through organics and inorganics. The ascorbic acid content of the chilli fruit was the highest with the combined application of N through organic and inorganic sources (178.9 mg 100 g^{-1}) compared to only inorganic sources of N nutrition. Similar to the above findings, Finch (1945) and Popokaya (1957) also observed the inverse relationship between ascorbic acid content and inorganic sources of N. Similar trend was observed with capsaicin content and Scovielle heat units (SHU). The integrated nitrogen management through equal quantity of N through organic and inorganic sources improved the capsaicin content and SHU to the extent of 25 and 23 per cent, respectively compared to only inorganic sources of N application. A positive correlation was obtained between chilli yield (kg ha^{-1}) and ascorbic acid content (r = 0.68) and yield of good quality chilli fruits (r = 0.95) (Table 91a).

The oleoresin per cent and oleoresin yield (15.56% and 113.9 kg ha^{-1} respectively) increased significantly with 50 per cent of N substitution through organics in the form of vermicompost and neem cake compared to inorganic source of N nutrition. The improvement in the oleoresin content and yield with the integrated N supply was to the extent of 8 and 32 per cent compared to only inorganic sources of N application (Table 89). The significant and positive correlation was observed between chilli yield (kg ha^{-1}) and oleoresin content (r = 0.73) and oleoresin yield (r = 0.93) in the present investigation (Table 91a).

The highest gross return, net return and B: C ratio (Rs.39730, Rs.20900 ha^{-1} and 2.31, respectively) were recorded with the treatment having equal supply of N through organics (2.5 t ha^{-1} vermicompost + 500 kg ha^{-1} neem cake) and inorganic source (CAN) and 50 kg P_2O_5 and K_2O ha^{-1}.

Effect of biorational sprays

The indiscriminate use of insecticides has led to insecticide resistance, pest resurgence, and environmental pollution besides upsetting natural eco-system (Lakhansingh and Sanjeevkumar, 1998). Further, presence of pesticide residue in chillies is the major non-tariff barrier against export of chillies to the developed countries. In overcoming these problems, biopesticides spray, plant based substances and indigenous materials offer safe and better alterative methods of pest management (Narayanaswamy, 1999).

The present study revealed the highest dry pod chilli yield (1050 kg ha^{-1}) with alternate spray of Abamectin and Perfect at 3, 5, 7, 9 and 11 WAT compared to rest of the treatments. Interestingly, improvement in the yield was to the extent of 54 per cent over recommended chemical spray (dimethoate +dicofal + carbaryl spray) and more than double (119%) over control treatment having no sprays. The superiority of Abamectin chemical in the management of sucking pests and increased yield was earlier reported by Tatagr (2004).

Nimbecidine alternated with GCK, leaf extract or panchagavya + leaf extract and panchagavya alone were next in the order and were on par with RPP (Table 65). The influence of neem products in increasing the chilli yield was earlier reported by Smitha (2002), Varghese (2003) and Gundannavar (2007). They reported that neem based chemicals preformed better and hence are best alternatives to RPP with on par/higher chilli yield. Similarly, Kulkarni and Shekarappa (2001) reported higher yield of chilli through NSKE as well as release of *Tricogramma*. Application of NSKE alone also registered higher chilli yield (Ukey and Saroda, 2001), Mallapur (2002) reported maximum dry chilli yield in GCK (garlic chilli kerosene) extract + nimbecidine treated plots. Thus, the results were clearly emphasizing the possibility of reducing pesticide load in the pest ridden crop like chilli. These practices also promise production of pesticide - free chilli, which is a major deterrent in the international market.

As already elaborated yield performance in chilli in the above treatments could be related to better performance of yield components mainly number of fruits per hill (Table 62), fruit length (Table 62), 100-fruit weight (Table 63), 1000-seed weight (Table 63) and seed to pod ratio (Table 64), Abamectin spray alternated with Perfect recorded higher number of matured fruits and improvement in the yield components was to the extent of 21and 248 per cent compared to RPP and no spray treatments respectively. Similarly, fruit length, 100-fruit weight, 1000-seed weight and seed to pod ratio improved to the extent of 8, 14, 20 and 15 per cent, respectively over RPP and 17, 31, 33 and 58 per cent, respectively over no spray treatments. Chakraborti (2000) reported higher number of fruits per plant with neem based insecticides. Ultimate yield was the cumulative effect of all these components. Neem based sprays alternated with few biorationals were next in the order and were comparable with RPP.

Further, a strong and positive relation could be drawn between the improvement in yield components and performance of growth components in the present experiment. The accumulation of dry matter in the plant is very important in regulating the crop yield. Alternate spray of Abamectin and Perfect recorded significantly higher dry matter production at all the stages of plant growth compared to other pesticide sprays.

The higher dry matter production in the plant can be achieved only with the development of higher leaf area in the plant. Improved plant growth in terms of height, number of branches and photosynthetic area could be attributed to reduction in the sucking pest complex and also increase in the predator population (discussed in detail elsewhere in the chapter).

The plant height and number of secondary branches per plant were also higher with alternate sprays of Abamectin and Perfect, which greatly contributed to TDMP. Further, the treatment also recorded higher leaf area throughout the growth of the crop in the above treatment. Besides larger leaf area, the damage to the photosynthetically active leaf area by sucking pests or murda complex was the minimum with the above treatment (discussed under 5.2). Therefore, the treatment could contribute towards better architect of the plant consequently for greater production of photosynthates and their transport to the reproductive parts.

As a consequence of minimum pest intensity with alternate sprays of Abamectin and Perfect, percentage of discoloured fruits were the lowest with the treatment. However, nimbecidine alternated with leaf extract + panchagavya spray recorded similar extent of percentage discoloured fruits. Nevertheless, yield of good quality fruits was the highest with former treatment among all the biorationals treatments and the extent of increase was of the order of 44 and 134 per cent over RPP and no protection treatments, respectively.

As far quality parameters are concerned the pattern was rather different. The highest ascorbic acid content was recorded with nimbicidine alternated with leaf extract + panchagavya spray (216.4 mg 100 g^{-1}). This was closely followed by alternate spray of Abamectin and Perfect, both were at par. The nimbecidine alternated with leaf extract + panchagavya enhanced the ascorbic acid content to extent of 60 and 73 per cent compared to RPP and control treatment having no sprays respectively. While, the extent of improvement with alternate spray of Abamectin and Perfect was 32 and 62 per cent over RPP and no spray treatment, respectively. The capsaicin content and Scovielle heat units followed the trend of ascorbic acid content. Nimbecidine alternated with leaf extract + panchagavya spray recorded significantly higher capsaicin and scovielle heat units and increase was to the extent of 120 and 214 per cent and 115 and 204 per cent compared to RPP and no spray (control) treatments, respectively (Table 86-87).

Oleoresin per cent though followed similar trend as that of other quality parameters discussed above, oleoresin yield was in line with the variation in the good quality fruit yield. The oleoresin per cent was significantly higher (17.48%) with alternate spray of nimbicidine and leaf extract + panchagavya spray compared to rest of the sprays except alternate spray of Abamectin and Perfect (16.51). The alternate spray of Abamectin and Perfect recorded the highest oleoresin yield (160 kg ha^{-1}) and the increment in the oleoresin yield was to the extent of 67 and 203 per cent over RPP and no spray treatment (control), respectively.

In the present study, it was clearly evident that integrated nutrient supply together with biorational spray (e.g. Abamectin-Perfect, Nimbecidine- Leaf extract + Panchagavya) for pest control effect remarkable influence on yield and quality of Bydagi chilli.

Chilli crop supplied with integrated sources of nitrogen through organic and inorganic sources coupled with Abamectin and Perfect sprays alternatively recorded the highest fruit yield (1131 kg ha^{-1}) and the increment was appreciable which was to the extent of 63 and 164 per cent over RPP and no spray treatment receiving only inorganic source of nitrogen, respectively (Plate 15 to 18). Alternate spray of Abamectin and Perfect coupled with inorganic source N application was next in the order (Plate 19 to 22). Further yield components, which ultimately contributed to yield, were also better and statistically superior with this treatment. The increment in fruit yield per hill was of the order of 36 and 291 per cent, fruit length by 13 and 24 per cent, 100-fruit weight by 32 and 23 per cent, 1000-seed weight by 33 and 61 per cent and seed to pod ratio by 28 and 73 per cent, respectively over treatment with inorganic nitrogen + recommended plant protection and no spray, respectively.

Similarly, total dry matter production (TDMP), plant height and number of branches were maximum with integrated N nutrition receiving alternate Abamectin and Perfect spray treatment. These were the consequences of larger photosynthetic area with the treatment (leaf area) and minimum pest intensity (thrips and mite) and foliage damage due to murda (discussed separately in the following pages). The photosynthetically active area with this treatment at final picking was higher by 39 and 129 per cent, respectively over treatment receiving N through inorganics coupled with RPP spray or no spray. Nevertheless, treatment receiving alternate spray of Abamectin + Perfect even under inorganic N nutrition was the next best treatment.

Unlike growth and yield parameters, the trend changed in the per cent-discoloured fruits. The per cent discoloured fruits was reduced significantly to a greater extent when chilli crop was nutritioned with equal proportion of organic and inorganic sources of N combined with alternate sprays of nimbecidine and leaf extract + panchagavya spray (7.8%) closely followed by alternate spray of Abamectin and Perfect with same nutrition. While, significantly higher discoloured fruits was recorded with only inorganic source of N and without any protective sprays. The reductions in the per cent discoloured fruits with above treatment combination was to the extent of 99 and 650 per cent over RPP and no spray treatment with inorganic source of N application, respectively. The yield of good quality fruits followed the trends in the chilli yield. The combined application of organic and inorganic sources of N coupled with alternate spray of Abamectin and Perfect recorded 72 and 188 per cent, respectively increase in the yield of good quality fruits compared to RPP and crop supplied with only inorganic sources of N but without any sprays.

Besides, growth and yield parameters the quality of chilli fruits was greatly influenced by different sources of N and biorational sprays. Unlike yield of good quality fruits, the ascorbic acid content followed the trends in the per cent discoloured fruits. The highest ascorbic acid content was recorded with chilli crop nutritioned with equal quantities of N through organic and inorganic sources coupled with alternate spray of nimbecidine and leaf extract + panchagavya (234 mg 100 g^{-1}). The ascorbic acid content was improved to the tune of 61 and 101 per cent, respectively over RPP and no spray crop nutritioned completely with inorganic source of N.

The capsaicin per cent and SHU followed the similar trend as that ascorbic acid content. Integrated source of N supply equally through organic and inorganic sources coupled with nimbicidine spray alternated with leaf extract + panchagavya recorded significantly higher capsaicin per cent and SHU.

The oleoresin per cent also followed the similar trend as that of other quality parameters. Application of N through organic and inorganic sources coupled with nimbecidine alternated with leaf extract + panchagavya recorded significantly higher oleoresin per cent (17.87). Unlike oleoresin per cent, oleoresin yield followed the trends of good quality chilli yield. Integrated N supply through organic and inorganic sources combined with alternate sprays of Abamectin and Perfect recorded 108 and 304 per cent higher, respectively higher oleoresin yield over RPP and no spray treatments supplied with only inorganic source of N application. However, similar spray combination under inorganic N nutrition registered next best values with regard to oleoresin yield.

Plate 15: 50% RDN + 50% organic N alternate spray of Abamectin and perfect at 120 DAT

Plate 16; 50% RDN + 50% organic N alternate spray of nimbecidine – panchagavya + leaf extract at 120 DAT

Plate 17: 50% RDN + 50% organic manure + Recommended plant protection (RPP) at 120 DAT

Plate 18: 50% RDN + 50% organic manure + No spray (control) at 120 DAT

Plate 19; RDF + Alternate spray of Abamectin – Perfect at 120 DAT

Plate 20: RDF + Alternate spray of nimbecidine – panchagavya + leaf extract at 120 DAT

Plate 21 : RDF + Recommended plant protection (RPP) at 120 DAT

Plate 22. RDF + No spray (control) at 120 DAT

Among the biopesticides sprays, alternate spray of Abamectin and Perfect recorded the higher gross return, net return and B:C ratio (Rs.52,480, 31,510 ha^{-1} and 2.54, respectively), while RPP was next in the order. On the other hand, no spray treatment recorded the lowest gross return, net return and B:C ratio. The monetary benefit from alternate sprays of Abamectin and Perfect was Rs.11,100 and 22,930 ha^{-1} higher over RPP and no spray treatments, respectively.

Among the treatments combinations of N sources and biopesticides sprays, the highest gross return was recorded with equal proportion of organic and inorganic sources of N coupled with alternate spray of Abamectin and Perfect (Rs. 56530 ha^{-1}). Only inorganic source of N application with alternate spray of Abamectin and Perfect was next in the order. Integrated source of N supply coupled with alternated spray of nimbecidine and leaf extract + panchagavya, leaf extract or panchagavya, and RPP were on par with one another. While, the lowest gross return was recorded with only inorganic sources of N application but without any sprays (Rs. 21,360 ha^{-1}).

Integrated supply of N through organic and inorganic sources coupled with alternate spray of Vertimac and Perfect recorded significantly higher net returns (Rs.34130 ha^{-1}). While, only inorganic N applied treatment with the above spray schedule was on par with the former treatment combination. On the other hand, irrespective of source of N, nimbicidine alternated with GCK, panchagavya, leaf extract + panchagavya or leaf extract, and only RPP were next in the order, while significantly lower net return was recorded with only inorganic N supplied treatment but without any sprays (Rs. 9,360 ha^{-1}). Chilli crop nutritioned with equal doses of N through organic and inorganic sources coupled with alternate spray of Abamectin and Perfect recorded significantly higher B: C ratio (2.75). Because of high cost of Abamectin spray and cost of organics the integrated N supply through organic and inorganic sources with alternate spray of nimbecidine, GCK, leaf extract sprays and leaf extract + panchagavya and alternate spray of Abamectin and prefect with only inorganic source of N were on par with the former treatment. Inorganic source of N application with alternate spray of nimbicidine and leaf extract and integrated N supply with alternate spray of leaf extract + panchagavya or RPP spray were next in the order. On the other hand, lower B: C ratio was recorded in the inorganic source of N applied plot but without any sprays (1.59).

5.2 REACTION OF CHILLI TO LEAF CURL COMPLEX (*MURDA*)

Murda is an important disease complex in chilli, which is rather inescapable and can cause total failure of the crop if not proper and timely care is taken in the production of chilli. It is one prime factor, which warrants greater attention and timely intervention. Unfortunately, there is no single causal agent, which could have been attended easily. Chemicals alone cannot assure better plant health. There is also added problem of pesticide residue in addition to environmental pollution and ecological implications. Component crops, balanced nutrition, integration of organics in nutrition and prophylactic measures *etc.* for sucking pest management are some of the important options. Fortunately, many of the traditional practices such as plant extracts and biorationals have exhibited greater promise in many other crop situations. Therefore results, of the experiments carried out on this line involving barriers, intercrops, nutrition and biorationals are discussed here under.

Influence of barrier crops

Leaf curl index is an important parameter, which gives the extent of damage to the foliage by the sucking pests, mosaic virus *etc.,* in general, and it is also used as an indirect indicator of crop performance as a whole. In spite of better above ground architect and crop canopy, many a times crop may fail to produce normal yields because of high LCI. In the present investigation, generally lower leaf curl indices were recorded in the leeward side of the barrier crop at all the stages of plant growth (0.41, 0.52 and 0.41 at 60 and 90 DAT and at final picking, respectively) compared to the windward side of the barrier crop (Table 27-29). The decrease in LCI in the leeward side was to the extent of 49, 50 and 39 per cent compared to the windward side at 60 and 90 DAT and at final picking, respectively. While, LCI on the windward side decreased to the extent of 448, 324 and 328 per cent over the crop without barrier and 666,487 and 456 per cent on the leeward side over the crop without barriers at 60 and 90 DAT and at final picking, respectively.

Barrier density (number of rows) comprising of six or more rows recorded significantly lower LCI at all the stages of plant growth (0.41, 0.51 and 0.41 with nine rows and 0.47, 0.61 and 0.45 with six rows at 60 and 90 DAT and at final picking, respectively) over barrier having three rows. The reduction in LCI with wider strips of the barrier crops particularly on the leeward side could be attributed to the availability of favourable micro-climate for the crop growth and reduction in the sucking pests such as thrips and wind carried pests like mites, besides postering of predator population by providing nectar and pollen feed relatively in large quantity compared to three row barrier strip. Similar to the barrier width (number of rows), the significant variation in LCI was observed with the species of barriers. Fodder sorghum recorded the lowest LCI at all the stages of crop growth (0.27, 0.38 and 0.28 in the leeward side and 0.48, 0.59 and 0.45 in the windward side at 60 and 90 DAT and at final picking, respectively). The reduction of LCI by the fodder sorghum barrier in the leeward side was to the extent of 618,416 and 405 per cent over chilli crop grown without barrier at 60 and 90 DAT and at final picking, respectively. Among the treatment combinations of number of rows and barrier species, fodder sorghum in nine rows recorded lower LCI at all stages of crop growth (0.20, 0.27 and 0.23 in the leeward side and 0.43, 0.43 and 0.37 in the wind ward side at 60 and 90 DAT and at final picking, respectively) followed by grain sorghum in nine rows and fodder and grain sorghum in six rows. The reduction of LCI by nine rows of fodder sorghum was to the extent of 1265, 837 and 713 per cent over chilli crop grown without barriers at 60 and 90 DAT and at final picking, respectively. A significant and negative correlation was observed between chilli yield (kg ha^{-1}) and LCI (r= -0.88, -0.94 and -0.93 in the leeward side and-0.94, -0.94 and -0.98 in the windward side at 60 and 90 DAT and final picking, respectively) (Table 33a).

Leaf curl is the result of the damage due to sucking pests like thrips and mites directly and due to the infection of leaf mosaic virus carried by these vector pests indirectly. In the present investigation, reduction in leaf curl index with barriers particularly with fodder sorghum grown in nine rows could be attributed to lower population of thrips and mites. Thrips and mites population was the lowest with the former treatment at all the stages of observations. The reduction in the population was to the extent of 356,406,633 and 635 per cent in thrips at 30, 60 and 90 DAT and at final picking, respectively and 829, 567 and 500 per cent in mite at 60 and 90 DAT at final picking, respectively over crop grown without barrier. Grain sorghum in nine rows and six rows of fodder and grain sorghum were next in the order and were significantly superior to the crop grown without barrier. Further, significant negative correlations were observed between chilli yield (kg ha^{-1}) and thrips (r = -0.91, -0.92, -0.95 and -0.94 in the leeward side and -0.95, -0.76, -0.94 and -0.90 in the windward side at 30, 60 and 90 DAT and at final picking, respectively) and mites (r= -0.88, -0.94 and -0.94 in the leeward side and -0.67, -0.92 and -0.97 in the windward side at 60 and 90 DAT and at final picking, respectively) population per leaf (Table 33a). The results are in line with Nelson and Natarajan (1994) in chilli. Drees (2008), Katti (2007) and Mesta *et al.* (2004) reported reduction in thrips population with sorghum as a barrier crop with sunflower.

The reduction in sucking pests under barrier could be partly attributed to reduced wind speed and consequently reduced spread of vector/sucking insects (as evidenced through lower thrips and mite population and LCI on the leeward side of barrier) by and partly to discontinuation of host crop canopy (0.9 to 2.7 meters of barrier width), partly to filtering action (since the barrier was taller than host by 1 to 2 meters), and partly to sheltering by predators of the barriers by providing nectar and pollen feed. As a consequence, populations of coccinelloids and spiders increased under barrier. The coccinelloids and spider populations were higher in the barrier cropping in comparison to crop without barriers. The population was higher with nine rows of barrier (six rows on par). Coccinelloids population was 213 per cent higher over crop with no barriers. It is interesting to note that the preference of the predators differed among the barrier species; coccinelloids concentrated more on chilli bordered with maize, particularly initially, while spiders inhabitated preferentially on chilli barriered with sorghum. The relative intensity on these crops was 165 and 209 per cent over crop without barriers on the windward and leeward side, respectively. Among the treatment combinations, chilli with fodder maize and fodder sorghum in nine rows recorded significantly higher population of *Chrysonellids* and spiders, respectively. Within the barriers also at 100 DAS, maize with nine rows recorded significantly higher coccinelloids and *Chrysoperla* population. The increase in the above two predators population with nine rows of maize was to the extent of 75 and 150 per cent, respectively over sorghum barrier with three rows. While, spider population was significantly higher with nine rows of sorghum. The increase in the spider population with nine rows of sorghum at 100 DAS of the barrier crop was to the extent of 186 per cent over control plot having no barriers.

In the present investigation, leaf curl index was lower, and also thrips and mites populations were lower with sorghum as a barrier irrespective of row density. This could be attributed to early senescence of maize in comparison to sorghum (fodder and grain). Sorghum barrier remained green beyond first picking in chilli. Higher population of predators namely *Coccinellids* and *Chrysoperla* with maize could be attributed to preference of these predators particularly adults for food (nectar and pollen) available in maize barrier. Further, lower LCI with fodder sorghum could also be due to higher effectiveness of spiders than C*occinellids* and C*hrysoperla* and other predators.

Influence of intercrop

Intercropping acts as a tool in the pest management strategy and plays a role in minimizing the pest build up through physical hindrance, polycrop ecosystem, change in microclimate, preferential build up of predator population and repellent action on pests by the production of volatile compounds synthesized by intercrops/component crops.

Leaf curl index is the parameter, which indicates the crop condition, sucking pest activity (thrips and mites) and status of viral infection. In the present study, chilli + garlic intercropping recorded the lowest LCI at all the stages of plant growth (0.63, 0.55 and 0.39 at 60 and 90 DAT and at final picking, respectively) (Table 47). Garlic intercropped with chilli reduced the LCI to the extent of 24, 44 and 33 per cent over sole chilli and 14, 25 and 23 per cent over chilli + coriander cropping system at 60 and 90 DAT and at final picking, respectively.

Leaf curl is the result of sucking pest activity in the foliage. In the present study, garlic intercropped with chilli recorded the lowest thrips population and significantly lower mites population at all the stages of crop growth (0.54, 0.82, 0.34 and 0.20 thrips leaf^{-1} at 30, 60 and 90 DAT and at final picking, respectively and 0.50, 0.68 and 0.66 mites leaf^{-1} at 60 and 90 DAT and at final picking, respectively). The extent of reduction in thrips and mites population with this treatment was 48, 24, 56 and 60 per cent of thrips at 30, 60 and 90 DAT and at final picking, respectively and 48, 30 and 27 per cent of mites at 60 and 90 DAT and at final picking, respectively. While, coriander intercropped with chilli closely followed chilli + garlic cropping system with respect to thrips and mites population. Similar result of decrease in the thrips and mites population due to intercropping practice was reported by Manjunath *et al.* (2001) in chilli. Sinha *et al.* (2007) also observed decreased sucking pest population (leaf hoppers and thrips) when bhendi was intercropped with baby corn. Intercropping system besides reducing the insect and pest population, also helps for build up of predator population. It is reported that the predators such as coccinelloids, spiders and green lacewing bugs *etc.* were increased when cotton was intercropped with maize, cowpea and sorghum (Kavitha *et al.*, 2003). Population of predators namely coccinelloids and spiders varied according to the population of thrips and mites, highest population of predators existed with the treatment having higher population of thrips and mites. Unlike in barrier cropping, in this experiment predators activity was more where thrips and mites flourished (1.08, 0.71 and 0.63 plant^{-1} coccinelloids and 0.21, 0.25 and 0.23 plant^{-1} spiders with sole chilli at 60 and 90 DAT and at final picking, respectively). This difference could be attributed to feeding material available for the adult predators under barrier crop.

Effect of graded levels of N and K

Leaf curl index (LCI) was the maximum with supply of N entirely through inorganics and it decreased as the proportion of organic sources of N and also potash nutrition increased. In the present study, chilli nutritioned with 100 per cent organic source of N coupled with highest level of potassium recorded significantly lower LCI at all the stages of observation (0.51, 0.45, 0.33 at 60 and 90 DAT and at final picking, respectively) and reduction in LCI was to the extent of 104,102 and 91 per cent over chilli nutritioned with only inorganic source of nitrogen but without any potassium application at 60 and 90 DAT and at final picking, respectively.

Crop nutritioned with highest level of potassium without any inorganic form of nitrogen recorded significantly lower thrips and mites population at all the stages of plant growth (0.44, 0.60, 0.27 and 0.16 thrips leaf^{-1} at 30, 60 and 90 DAT and at final picking, respectively and 0.38, 0.53 and 0.51 mites leaf^{-1} at 60 and 90 DAT and at final picking, respectively). The reduction in thrips and mites population was to the extent of 132, 110, 133 and 156 per cent with respect to thrips at 30, 60 and 90 DAT and at final picking, respectively and 142, 102 and 101 per cent of mites at 60 and 90 DAT and at final picking, respectively over crop nutritioned with 100 per cent inorganic N alone with zero potassium application. Similar results of reduction in the sucking pest population with higher level of potassium application coupled with lower quantity of inorganic N application was reported by Jeyaraman and Balasubramanian (1988), Ukey *et al.* (1998) and Mallapur *et al*. (2003) in chilli and Godse and Patel (2001) in brinjal and Sabbour and Abbass (2006) in onion.

Among the chemical fertilizers, nitrogenous fertilizers have a positive role in the build up of pest population. On the other hand, potassium fertilizers generally appeared to have a negative influence on the pest population by higher protogenesis in plants, a physiological phenomena correlated with elimination of amino acids and reducing sugars in the sap, which otherwise favour the development of sap feeders (Sudhakar *et al.*, 1988a). While, increased incidence of sucking pests might be due to increased auxin content of the plants under heavy nitrogenous manuring (Balakrishnan *et al.*, 2007).

The predators like coccinellids and spiders varied according to the population of thrips and mites, since they act as food for the carnivorous predators. Sucking pest population was directly correlated with the density of predators. Chilli crop nutritioned with 100 per cent N through inorganics along with no potassium application recorded the highest population of coccinellids and spiders (1.17, 0.88 and 0.77 coccinelloids plant^{-1} and 0.25, 0.27 and 0.30 spider plant^{-1} at 60 and 90 DAT and at final picking, respectively) compared to the crop nutritioned with 100 per cent organic source of N coupled with 100 kg ha^{-1} potash application.

Garlic intercropped with chilli supplied with 100 per cent organic source of N with highest level of potassium application recorded significantly lower LCI at all the stages of plant growth (0.57, 0.45 and 0.33 at 60 and 90 DAT and at final picking, respectively). The reduction in LCI was to the extent of 172, 157 and 152 per cent, respectively at 60 and 90 DAT at final picking over sole chilli crop nutritioned with 100 per cent inorganic N along with zero level of potassium application. Nevertheless, treatment receiving 50 per cent N through organics and remaining 50 per cent N through inorganic source and 50 kg each of P_2O_5 and K_2O was comparable with the former treatment (0.50,0.50 and 0.35 at 60 and 90 DAT and at final picking, respectively).

Leaf curl index is the manifestation of thrips and mites infestation, which affects the plant growth and in turn the yield adversely. Garlic intercropped with chilli nutritioned with 100 per cent organic N with highest level of potassium application recorded significantly lower thrips and mites population at all the stages of plant growth (0.40, 0.56, 0.20 and 0.14 thrips leaf^{-1} at 30, 60 and 90 DAT and at final picking, respectively and 0.32, 0.47 and 0.46 mites leaf^{-1} at 60 and 90 DAT and at final picking, respectively). The per cent reduction in the thrips and mites population was to the extent of 235, 175, 290 and 286 per cent of thrips at 30, 60 and 90 DAT and at final picking, respectively, and 328, 160 and 154 per cent of mites at 60 and 90 DAT and at final picking, respectively over sole chilli nutritioned with 100 per cent inorganic N but without K nutrition. However, N_{50}+P_{50}+K_{50} nutrition was on par with the former (I_1S_3) treatment combination.

Predators vary according to the population of sucking pests. Significantly higher population of coccinelloids and spiders were recorded with sole chilli nutritioned with 100 per cent inorganic N and without K application at all the stages of plant growth (1.29, 0.97 and 0.92 plant^{-1} C*occinellids* and 0.34, 0.37 and 0.40 spiders plant^{-1} at 60 and 90 DAT and at final picking, respectively). Predator population within the intercrop was significantly higher with coriander intercropped with chilli nutritioned with 100 per cent inorganic N and no K nutrition (1.60, 1.02 and 1.04 plant^{-1} with respect to *coccinellids*, spiders and C*hrysoperla* at 60 DAS, respectively). While, the lowest predator population was observed with chilli + garlic cropping system with zero level of inorganic N but highest level of K nutrition followed by same cropping system nutritioned with N_{50}:P_{50}:K_{50} level.

Within the intercrops also similar trend was observed. The predators such as *Coccinellids*, spiders and *Chysoperla* were significantly higher when crop nutritioned with 100 per cent inorganic N but without K application (1.48, 1.08 and 1.04 plant^{-1} at 60 DAS, respectively). While, lowest population of predators was recorded with highest level of potassium application with no inorganic source of N.

Effect of sources of nitrogen

In the present investigation, substitution of 50 per cent of recommended N through organics (vermicompost @ 2.5 t ha^{-1} and 500 kg ha^{-1} neem cake) recorded the lowest LCI at all the stages of observation. These sources of nitrogen reduced the LCI to the extent of 17, 23, 20 and 27 per cent before a week of 2^{nd}, 3^{rd}, 4^{th} and 5^{th} sprays and 28, 28, 21 and 21 per cent after a week of 2^{nd}, 3^{rd}, 4^{th} and 5^{th} sprays, respectively over only inorganic source of N application. The results are in line with the findings of Vargese (2003) who also reported reduction in LCI due to N supplementation through vermicompost (1000 kg ha^{-1}) and neem cake (500 kg ha^{-1}). Giraddi and Smitha (2004) also reported reduction in LCI due to N supply through vermicompost and *in situ* green manuring besides inorganic fertilizers.

Leaf curl index is a measure of extent of murda incidence in chilli crop caused by sucking pests (thrips and mites), which is the major handicap for obtaining potential yields. In the present study, supplementation of organic N along with inorganic sources of N recorded the lowest thrips and mites population and the reduction in the thrips population was to the extent of 27, 16, 90, 27 and 23 per cent before II, III, IV and V spray and 24, 25, 25 and 29 per cent after a week of II, III, IV and V spray, respectively over only inorganic N nutrition. Similar results of reduction in sucking pests population by the combined application of organic and inorganic sources of N was reported by Varghese (2003), Giraddi and Smitha (2004), Saumya (2006) and Gundannavar (2007) in chilli.

Nutrition of chilli crop through both organic and inorganic sources is very important for the healthy growth of the crop and for reducing the sucking pest complex. The organic sources like poultry manure or vermicompost and neem cake apart from improving the yield and quality, reduced the build up of sucking pests in chilli. It is reported that the vermicompost helps for the better growth and development of the crop and imparts resistance to the crop against pests and diseases, while neem cake helps in reducing the sucking pests due to the presence of bitter terpenoids mainly azardirachtin which is responsible for anti-feedant, anti-ovipositional, growth disrupting, fecundity and fitness reducing properties of pests (Alam *et al.*, 1979).

Predators varied according to the populations of pests. The spider population was the highest with only inorganic sources of N application at all the stages of observation (0.40, 0.42 and 0.40 $plant^{-1}$ before III, IV and V spray and 0.27, 0.35 and 0.31 $plant^{-1}$ after a week of III, IV and V spray).

Effect of biorationals

A few of the biorationals are very effective against sucking pests, besides, they also help in maintaining the natural ecosystem and maintaining food web chain system in the insect ecosystem. Since many of the biorationals are not toxic to useful predator population, they permit control of pest naturally too by encouraging predator population. In the present experiment, alternate spray of Abamectin and Perfect recorded the lowest LCI at all the stages of observation and the reduction in the LCI was to the extent of 79, 51, 28 and 42 per cent before and 23, 96, 41 and 105 per cent after a week of II, III, IV and V spray, respectively over RPP and 213, 17, 313 and 263 per cent before and 229, 300, 300 and 440 per cent after a week of II, III, IV and V, respectively over control having no sprays. Similar result of lower LCI by Abamectin spray was reported by Tatagar (2004). Nimbecidine alternated with leaf extract + panchagavya, leaf extract, GCK and panchagavya were next in the order and were on par with RPP.Similar results of reduced LCI by the spray of botanicals, neem products and indigenous materials were also reported by Bagle (1998), Smitha (2002), Varghese (2003) and Mallapur *et al.* (2004) in chilli crop.

Thrips and mites are major causal agents for the occurrence and spread of leaf curl and were influenced due to biorational sprays. Significantly lower thrips and mites population was recorded with alternate spray of Abamectin (3 sprays) and Perfect (2 sprays). The reduction in thrips population was to the extent of 0, 96, 22,121, and 65 per cent before and 225, 62, 235, 94 and 329 per cent after a week of I, II, III, IV and V sprays, respectively over RPP and 3, 240, 106, 321 and 249 per cent before and 595, 215, 488, 283 and 757 per cent after a week of I, II, III, IV and V sprays, respectively over control having no sprays. Similar result of reduction in thrips and mites population with Abamectin spray was reported by Tatagar (2004). The nimbicidine alternated with leaf extract + panchagavya, leaf extract, GCK and panchagavya were the next best treatments and were on par with RPP. The effect of botanicals, neem products and indigenous materials in reducing thrips and mites population was reported by Mallikarjuna Rao *et al.* (1999), Ahmed *et al.* (2001), Smitha (2002), Sanjeev Reddy (2003), Varghese (2003) and Mallapur *et al.* (2004).

The predators population of coccinelloids and spiders were significantly higher in the control plot having no spray (0.82, 0.74, 0.66 and 0.70 plant^{-1} before and 0.85, 0.66, 0.62 and 0.62 plant^{-1} population of coccinelloids after a week of II, III, IV and V sprays, respectively and 0.51, 0.60 and 0.48 plant^{-1} before 0.38, 0.53 and 0.40 plant^{-1} spiders after a week of III, IV and V spray, respectively). While the lowest predator population was recorded with the RPP (0.43, 0.20, 0.21 and 0.14 plant^{-1} before and 0.34, 0.18, 0.19 and 0.06 plant^{-1} population of coccinelloids after a week of II, III, IV and V spray, respectively and 0.16, 0.13 and 0.19 plant^{-1} before and 0.07, 0.43 and 0.06 plant^{-1} spiders after a week of III, IV and VI spray, respectively). Higher population of predators in the control treatment was on the expected line because of availability of abundant food (thrips and mites) in the treatment for the predators as control measures were not taken.

Further investigations indicated that chilli crop supplied with integrated sources of N equally through organic and inorganic sources with alternate spray of Abamectin and Perfect recorded significantly lower LCI. The reduction in LCI was to extent of 143, 95, 41 and 78 per cent before and 67, 139, 65 and 153 per cent after a week of II, III, IV and V spray, respectively over RPP nutritioned with only inorganic sources of N and 371, 216, 389 and 347 per cent before and 307, 400, 375 and 606 per cent after a week of II, III, IV and V spray, respectively over no spray supplied with only inorganic source of N. Nimbecidine sprays alternated with leaf extract + panchagavya, leaf extract, or GCK with integrated N supply through organic and inorganic resources were next in the order. The reductions in LCI by the integrated N supply through organic and inorganic resources with neem based biopesticides and indigenous material sprays was reported by Mallikarjuna Rao *et al.* (1999), Varghese (2003), Saumya (2006) and Gundannavar (2007).

Leaf curl index is the indirect indicator of sucking pest population in the chilli crop canopy. Significantly lower thrips population was recorded with combined application of N through organics and inorganic sources coupled with alternate spray of Abamectin and Perfect. The reduction in thrips population was to the extent of 23, 165, 56, 187 and 120 per cent before and 393, 87, 400, 135 and 520 per cent after a week of I, II, III, IV and V spray, respectively over RPP supplied with only inorganic source of N and 23, 335, 87, 144, 480 and 413 per cent before and 847, 278, 685, 353 and 1240 per cent after a week of I, II, III, IV and V spray, respectively over no spray treatment supplied with only inorganic source of N supply. Reduction in mites population was to the extent of 52, 76, 91 and 132 per cent before and 125, 180, 161 and 700 per cent after a week of II, III, IV and V spray, respectively over RPP supplied with only inorganic source of N and 229, 182, 194 and 308 per cent before and 275, 453, 372 and 1440 per cent after a week of II, III, IV and V spray, respectively over no spray treatment supplied with only inorganic source of N. Nimbecidine sprays alternated with leaf extract + panchagavya, leaf extract or GCK with integrated N supply through organics and inorganic sources were next in the order and were on par with RPP. Similarly, Giraddi and Smitha (2004) reported that application of organic amendments like neemcake (500 kg ha^{-1}) along with 50 per cent RDF and *in situ* green manuring @ 5 t ha^{-1} + 50% RDF resulted in significantly lower thrips and mites population and LCI, the treatment was as effective as RDF with RPP.

Significantly higher population of predators, coccinellids and spiders were recorded with no spray treatment supplied with inorganic source of N (0.86, 0.80, 0.72 and 0.78 plant^{-1} before and 0.85, 0.70, 0.69 and 0.70 plant^{-1} coccinellids after a week of II, III, IV and V spray respectively) and 0.57, 0.70 and 0.55 plant^{-1} before and 0.42, 0.62 and 0.45 plant^{-1} spiders after a week of III, IV and V spray, respectively). While, the lowest population of predators was recorded with RPP treatment supplied with integrated source of N nutrition (0.38, 0.19, 0.20 and 0.07 plant^{-1} before and 0.26, 0.16, 0.19 and 0.00 plant^{-1} coccinellids after a week of II, III, IV and V spray respectively and 0.15, 0.11 and 0.16 plant^{-1} before and 0.04, 0.11 and 0.00 plant^{-1} spiders and after III, IV and V spray, respectively).

5.3 SALIENT FEATURES OF THE INVESTIGATION

Investigations on component cropping, crop nutrition and biorationals use in the chilli production and management of leaf curl complex led to the identification of following technologies of practical significance for large scale adoptability.

1. Barrier cropping proved to be the important agronomic intervention for quality chilli production
    - Barrier crop in six to nine rows is advantageous in creating favourable microclimate for chilli crop particularly on the leeward side besides reducing thrips and mites population.
    - Cereal crops particularly fodder and grain sorghum proved to be superior barrier crops as these harbored more predators (particularly spiders) and resulted in the reduction in leaf curl and percentage discoloured fruits, besides yield benefits.
    - Growing of fodder and grain sorghum in six to nine row strips after every 40 rows of chilli in north-west or south-east direction (S-W/N-E) that is against the prevailing winds could be adopted advantageously to manage the menace of *murda*/leaf curl/thrips and mites incidence and for obtaining higher quantity of good quality fruits.
2. Intercropping is advantageous in the management of chilli murda complex besides yield benefits
    - Garlic in two rows alternated with every row of chilli helps to obtain good quality fruit yield through reducing leaf curl by reducing the population of thrips and mites in addition to providing the bonus yield in the form of garlic bulb thereby enhancing the chilli equivalent yield and net return from the system.
3. Since there is positive relationship between quantities of inorganic N supply or N substitution through organics, total N supply remaining constant (100 kg) and negative relationship between potash levels and population of thrips and mites and leaf curl incidence, nutrient management in *murda* endemic areas becomes critical for higher returns from chilli production.
    - Entire N through organic (poultry manure @ 3.7 t ha^{-1}) and 100 kg ha^{-1} K_2O could reduce thrips and mites and leaf curl incidence to the minimum, however for economic production of chilli, supply of recommended N equally through urea and poultry manure along with 50 kg ha^{-1} each of P_2O_5 and K_2O could be made use. Resources being limiting/under resource constraints a reduction in inorganic N supply to 25 kg N ha^{-1} (75 kg ha^{-1} N through poultry manure) and increase in K_2O upto 75 kg ha^{-1} could also be adopted with equal advantage.
    - Nitrogen (100 kg ha^{-1}) equally through fertilizer (50%) and poultry manure (50%) along with 50 kg each of P_2O_5 and K_2O in chilli + garlic intercropping system is promising from the point of overall production, quality fruits, net returns besides better management of chilli *murda* complex.
    - Chilli + garlic supplied with 25 kg N through fertilizer and 75 kg through poultry manure, 50 kg P_2O_5 + 75 K_2O kg ha^{-1} is as advantageous as the system supplied with equal (50 kg ha^{-1}) doses of organic N and N, P and K fertilizers.
    - Integration of vermicompost (2.5 t ha^{-1}) + neem cake (500 kg ha^{-1}) each supplying 25 kg N ha^{-1} along with inorganic nitrogen (50 kg ha^{-1}) is equally advantageous in reducing thrips and mites population and leaf curl index and obtaining good quality chilli yield and returns.
4. Use of biorationals as an eco-friendly measure has a distinct advantage over recommended chemical spray for the control of sucking pests and murda complex in general and in chilli production in particular.
    - Alternate spray of Abamectin (3 times) + Perfect (2 times) could help in obtaining good quality fruit by nearly 44 per cent over chilli grown with normal recommended (dimethoate (1.7 ml l^{-1}) + dicofal (2.5 ml l^{-1}) + carbaryl (4 g l^{-1})) spray.
    - This spray practice can result in 58 per cent reduction in leaf curl disease over RPP and almost by 279 per cent over crop without protection measures.

- Alternate spray of nimbecidine and leaf extract + panchagavya is as effective as alternate sprays of Abamectin + Perfect with regard to growth, yield and quality of chilli in addition to insect and disease reduction.

Either of the practices could be adopted advantageously depending on the availability of materials. These practices are eco-friendly and ensure reduction in the pesticide load in the environment.

5. Production intervention namely nitrogen nutrition equally through fertilizer and organics (vermicompost, 2500 kg ha^{-1} + neem cake 500 kg ha^{-1}) and biorational spray comprising Abamectin and Perfect alternatively is most promising in the production of export quality chilli with efficient management of leaf curl compared to recommended chemical pesticide schedule.

6. Export quality chilli could also be produced by using on form resources like vermicompost and neem cake integrated through supply of equal quantity of nitrogen as fertilizer treatment (50 kg ha^{-1}) and management of leaf curl through alternate spray of nimbecidine and leaf extract (*Vitex nigundo, Azardirachta indica*, *Adothoda vesica, Pongamia pinnata, Argimone maxicana* and neem seed kernel extract) + panchagavya, nimbecidine + GCK, nimbecidine + leaf extract. Fruit yield with these practices are as much as those obtained with RPP but fruits are free of pesticide residue.

5.4 FUTURE LINE OF WORK

The findings of the present investigation on *murda* management through agronomic practices have opened scope for investigation on similar lines in the eco-friendly crop pest management. In chilli, following points need consideration for feature research.

1. In the present study, barrier crops were sown 15 days in advance of chilli transplanting and 20 rows of chilli were transplanted on either side of the barrier. Therefore, there is a need for further investigation on staggered planting of barrier (both number of rows/species), effective distance of protection on either side and correlation on wind velocity and movement of vector pests.

2. Reports indicate advantage of silica in many instances. In the present study also visual indications indicated better plant health, however in view of absence of desirable final result it is necessary for further refinement of silica treatment for its effectiveness.

3. With the advent of new and effective biorationals continuous evaluation of these materials along with micronutrients and other interventions are also needed to develop effective strategy for sustainable chilli production.

6. SUMMARY AND CONCLUSIONS

Leaf curl (*murda* complex) is an important disease affecting production and export of chilli. Studies were carried out to develop agronomic interventions for the management of leaf curl disease to realize potential yields of chilli in the northern transition zone of Karnataka under rainfed situation. There were three field experiments. The evaluation of barrier crop efficiency comprised of three barrier strips (3, 6 and 9 rows) and four barrier species (grain and fodder maize and sorghum crops) forming twelve treatments combinations was carried out using RBD with three replications. The second experiment comprised of three cropping systems (sole chilli, chilli + garlic and chilli + coriander) and the graded levels of NK fertilizers with nitrogen substitution using poultry manure was carried out using split plot design with three replications. The third experiment consisted of two nitrogen nutrition treatments and biorationals sprays including RPP and control forming 20 treatment combinations was laid out using split plot design with three replications. These experiments were executed at Agricultural Research Station, Devihosur, Haveri, Karnataka during growing seasons of 2005-06 and 2006-07. The results of the experiments are furnished hereunder.

- In the experiment on effectiveness of barrier in quality chilli production, all growth parameters viz., plant height, number of secondary branches per plant and leaf area per hill at all the stages of observation were significantly higher with six and nine rows of barriers, maximum being with nine rows. Of the barrier species, fodder and grain sorghum recorded significantly higher values for these attributes. Among the treatment combinations, fodder sorghum in nine rows recorded significantly higher plant height, number of secondary branches and leaf area at all the stages than other treatments. Grain sorghum in nine rows and fodder and grain sorghum in six rows were next in the order.

- Similar to the growth components, TDMP (52.8 g and 56.4 g with six and nine rows, respectively), number of fruits hill^{-1} (45 and 47 with six and nine rows, respectively), 100-fruit weight (119 g and 123 g with six and nine rows, respectively), fruit length (12.9 cm and 12.1 cm with six and nine rows, respectively), 1000-seed weight (7.3 g and 7.5 g with six and nine rows, respectively), and seed to pod ratio (36 and 37 with six and nine rows, respectively) were higher with six and nine rows of barriers than with three rows barrier. Among the barriers species, higher values of all these attributes were recorded with fodder sorghum as a barrier. Grain sorghum was next in the order. Of all the treatment combinations, fodder sorghum in nine rows recorded significantly higher TDMP (59.1 g), fruits hill^{-1} (51), 100-fruit weight (127 g), fruit length (12.7 cm), 1000-seed weight (7.8 g) and seed to pod ratio (39.5). Grain sorghum in nine rows, fodder and grain sorghum each in six rows were next in the order and were often at par with one another. Fodder sorghum in nine rows was significantly superior to fodder and grain maize in general.

- Quality of chilli particularly percentage discoloured fruits (11.8%), yield of good quality fruits (1054 kg ha^{-1}), oleoresin per cent (16.2%) and oleoresin yield (170.8 kg ha^{-1}) were the highest in chilli with nine rows of barrier and the values decreased with reduction in number of rows, and three rows of barrier was the least effective. While ascorbic acid content, capsaicin content and SHU were not affected by the barrier rows. In the barrier species, fodder sorghum and grain sorghum were comparable while fodder maize fared rather poorly. Among the treatment combinations fodder sorghum in nine rows recorded significantly higher yield of good quality fruits (1126 kg ha^{-1}), oleoresin per cent (16.6%) and oleoresin yield (187.3 kg ha^{-1}). Similarly, per cent discoloured fruit was significantly lower with the above treatment combination. On the other hand, ascorbic acid content, oleoresin per cent and SHU were unaffected by barrier cropping.

- As far the leaf curl index was concerned, lower indices were recorded with nine rows of barrier and the values increased with decrease in number of rows. Among barrier species fodder sorghum recorded the lowest LCI at all the stages followed by grain sorghum, while grain and fodder maize had higher indices. Thrips and mites population followed the leaf curl indices and lower population of these pests were observed in chilli with nine row barrier and the population increased with corresponding decrease in row number. Among the barrier species, fodder sorghum was most effective in reducing thrips and mites (0.67, 0.35, 0.33 and 0.37 thrips leaf^{-1} at 30, 60 and 90 DAT and at final picking, respectively and 0.16, 0.25 and 0.26 mites leaf^{-1} at 60 and 90 DAT and at final picking, respectively) followed by grain sorghum while maize was not as effective as sorghum.

- Variation in predator population followed rather different pattern. Coccinelloids and chrysoperla were relatively higher with maize barrier, while spiders were more with sorghum at all the stages of observation. Further, the data revealed superiority of sorghum barrier and of spiders in reducing the incidence of leaf curl incidence.

- Gross return, net return and B: C ratios were higher with six and nine rows of barrier than with three rows of barrier. Among the barrier species, higher values of all these economic indicators were recorded with fodder sorghum as a barrier. Grain sorghum was next in the order. Among the treatment combinations fodder sorghum with six rows recorded significantly higher gross return (Rs. 58180 ha^{-1}), net return (Rs. 40680 ha^{-1}) and B: C ratio (3.43). Grain sorghum in nine rows, fodder and grain sorghum each in six rows were next in the order and were on par with each other. Fodder sorghum with nine rows was significantly superior to fodder and grain maize, in general.

- In the experiment on effect of intercrops, substitution of N, and graded levels N and K on the performance of chilli and behaviour of murda complex, all the growth parameters viz., plant height, number of secondary branches plant^{-1} and leaf area hill^{-1} at all the stages of observation were significantly higher with chilli + garlic intercropping system. Among N substitution and graded levels of K, crop nutritioned with equal proportion of N through organic and inorganic sources with recommended P and K (N_{50+50}+$P_{50}K_{50}$) recorded significantly higher values of these attributes. Among the treatment combinations, chilli + garlic cropping system nutritioned with equal quantities (50+50 kg ha^{-1}) of N through organic and inorganic sources with 50 kg ha^{-1} each of P_2O_5 and K_2O recorded higher plant height, number of secondary branches and leaf area at all the stages of crop growth than other treatment combinations. Chilli + garlic system supplied with 75 kg N through organics and 75 kg ha^{-1} K_2O was next in the order.

- Similar to growth components, TDMP (2.80, 11.0, 43.9 and 83.0 g at 30, 60 and 90 DAT and at final picking, respectively), number of fruits hill^{-1} (34.4), fruit length (10.90 cm), 100-fruit weight (119.6 g), 1000-seed weight (7.3 g) and seed to pod ratio (36.5) were higher with chilli + garlic intercropping system. Among the graded levels of N and K, higher values of these attributes were recorded with chilli crop nutritioned with equal quantities of all the three major nutrients through inorganic sources coupled and 50 per cent N through organics (poultry manure). Chilli crop supplied with 75 per cent N through organic source + 25 per cent N through inorganic source with 50 kg each of P_2O_5 and K_2O was next in the order. Of all the treatment combinations, chilli + garlic intercropping nutritioned with equal doses of all the three major nutrients with 50 kg ha^{-1} each of N, P_2O_5 and K_2O recorded significantly higher TDMP at all the stages of crop growth (3.4, 12.8, 50.1 and 95.9 g at 30, 60 and 90 DAT and at final picking, respectively), fruits hill^{-1} (44.0), 100-fruit weight (132.3 g), fruit length (12.4 cm), 1000-seed weight (8.9 g) and seed to pod ratio (42.7). Chilli + garlic intercropping with over 75 per cent recommended N through organic substitution coupled with 25 kg ha^{-1} extra K_2O (75 kg ha^{-1}) was next in the order and both the treatments were often on par with each other. Chilli + garlic cropping system with equal doses (50 kg ha^{-1}) of all the three major nutrients through inorganics and 50% N through poultry manure was significantly superior to all the three cropping systems nutritioned with 100 per cent N through inorganics coupled with zero level of potassium or 100 kg potassium application without any inorganic N application, in general.

- Sole chilli nutritioned with equal quantities of all the three major nutrients (I_0S_3) recorded significantly higher N uptake values (20.87 kg ha^{-1}), while it was on par with rest of the treatment combinations except I_0S_1, I_1S_1, I_1S_2, I_2S_1 and I_2S_2 treatment combinations. While the lower N uptake was recorded with garlic and coriander intercropped with chilli supplied with zero level of inorganic N nutrition coupled with 100 kg K_2O ha^{-1} (I_1S_1 and I_2S_1). Garlic intercropped with chilli nutritioned with higher levels of potassium (≥50 kg ha^{-1}) application recorded significantly higher potassium uptake (53.84 to 60.58 kg ha^{-1} with I_1S_1 and I_1S_2, respectively), while lowest uptake was recorded with chilli + coriander intercropping system nutritioned with zero level of potassium (I_2S_5) and sole chilli with similar fertilizer levels (25.89 kg ha^{-1}).

- Quality of chilli particularly yield of good quality fruits (786 kg ha^{-1}), SHU (22650), oleoresin per cent (13.16) and oleoresin yield (104.3 kg ha^{-1}) were the highest with chilli + garlic cropping system, while lowest per cent (11.78) of discoloured fruits was observed with the same system. Ascorbic acid content and capsaicin content were unaffected by the cropping system. Among the graded levels of N and K, ascorbic acid content (226.8 mg 100 g^{-1}), capsaicin content (0.18%), SHU (26080) and oleoresin content (14.78%) were the highest with application of 100 per cent organic source of N coupled with 100 kg K_2O ha^{-1}. While, per cent discoloured fruit was the lowest with this treatment (11.14%). The yield of good quality fruits (827 kg ha^{-1}) and oleoresin yield (106.5 kg ha^{-1}) were the highest with crop nutritioned with equal doses of all the three major nutrients through inorganic sources and 50 per cent N through organic source. While, quality parameters were poor when entire N (100 kg N) was supplemented through inorganics along with zero level of K application. Among the treatment combinations, ascorbic acid content (272.7 mg 100 g^{-1}), SHU (28500), capsaicin content (0.19%) and oleoresin content (14.88%) were significantly higher with chilli + garlic cropping system nutritioned with 100 per cent organic source of N along with 100 kg ha^{-1} K_2O. While, the per cent discoloured fruit was lowest with the above said treatment combination (10.06%). Yield of good quality fruits (993 kg ha^{-1}) and oleoresin yield (130.4 kg ha^{-1}) were the highest with chilli + garlic cropping system supplied with equal doses of all the three major nutrients through inorganic sources and 50 kg ha^{-1} N supplemented through organics. While, lower quality parameters were recorded when sole chilli was nutritioned with 100 per cent N through inorganics along with zero level of K application.

- As far leaf curl index was concerned, chilli + garlic intercropping recorded the lowest index value. While, sole chili and chilli + coriander recorded the higher indices at all the stages of observation (0.78, 0.79 and 0.52 with sole chilli and 0.72, 0.69 and 0.48 with chilli + coriander at 60 and 90 DAT and at final picking, respectively). Among the graded levels of N and K, crop nutritioned with 100 per cent N through organics coupled with 100 kg ha^{-1} K_2O recorded significantly lower LCI at all the stages of observation (0.51, 0.45 and 0.33 at 60 and 90 DAT and at final picking, respectively). While, highest indices were recorded with crop supplied with 100 per cent N through inorganics without K application (1.04, 0.92 and 0.63 at 60 and 90 DAT and at final picking, respectively). Among treatment combinations, chilli + garlic intercrop system nutritioned with 100 per cent organic source of N application with 100 kg ha^{-1} K_2O recorded significantly lower index of leaf curl at all the stages of plant growth (0.43, 0.42 and 0.27 at 60 and 90 DAT and at final picking, respectively). While, the highest LCI was observed with sole chilli nutritioned with 100 per cent inorganic source of N without potassium application (1.17, 1.08 and 0.68 at 60 and 90 DAT and at final picking, respectively).

- Thrips and mites population followed the same trend of leaf curl indices. The lower thrips and mites population were observed with chilli + garlic cropping system. Among the graded levels of N and K, crop supplied with 100 per cent N through organics with 100 kg ha^{-1} K_2O recorded significantly lower thrips and mites population at all the stages of observation (0.44, 0.60, 0.27 and 0.16 thrips $leaf^{-1}$ at 30, 60 and 90 DAT and at final picking, respectively and 0.38, 0.53 and 0.51 mites $leaf^{-1}$ at 60 and 90 DAT and at final picking, respectively). While, it was on par with 25 kg ha^{-1} N through inorganic source with 25 kg extra K_2O ha^{-1} (N_{25}:P_{25}:K_{25}). Among the treatment combinations, chilli + garlic intercropping system nutritioned with 100 per cent organic source of N with 100 kg ha^{-1} K_2O recorded significantly lower thrips and mites population at all the stages of observation. Sole chilli with 100 per cent inorganic source of N but with zero level of K recorded further significantly higher population of sucking pests, among all.

- Variation in predator population followed rather different trend. Sole chilli and chilli + coriander recorded the highest predator population of coccinellids and spiders. While, garlic intercrop recorded the lowest predator population. Among graded levels of N and K, chilli crop nutritioned with 100 kg N through inorganics and zero level of potassium application recorded the highest spider population. Among interactions, sole chilli and chilli + coriander nutirtioned with higher level of inorganic source of N and lower level of K recorded higher population of predators. Coriander recorded higher coccinelloids populations, while no significant variation was visible in the spider and chrysoperla population among the intercrops. Significantly lower predator population within the intercrop was recorded with chilli + garlic with 100 per cent N through organics along with

100 kg ha^{-1} K_2O. While, higher predator population was recorded with 100 per cent inorganic N with zero level of K application to chilli crop. Among the treatment combinations, chilli + coriander system supplied with higher doses of inorganic N coupled with lower levels of K recorded higher predator population.

- Gross return, net return and B: C ratio were the highest with chilli + garlic cropping system. Among N substitution and graded levels of N and K, crop nutritioned with equal quantities of all the three major nutrients with 50 kg ha^{-1} N through organics recorded significantly higher gross return (Rs. 63000/- ha^{-1}), net return (Rs. 42550/- ha^{-1}) and B: C ratio (3.08). Among the treatment combinations, chilli + garlic nutritioned with equal quantities of all the three major nutrients with 50 kg ha^{-1} N through organics recorded significantly higher gross return (Rs. 76230/- ha^{-1}), net return (Rs. 55660/- ha^{-1}) and B: C ratio (3.71). While, lower economic indicators were recorded with sole chilli crop nutritioned with 100 per cent inorganic source of N but without K application.

- In the experiment on evaluation of effect of integrated N supply and use of biorationals in the management of leaf curl complex (*murda*) in chilli, all the growth parameters namely plant height, number of secondary branches per plant and leaf area per hill at all the stages of observation were significantly higher with chilli crop nutritioned with 50 per cent N substitution through organics. Among the biorationals, alternate spray of Abamectin and Perfect recorded significantly higher values of these attributes.

- Similar to growth components, TDMP at all the stages of crop growth (5.0, 12.8, 28.2 and 48.6 g at 30, 60 and 90 DAT at final picking, respectively), number of fruits per hill (32.5), fruit length (10.3 cm), 100-fruit weight (102.6 g), 1000-seed weight (7.03 g) and seed to pod ratio (38.4) were higher with crop nutritioned with 50 per cent N equally through organic and inorganic sources. Among biorationals, Abamectin alternated with Perfect recorded significantly higher values of these attributes. Nimbecidine sprays alternated with GCK, leaf extract and leaf extract + panchagavya, panchagavya and RPP were next in the order. While, control plot having no spray treatment recorded lower values of these parameters. Among treatment combinations, alternate spray of Abamectin and Perfect coupled with integrated source of N supply recorded significantly higher TDMP at all the stages of observation (5.9, 16.1, 35.4 and 59.4 g at 30, 60 and 90 DAT and at final picking, respectively), number of fruits per hill (45.7), 100-fruit weight (118.0 g), fruit length (11.2 cm), 1000-seed weight (8.87 g) and seed to pod ratio (44.7). Alternate spray of Abamectin and Perfect with inorganic source of N application was next in the order. Chilli crop supplied with equal doses of all the major nutrients with 50 per cent N through organics coupled with Nimbecidine alternated with GCK, panchagavya, leaf extract or leaf extract + panchagavya and RPP were on par with each other.

- Yield of good quality fruits (715 kg ha^{-1}) and quality parameters viz., ascorbic acid content (178.9 mg g^{-1}), capsaicin content (0.15%), SHU (22250), oleoresin content (15.56%) and oleoresin yield (113.9 kg ha^{-1}) were the highest with integrated sources of N nutrition through organic and inorganic sources. While, per cent discoloured fruit (10.27) was the lowest with the above mentioned treatment. Among biorationals alternate spray of Abamectin and Perfect recorded significantly higher yield of good quality fruits (962 kg ha^{-1}) and oleoresin yield (159.78 kg ha^{-1}). While, Nimbecidine alternated with leaf extract + panchagavya recorded significantly higher values of ascorbic acid content (216.4 mg 100 g^{-1}), capsaicin content (0.22%), SHU (32250) and oleoresin per cent (17.48), and significantly lower per cent of discoloured fruits (8.61). While, only inorganic source of N supplied treatment with no sprays recorded lower values of these quality parameters. Abamectin alternated with Perfect coupled with integrated source of N application through organic and inorganic sources was next in the order. While, lower values of these parameters were recorded with the treatment combination having only inorganic source of N application without any sprays. Among the treatment combinations, alternate sprays of Abamectin and Perfect coupled with integrated source of N supply recorded significantly higher yield of good quality fruits (1039 kg ha^{-1}) and oleoresin yield (176.6 kg ha^{-1}). While, nimbicidine alternated with leaf extract + panchagavya applied with integrated sources of N through organic and inorganic sources recorded significantly higher values of ascorbic acid content (232.4 mg 100 g^{-1}), capsaicin content (0.23%), SHU (34500) and oleoresin per cent (17.87%) and significantly lower per cent of discoloured fruits (7.82%). While, only inorganic source of N application with no spray recorded lower values of these quality attributes except percent discoloured fruits.

- As far leaf curl, and thrips and mite population were concerned, integrated N supply recorded lowest values of these parameters. Among biorationals, alternate spray of Abamectin and Perfect recorded significantly lower values of leaf curl index, thrips and mites population during all the stages of observation before and after a week of spray. While, control plot having no sprays recorded higher values of these entomological parameters. Among treatment combinations, N supply through integration of organic and inorganic sources coupled with alternate spray of Abamectin and Perfect recorded significantly lower LCI, thrips and mites population at all the stages of observation. Inorganic source of N supply with alternate spray of Abamectin and Perfect were next in the order. While, inorganic N supplied plot, without any sprays recorded higher values of these parameters. Integrated N supply through organics and inorganic sources coupled with nimbicidine spray alternated with GCK, leaf extract, leaf extract + panchagavya or panchagavya and RPP were on par with one another.
- Variation in predator population followed rather different trend. Only inorganic source of N application recorded highest level of spider and coccinelloid population. Among the biorational sprays, no spray (control) treatment recorded the highest population of predators. While, RPP recorded the lowest predator population at all the stages of observation. Among treatment combinations, inorganic N supplied crop without any sprays recorded the highest predator population at all the stages of observation. While, integrated source of N supply through organics and inorganic sources coupled with RPP spray recorded the lowest predator population.
- Gross return (Rs. 39730 ha^{-1}), net return (Rs. 20900 ha^{-1}) and B: C ratio (2.31) were higher with integrated sources of N supply equally through organics and inorganic sources. Among biorationals, alternated spray of Abamectin and Perfect recorded the highest values of these economic indicators. While, nimbecidine alternated with GCK, panchagavya, leaf extract or leaf extract + panchagavya and RPP were next in the order. The lowest values of these economic parameters were observed in the control treatment having no sprays. Among the treatment combinations, integrated N supply equally through organics and inorganic resources coupled with alternate spray of Abamectin and Perfect recorded higher values of gross return (Rs. 56530 ha^{-1}), net return (Rs. 34130 ha^{-1}) and B: C ratio (2.75). Crop nutritioned with inorganic sources of N coupled with above mentioned spray schedule was next in the order. Integrated source of N supply coupled with Nimbicidine alternated with GCK, panchagavya, leaf extract or leaf extract + panchagavya and RPP were on par with one another.

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APPENDIX I

Prices of inputs and outputs

Sl. No.	Particulars	Price (Rs.)
I	Inputs	
1	Seeds	
a)	Chilli (*Byadagi* dabbi)	400/kg
b)	Coriander (Local)	40/kg
c)	Garlic (Local)	50/kg
d)	Maize (DMH-2 and SA-Tall)	25/kg
e)	Sorghum (DSV-6 and SSV-74)	15/kg
2	Manures and Fertilizers	
a)	Urea	4.8/kg
b)	DAP (Diammonium phosphate)	9.7/kg
c)	Murate of potash (MOP)	3.7/kg
d)	CAN (Calcium ammonium nitrate)	9.6/kg
e)	Poultry manure	500/t
f)	Neem cake	600/q
g)	FYM	300/t
3	Microbial consortium	480/ha
4	Biopesticides and Chemicals	
	Nimbecidine	185/l
	Vertimac (Abamectin)	1800/l
	Action 100	208/l
	Perfect	280/100 ml
	Panchagavya preparation	400/spray/ha
	Leaf extract preparation	200/spray/ha
	GCK preparation	100/spray/ha
	Dicofol	240/l
	Carbaryl (Sevin)	360/kg
	Dimethate (Rogar)	220/l
	Belatan for powdery mildew	700/l
5	Labour wages	
a)	Men	60/day
b)	Women	50/day
c)	Bullock pair with men	300/day
6	Tractor rates	
a)	Field operations	280/h
b)	Transportation	270/h
II	Outputs	
a)	Chilli	5500/q
b)	Garlic	4000/q
c)	Coriander	4500/q
d)	Maize	650/q
e)	Sorghum	800/q

AGRONOMIC INVESTIGATIONS FOR YIELD MAXIMIZATION IN CHILLI THROUGH MANAGEMENT OF LEAF CURL (*MURDA*) COMPLEX

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ABSTRACT

Field experiments were conducted at Agricultural Research Station, Devihosur, Haveri, during the growing seasons of 2005 and 2006 to study the effect of barrier cropping (3, 6 and 9 rows of barrier with fodder/grain sorghum/maize), crop nutrition in chilli based intercropping system (chilli+ garlic, chilli + coriander and sole chilli with N substitution and graded level of K) and use of biorationals in quality chilli production and management of leaf curl (*murda*) complex.

The experiments on barrier cropping revealed significantly higher dry pod yield of chilli with nine rows of sorghum (both fodder and grain) barrier (1311 and 1222 kg ha^{-1}, respectively). The yields with six rows of grain/fodder sorghum were on par. The growth and yield attributes, quality, oleoresin yield and economic returns were also improved under barrier cropping compared to no barrier. Besides, lower leaf curl index (LCI) as a consequence of lower thrips and mites population and increased predator population was observed in the chilli crop under fodder and grain sorghum barriers compared to chilli crop without barrier. Impacts were more conspicuous on the lee ward side of the barrier than on the wind ward side.

Similarly, polycropping involving garlic as intercrop and 50 per cent substitution of recommended nitrogen through poultry manure increased good quality fruit yield with concomitant reduction in thrips and mites population and LCI in comparison to sole chilli with conventional fertilization. Though entire substitution of nitrogen through poultry manure and application of double the recommended potassium (100 kg ha^{-1}) had grater suppressing effect on insect pests and leaf curl complex, the economic returns were significantly higher with the former treatment combination.

The experiment on the use of biorationals with N substitution revealed that 50 per cent N substitution equally through vermicompost (2.5 t ha^{-1}) and neem cake (500 kg ha^{-1}) along with pest control through alternate sprays of Abamectin (3 times) and Perfect (2 times) biorationals, recorded significantly higher dry fruit yield of chilli (1131 kg ha^{-1}) over conventional chemical fertilizer and plant protection measures (693 kg ha^{-1}). Similar trends were observed in economics (Rs.56,530, 34,130 and 2.75 of gross return, net return and B: C ratio, respectively) and predator population of coccinelloids and spiders. Whereas reverse trend was visible in thrips and mites population and LCI. Nevertheless, Nimbicidine alternated with leaf extract, *Panchagavya* and leaf extract + *Panchagavya* irrespective of source of nutrition resulted in comparable effects as that of recommended chemical schedule (two sprays of Dimethoate (1.7 ml l^{-1}) + 2 sprays of dicofal (2.5 ml l^{-1}) + Carbaryl (4g l^{-1}). Thus, the study brought out the technologies for yield maximization in Byadgi chilli cultivar with least chemical spray.