Evaluation of TNAU-Made Soft Soaps against Sucking Pests of Certain Crops

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Thesis submitted in part fulfillment of the requirements

for the Degree of Master of Science (Agriculture) in Agricultural Entomology

to the Tamil Nadu Agricultural University, Coimbatore.

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CERTIFICATE

This is to certify that the thesis entitled **'Evaluation of TNAU-Made Soft Soaps against Sucking Pests of Certain Crops'** submitted in part fulfilment of the requirements for the degree of Master of Science (Agriculture) in Agricultural Entomology to the Tamil Nadu Agricultural University, Coimbatore is a record of *bona fide* research work carried out by **Mr. K. Rajkumar** under my supervision and guidance and that no part of this thesis has been submitted for the award of any other degree, diploma, fellowship or similar titles or prizes and that the work has not been published in part or full in any scientific or popular journal and magazine.

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ABSTRACT

Title : Evaluation of TNAU-Made Soft Soaps against Sucking Pests of Certain Crops

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Potassium salts of fatty acids, called soft soaps, possess selective insecticidal properties. Eight soft soaps developed by the Department of Plant Protection, Agricultural College and Research Institute, Killikulam were evaluated at laboratory, screenhouse and field conditions during 2008 – 2009 against selected insects/mites that include: mealybugs, *Phenacoccus solenopsis* Tinsley on bhendi, brinjal and cotton; whiteflies, *Bemisia tabaci* (Gennadius) on bhendi and brinjal; *Trialeurodes ricini* Misra on castor; aphids, *Aphis gossypii* Glover and *Myzus persicae* (Sulzer) on bhendi, cotton and chillies; psyllids, *Heteropsylla cubana* Crawford on

subabul; hoppers, *Nilaparvata lugens* (Stal.), *Nephotettix nigropictus* (Stat.) and *N. virescens* (Distant) in rice nursery; *Amrasca devastans* Ishida on bhendi and brinjal; *Idioscopus clypealis* (Lethierry), *I. niveosparsus* (Lethierry) and *Amritodus atkinsoni* (Lethierry) on mango; thrips, *Scirtothrips dorsalis* Hood on chillies and mites, *Tetranychus cinnabarinus* (Boisd.) on bhendi and brinjal and *Polyphagotarsonemus latus* Banks on chillies. The soft soaps were sprayed at weekly interval at 2.0 per cent concentration in comparison with fish oil soap at 2.5 per cent, imidacloprid 17.8 SL at 50 g ai/ha, spinosad 45 SC at 90 g ai/ha, triazophos 40 EC at 400 g ai/ha, malathion 50 EC at 500 g ai/ha, avermectin 1.9 EC at 5 g ai/ha, profenofos 50 EC at 500 g ai/ha, carbaryl 50 WDP at 1.5 kg ai/ha, sulphur 80 WP at 200 g ai/ha and acephate 75 SP at 750 g ai/ha in different experiments. Observations were made on the target pests by following the standard methods to assess their population density or damage. The results indicated that soft soaps exhibited significant levels of effectiveness against the above pests on different crops. At laboratory conditions, the efficacy of soft soaps ranged from 71.8 – 81.9 per cent mortality to *T. ricini* eggs and 77.6 – 82.7 per cent mortality to fourth instar nymphs of *T. ricini* as against 90.0 per cent mortality by imidacloprid and triazophos. They were also toxic to *T. ricini* adults at screenhouse conditions, causing more than 83.0 per cent mortality over a period of 10 days, which was comparable to mortalities caused by imidacloprid and triazophos. Soft soap: 4 was significantly more toxic to *B. tabaci* at both screenhouse and field conditions on brinjal and bhendi with reduction in population as high as 84.6 per cent on bhendi, relative to that in control. Occurrence of *B. tabaci*-vectored BYVMD on bhendi was significantly less after spraying soft soap: 4. Toxicity of soft soaps to *A. gossypii* and *M. persicae* on chillies, bhendi, cotton and brinjal was moderate to high (37.1-77.8 %), which was on a par with fish oil soap and inferior to imidacloprid. Soft soaps suppressed populations of *H. cubana* nymphs and adults significantly (62.0-85.8 %), although inferior to imidacloprid, triazophos and

malathion. Cotton mealybug *P. solenopsis* was as much significantly susceptible to soft soaps: 4, 5 & 7 as to fish oil soap and imidacloprid (58.3-77.2 %). At screenhouse conditions the efficacy of soft soap: 3 was on a par with that of imidacloprid while at field conditions, soft soap: 5 was inferior to both imidacloprid and spinosad against *S. dorsalis* on chilli (32.1-40.0 %). Soft soaps reduced mangohopper populations up to 46.8 per cent, as against 87.2–93.6 per cent by imidacloprid and carbaryl. They decreased the numbers of mixed species of leaf and planthoppers on rice seedlings in the nursery by only 38.9 per cent as against 66.7 per cent by imidacloprid. Soft soaps reduced *A. devastans* numbers on bhendi by only 21.3 per cent as against 70.5 per cent by imidacloprid, while soaps had no significant effect on *A. devastans* on brinjal. Soft soaps, especially soft soap: 1 reduced the red spider mite, *T. cinnabarinus* population density on brinjal and bhendi at screenhouse conditions by over 60.0 per cent as against 70.8-84.5 per cent by avermectin. Soft soaps: 1 & 4 caused *P. latus* numbers fewer by 28.1-69.3 per cent as against 56.3-92.8 per cent by avermectin at both screenhouse and field conditions. Typical mite-damaged plants were significantly more abundant after imidacloprid sprays, whereas soft soaps did not result in such injury to chilli under field conditions. The results also indicated that soft soaps were 50 per cent less toxic to mixed species of ladybird beetles (coccinellidae) on chillies and mirid bugs, *Cyrtorhinus lividipennis* Reuter (Miridae) in rice nursery. TNAU-made soft soaps did not cause any phytotoxicity to bhendi, chillies, cotton, rice and mango even at 2.0 per cent concentration. Phytotoxic symptoms such as marginal scorching and leaflets shedding were noticed on castor and subabul at 2.0 % dose.

1. INTRODUCTION

Potassium salts of fatty acids derived from the oils of plant or animal orgin, home-made soft soaps can be used as insecticides, herbicides, fungicides and algaecides as no food tolerance is required for this active ingredient by the United States Environmental Protection Agency (EPA) (Anon., 1992), while the Food and Drug Administration (FDA) classifies them as GRAS (Generally Recognized As Safe) (Anon., 1998). Selective towards soft-bodied insects such as aphids, whiteflies, mealybugs, scale insects, psyllids, aphids and mites, soaps act by causing spiracle blockage, cellular disruption and cuticle desiccation (Puritch, 1981; Ware, 1994; Olkowski *et al.,* 1996). That is they act upon the insect cuticle and disrupt the cell membrane so that the cell contents leak out and the insect die of dehydration (Osborne and Henley, 1982). They may interfere with the water balance of eggs, preventing further development. (Tikku *et al.*, 1981). They leave no residue on treated plants and in soil (Moore *et al.,* 1979). Their half life is less than a day while microbes in the soil rapidly break down this active ingredient (Anon., 1992).

Vegetable oils are well known as control agents against stored product pests, mites, scales, aphids and whiteflies and formulations derived from such oils have remarkable scope in agricultural pest management (Fenigstein *et al.,* 2001). Castor oil is one of the plant derived oils with proven utility in agriculture against scale insects (Xu and Xu, 2000), mealybugs (Lakra *et al.,* 1979; Chandra *et al.,* 1991), aphids (EI-Hamady, 1998), termites and cockroaches (Sharma *et al.,* 1990), and pest of stored products (Mahgoub and Ahmed, 1996; Ran-Pal *et al.,* 1988; Sharvale and Borikar, 1998). Sometimes it has proven even superior to neem oil (Reddy *et al.,* 1994). Soybean oil (Pacheco *et al.,* 1995) and citrus oils (Giga and Munetsi, 1990) have ovicidal action against *Callasobruchus* spp. as they penetrate the wax layer under the chorion and interfere

with the water balance of eggs (Tikku *et al.,* 1981). They can also block the tracheae of insects (De-Luca and De-Luca, 1979). For adult insects, castor oil may act as an oviposition deterrent as well (Khaire *et al.,* 1992). Castor oil has proved effective in suppressing virus transmission by vectors, especially aphids such as leaf crinkle virus in urd bean transmitted by *Aphis craccivora* Koch (Bharadwaj and Dubey, 1988) and chilli mosaic virus by *A. gossypii* in chilli (Khatri and Sekhon, 1973).

Fish oil soap is a well known soft soap of animal orgin effective against whiteflies *Bemisia tabaci* (Gennadius), aphids, *Aphis gossypii* Glover and thrips such as *Thrips tabaci* Lind. and *Scirtothrips dorsalis* Hood (Patil *et al.,* 1991; Surulivelu, 1991; Natarajan *et al.,* 1991). Katole *et al.* (1993) reported that fish oil rosin soap was effective against citrus leaf miner as compared to castor oil was not. This indicates that home-made soaps from castor oil may be more effective than its oil.

The objective of this study was to evaluate the spectrum of action of a few newer TNAU–made soft soaps developed by the Department of Plant Protection, AC & RI, Killikulam against the sucking pests as listed below.

Category	Family/Order	Test Insects/Mites
Mealybugs	Coccidae	*Phenacoccus solenopsis* Tinsley on brinjal, bhendi, cotton
Whiteflies	Aleyrodidae	*Bemisia tabaci* (Gennadius) on bhendi, brinjal *Trialeurodes ricini* Misra on castor
Aphids	Aphididae	*Aphis gossypii* Glover and *Myzus pessicae* (Sulzer) on bhendi, cotton and chillies
Psyllids	Psyllidae	*Heteropsylla cubana* Crawford on subabul
Hoppers	Cicadellidae	*Amrasca devastans* Ishida on bhendi and brinjal; *Nephotettix nigropictus* (stat.), N. virescens (Distant) on rice
	Delphacidae	*Nilaparvatha lugens* (Stal.) on rice; *Idioscopus clypealis* (Lethierry), *I. niveosparsus* (Lethierry), *Amritodus atkinsoni* (Lethierry) on mango
Thrips	Thysanoptera	*Scirtothrips dorsalis* Hood on chillies
Mites	Acari	*Tetranychus cinnabarinus* (Boisd.) on bhendi, brinjal *Polyphagotarsonemus latus* Banks on chillies

2. LITERATURE REVIEW

For centuries, soft soaps, *i.e.* potassium salts of fatty acids, have been reported to show insecticidal properties. However, the discovery of pesticides, especially DDT, slowed down the research on the insecticidal properties of soaps. The interest on this research has been revived since 1970s as it is one of the biorational methods of pest management (Edelson *et al.*, 2002).

2.1. Homoptera

Soaps are especially toxic to soft-bodied insects. Insecticidal soaps offer promise to pest control because of their low mammalian toxicity and activity against soft scale insects (Singh and Rao 1979), leafhoppers (Van Epenhuijsen *et al.,* 1992). Fournier and Brodeur (2000) observed in the laboratory that three lettuce infesting aphids species *Macrosiphum euphorbiae* (Thomas), *M. persicae* and *Nasonovia ribisnigri* (Musley) were susceptible to an insecticidal soap (Safer) as good as azadirachtin (Bioneem) and an entomopathogenic hyphomycete *Verticillium lecanii* (Viegas) (Strain vertilac). Edelson *et al.* (2002) reported that insecticidal soaps were as toxic to aphids *M. persicae* as pyrethrins, neem extract and capsicin extract. An essential oil extract from *Chenapodium ambrosioides* at 0.5 % was found to be significantly more effective than an insecticidal soap and neem oil in laboratory bioassay against *M. persicae,* however, it was as effective as the insecticidal soap against greenhouse whitefly *Trialeurodes vaporariorum* (Westwood) by Chiasson *et al.* (2004b). Fish oil rosin soap was effective against aphid, *Aphis gossypii* (Natarajan *et al.*, 1991). A detergent (Masrol 410) was moderately toxic to *A. craccivora* (Saad *et al.*, 2007).

An insecticidal soap, mineral oil kaolin and imidacloprid were promising against *M. persicae* in peach orchards (Karagounis *et al.*, 2006). Examining with electron feeding monitor

the feeding behaviour of *M. persicae* on lettuce, *Lactuca sativa* L. Reuter *et al.* (1993) found that the number of probing events recorded per hour was significantly higher on plants treated with the behaviour modifying compounds such as an insescticidial soap, azadirachtin and an acrylic copolymer than on control plants. Kourdoumbalos *et al.* (2006) found that an insecticidal soap reduced the aphid, *M. persicae* population by 19.1 per cent while imidacloprid reduced the aphid population by 53.1 per cent, kaolin by 26.8 per cent, light mineral oil by 6.7 per cent, compared to control. Parry *et al.* (1989) stated that the organophosphorous insecticides dimethoate, fenitrothion and malathion were more toxic than soaps to sycamore aphid *Drepanosiphum platanoidis* (Schr.). They also found that the viviparae aphids were most susceptible to insecticidal soaps followed by males, while oviparae were least susceptible. Fish oil rosin soap reduced the *B. tabaci* population significantly on cotton (Rao *et al.*, 1990a; Patil *et al.*, 1993 and Prabhu *et al.*, 1993). Fish oil rosin soap at 25 g/lit reduced both immature and adult *B. tabaci,* leafhoppers and aphids on cotton, being even superior to monocrotophos 36 WSC at 1.5 ml/lit (Patil *et al.,* 1991). However, Surulivelu, (1991) reported that the populations of *B. tabaci* increased in niches exposed to fish oil rosin soap and neem oil. David *et al.* (2000) recommended fish oil rosin soap at 40 ml/lit to control the spiralling whitefly *Aleurodicus dispersus* Russell. Fish oil rosin soap was effective against whitefly, *B. tabaci* (Natarajan *et al.*, 1991).

In greenhouse a 2.0 % insecticidal soap solution was inferior to 1.0 % limonene against mealybugs, whiteflies and scales (Hollingsworth, 2005). Gould and McGuire (2000) reported that coatings of insecticidal soap 3.0 % gave 94.0 per cent kill of mealybugs *Planococcus citri* Risso and *Pseudococcus odermatti* Miller & Williams as a post-harvest dip before shipment of the Persian limes, *Citrus latifolia* Tanaka. Hastings *et al.,* (1986) observed that 0.52 % insecticidal soap did not have any effect on the non-egg stages of balsam woolly adelgid, *Adelges piceae*

(Ratzeburg). Jalaluddin and Mohanasundaram (1989) reported that fish oil rosin soap was effective against coconut scale, *Aspidiotus destructor* Sign. due to asphyxiation action.

Liu and Stansly (1995 a) conducted bioassay to test the toxicity of insecticide leaf residue to adults and contact toxicity to egg and nymphs of the silverleaf whitefly, *Bemisia argentifolii* Bellows & Perring (=*B. tabaci* (Gennadius) biotype B). They found that dried residues of insecticidal soap, were not effective on adults, eggs and older nymphs but was effective on young nymphs. Liu and Stansly (1995 b), studying the ovipositional preference based on leaf age, height, surface orientation and the presence of insecticidal residues for *Bemisia argentifolii* Bellows & Perring, found fewest eggs on young leaves treated with an insecticidal soap, mineral oil and sucrose and glucose esters in choice and no-choice test. Larew and Locke (1990) reported reduction in the spread of aphid-vectored virus as a result of mortality to the aphid vectors from insecticidal soap. A detergent soap (Masrol 410) had no effect on *B. tabaci* (Saad *et al.*, 2007).

An insecticidal soap provided only a slight reduction in whitefly, *Trialeurodes vaporariorum* (Westwood) population (Sclar, 1999). Kraiss and Cullen (2008) found that although pyrethrins and mineral oil caused 100 per cent mortality to *Aphis glycines* Matsumara nymphs and adults at 72 hour post treatment, an insecticidal soap caused equivalent mortality to only the nymphs during the same time period. However, *A. glycines* adult mortality due to the insecticidal soap (83.3 %) was significantly greater than the control. An insecticidal soap did not prevent armoured scale insects *Hemiberlesia rapax, Aspidiotus nerii* infesting fruits in kiwi tree (Tomkins, 1996). A systemic approach consisting of insecticides application before harvest and use of insecticidal dip (a combination of fluvalinate and insecticidal soap) after harvest eliminated all insect pest of red ginger flower *Alpinia purpurata* (Vieil) K. Schum, namely, banana

aphids, *Pentalonia nigronervosa* Coquerer, mealybugs, *P. citri*, *Pseudococcus affinis* (Marshell), *Pseudococcus longispinus (Targioni–Tozzetti*), cotton aphids, *A. gossypii* and cardamom thrips, *Sciothrips cardamomi* (Ramaki) (Hata *et al.*, 1992; Hara *et al.*, 1996).

2.2. Thysanoptera

Insecticidal soap did not prevent thrips *Thrips obscuratus, Heliothrips haemorrhoidalis* from damaging kiwi tree leaves (Tomkins, 1996). Possibly due to low residual toxicity (Moore *et al.*, 1979). Fish oil rosin soap was effective against thrips, *Thrips tabaci* and *Scritothrips dorsalis* (Natarajan *et al.*, 1991). Post harvest dip with mixture of an insecticidal soap and fluvalinate eliminated *S. cardamomi* from red ginger flowers (Hata *et al.*, 1992 and Hara *et al.*, 1996).

2.3. Acari

Multiple application of soaps was advocated to maintain spider mite population at low levels (Hamlen *et al.,* 1981; Osborne, 1982). In a laboratory bio-assay Chiasson *et al.,* (2004a) found that European red mite, *Panocychus ulmi* (Koch) egg hatch was significantly lower after treatment with 0.006 % (ai) of abamectin, 0.7 % of neem oil, and 1.0 % of an insecticidal soap than an essential oil extract from *C. ambrosioides.* An egg slide dip study indicated that an insecticidal soap application at 12.5 ml/lit resulted in a significant reduction in *Tetranychus urticae* Koch egg hatch in greenhouse (Osborne and Petitt, 1985). Lawson and Weires (1991) tested the ovicidal efficacy of an insecticidal soap against overwintering *P. ulmi* eggs and found that application of the soap caused low mortality of overwintering eggs in laboratory study. However, summer application had significant ability to suppress populations of *P. ulmi,* and aphids, *Dysaphis plantaginea* (Passerini), *Aphis pomi* DeGeer and *Aphis spiraecola* throughout the growing seasons. Osborne (1984) also observed that residues of soap on treated

plants reduced the number of mites. Saad *et al.* (2007) reported on the moderate level of toxicity of a detergent (Masrol 410) to *T. urticae* on garden beans.

2.4. Natural Enemies

Osborne and Petitt (1985) reported that an insecticidal soap application at 12.5 ml/l did not reduce egg hatch in predatory mite *Phytoseiulus persimilis* Athias-Henriot in greenhouse standard slide dip method. An insecticidal soap 1.0 to 2.0 % was less harmful to the Western flower thrips predatory mite, *Neoseiulus* (=Amblyseius) *cucumeris* even less toxic than horticultural oils, while sprays at 4.0 % was very toxic (90.0 % mortality after 48 hours) (Oetting and Latimer, 1995). Dimethoate, abamectin and an insecticidal soap were toxic to *Amblyseius fallacis* (Garman), *P. persimilis* (Phytoseiidae) and nymphs of *Orius insidiosus* (Say) (Anthocoridae) (Bostanian *et al.,* 2005). An insecticidal soap was toxic by contact to *O. insidiosus* and *Aphidius colemani* Viereck (Braconidae) (Bostanian and Akalach *et al.,* 2006). However, the insecticidal soap had no effect on the emergence of *A. colemani* from tested aphid mummies. Smith and Krischik (2000) reported that an insecticidal soap (M-Pede) significantly reduced the survival of *Coleomegilla maculata* (DeGeer) and *Hippodamia convergens* (Guérin–Ménéville), *Harmonia axyridis* Pallas, *Cryptolaemus montrouzieri* Mulsant, causing less mortality than carbaryl.

Fish oil rosin soap was less harmful to parasitoids (Natarajan *et al.*, 1991). Brunner *et al.* (2001) reported that a soap was not toxi to *Colpoclypeus florus* (Eulophidae) but had direct impact on *Trichogramma platneri* (Trichogrammatidae) as topical application through physical immobilization, while imidacloprid, abamectin, organophosphates and carbamate insecticides were highly toxic when applied topically to both parasitoids.

Parrella *et al.* (1991) suggested a combination of parasitoid *Encarsia formosa* Gahan releases, application of an insecticidal soap and roguing infested cuttings to produce export-quality cuttings against sweet potato whitefly *B. tabaci* in commercial poinsettia (*Euphorbia pulcherima*) stock plant production. Tremblay *et al.* (2008) reported that an insecticidal soap caused 100 per cent adult mortality in *Aphidius colemani* (Braconidae) 24 hours after treatment at 17.5 g/lit. It did not have any effect on the survival of parasitoid immatures or number of eggs produced per female parasitoid that survived in third and fourth instar aphids treated with the soft soap. They also observed that the wasps that were in contact with treated aphids did not oviposit indicating that female parasitoids detected aphids treated with insecticidal soap. They suggested that soap applications might be made one day before the release of wasps in the greenhouse for a successful biological control programme.

Hough-Goldstein and Keil (1991) found that an insecticidal soap, cryolite (sodium fluoaluminate), *Bacillus thuringiensis* var. san diego, hoticultural oil and fungicides (chlorothalonil) were least toxic to the predator *Perillus bioculatus* (F.) (Pentatomidae), predaceous on Colorado potato beetle, *Leptinotarsa decemlineata* (Say), while the synergist piperonyl butoxide, the botanical insecticide rotenone and chemicals endosulfan, oxamyl and fenvalerate caused significant mortality. Schuster and Stansly (2000) reported that at field concentrations topical and residual toxicity of an insecticidal soap (1.0 %) (M-Pede), azadirachtin (0.005 %) and paraffinic oil (1.0 %) were not toxic to the larvae and adults of green lacewings *Chrysoperla rufilabris* (Burmeister) and *Ceraeochrysa cubana* (Hagen), while paraffinic oil was toxic to eggs, azadirachtin and soaps were not when applied topically. Rao *et al.* (1990c) reported that fish oil insecticide soap was least harmful to *Eretmocerus* sp*., Menochilus* sp*., Verania* sp*., Chrysopa carnea,* and Phytoseiid mites*.*

An insecticidal soap and azadirachtin had relatively little effect on whitefly parasitoid *Encarsia pergandiella* Howard but were toxic to larvae of coccinellid *Nephaspis oculatus* (Blatchley) (Liu and Stansly, 1996; Stansly and Liu 1996). Insecticidal soap proved toxic to the parasitoid *Encarsia formosa* (71.9 % mortality) (Edelson *et al.*, 2002). Karagounis *et al.* (2006), evaluating the efficacy of organic farming products such as kaolin, mineral oil and insecticidal soap in comparison with imidacloprid, found that kaolin and insecticidal soap did not reduce the number of coccinellids after application while imidacloprid and mineral oil did.

An insecticidal soap did not affect the nontarget organisms in the litter (Hastings *et al.*, 1986). Mineral oil and an insecticidal soap were moderately lethal to first (48.9 and 40% mortality, respectively) and third (31.9 and 38.8% mortality, respectively) instars of *H. axyridis*, but they had no effect on pupae and adults (Kraiss and Cullen (2008). An insecticidal soap and light mineral oil had no adverse effect on coccinellid populations, except for imidacloprid, such as *Coccinella septumpunctata* (L.), *Adalia bipunctata* (L.) and *Hippodamia variegata* (Goeze) in peach orchard (Kourdoumbalos *et al.*, 2006). In several instances parasites and predators were less susceptible to soaps than were the prey (Puritch and Brooks, 1981; Puritch *et al.,* 1982; Parry and Rose, 1983). Fatty acids insecticidal soap, corn oil soap and sunflower soap were equally toxic and were significantly less toxic than organophosphates to adult coccinellid predator *Aphidecta obliterata* L. (Musau and Parry 1988).

Phytotoxicity

Some plants are sensitive to the oils and soaps and phytotoxicity may be enhanced on plants that are under conditions of stress (Russell, 1991). With increasing volume, coverage and rates insecticidal soaps might result in greater control and phytotoxicity (Lawson and Weires, 1991). Osborne (1984) observed significant phytotoxicity in *Cissus rhombifolia* and *Hedera helix*

when soaps were applied using 12.4 g/lit but phytotoxicity was not observed on *Brassaia actinophylla*, *Chamaedarea elegans, Codiaeum variegatum, Dieffebachia maculate, Dizygotheca elegantissima* and *Dracaena marginata.* Hastings *et al.* (1986) observed that the succulent foliage of trees such as Christmas tree was sensitive to soap treatments. An insecticidal soap (Savona) used to control green spruce aphid, *Elatobium abietinum* (Walker) caused needle browning on sitka spruce, *Picea sitchensis* (Bong.) Carr. while it did not affect the needle density (Straw *et al.*, 1996).

Russell (1991) observed no phytoloxicity on plants applied with 2.0 % insecticidal soap (Safer) on 56 plant species tested. Tradan *et al.* (2006) observed that cabbage plant treated with a potassium soap to control cabbage stink bugs *Eurydema ventrale* and *E. oleracea* (Pentatomidae) had highest plant weight and head weight. Sclar (1999) reported that the insecticidal soap (M-pede) and a neem seed extract (Margosan-o) had little phytotoxicity to tomato. Cycholl (2002) observed in greenhouse that potassium salts of fatty acids and cinnamaldehyde were consistently more phytotoxic than *Beauveria bassiana* Strain GHA, pyrethrin, azadirachtin, parafinnic oil and capsicin to Spanish lavender (*Lavandula stoechas* L.), oregano (*Origanum vulgare* L.), wolly thyme (*Thymus vulgaris* L.) and nutmeg thyme (*Thymus vulgaris* L.). Phytotoxicity symptoms appeared on sitka spruce needles after application of sunflower oil soap but not after corn oil soap or insecticidal soap (Safer) (Musau and Parry, 1988).

3. MATERIALS AND METHODS

Eight castor-oil based soft soaps developed by TNAU, the Department of Plant protection, Agricultural College and Research Institute, Killikulam [Latitude: 8° 46' N; Longitude: 77° 42' E; Altitude: 40 M (MSL)] were evaluated at laboratory, screenhouse and field conditions for its efficacy against selected sucking pests. In all the experiments the spray fluid was used at the rate of 500 l/ha.

3.1. Laboratory Experiments

The laboratory and screenhouse experiments were conducted at 33.4 ± 2.32 °C; RH 85.4 ± 2.86 %; photoperiod 12:12 (L : D) h.

3.1.1. Efficacy of TNAU-made soft soaps on castor whitefly, *T. ricini*

3.1.1.1. Whitefly Egg

The effect of soft soaps on the eggs of castor whitefly, *T. ricini* was studied with castor leaf discs at laboratory conditions. A cork borer (0.5 cm dia.) was used to cut the discs of tender castor leaves laden with eggs. One leaf disc was used per replication and there were 15 discs per treatment. The treatments were soft soap: 1-5 at 2.0 %, fish oil soap 2.5%, imidacloprid 17.8 SL 50 g ai/ha, triazophos 40 EC 400 g ai/ha, water spray and control without water spray. The soft soap solutions were applied topically to run off by using a hand atomizer. Observations were made on crawler emergence at 24 h interval until all the eggs hatched out in the untreated control discs. The crawler emergence was expressed in percentage and this experiment was repeated twice.

3.1.1.2. Whitefly Nymph

Fourth instar *T. ricini* nymph were exposed to soft soap sprays as in the previous experiments. However, the leaf discs possessing the fourth instar nymphs were larger in size (1.0 cm dia.) than those used in the previous experiment. Adult emergence was recorded 6 and 8 days after treatment (DAT).

3.2. Screenhouse Experiments

3.2.1. Whitefly Recolonization

Castor plants (45-day old) in pots infested heavily by *T. ricini* were used to study the recolonization of adult whiteflies after applying one round of soft soap solutions to a level of run off with the help of a hand atomizer. There were four replicates per treatment with one plant serving as a replication. The treatments included: soft soap: 1-5 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, triazophos 40 EC 400 g ai/ha and untreated control. Whiteflies present on the second leaf from shoot tip were counted daily for 10 days after spray. Those whiteflies found in a sub-triangular area (3-4 cm^2 ca.) on the lower surface of second leaf in between any two radiating lateral veins limited by veinlets were counted using a 10 x hand lens. This experiment was also repeated twice.

As the adult whiteflies kept switching over to the unsprayed newly emerging leaves after applying the soft soap solutions on castor shoots, the population of these whiteflies on the leaves just above the treated second leaves were recorded 7 and 14 days after the first application. These data were analysed in comparison with the first day data collected from the leaf subjected to spray application.

3.2.2. Whitefly Adult Mortality

This experiment was conducted by confining *T. ricini* adults in cages clipped to 60-day old castor plants in pots. Leaf cages (2 cm dia., 1 cm high, mesh covered, (100 holes/sq. cm) were made from transparent OHP sheets. The number of whiteflies suddenly confined to each leaf cage was recorded before application. Five cages serving as replicates were kept for each treatment. The treatments were as follows: soft soap: 1-5 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, triazophos 40 EC 400 g ai/ha, water spray and control without water spray. Soft soap sprays from a hand atomizer were directed into the leaf cage. Post-treatment counts were made on the live whiteflies at 2 and 3 DAT. Adult mortality was calculated in percentage. The natural mortality in control was corrected before statistical analysis (Abbott, 1925).

3.2.3. Bio-efficacy

3.2.3.1. Brinjal

Brinjal plants (KKM 1) were raised in pots to study the effect of soft soaps on cotton aphid *Aphis gossypii* (one experiment), cotton whitefly *Bemisia tabaci* (one experiment), mealybug *Phenacoccus solenopsis* (one experiment) and red spider mite, *Tetranychus cinnabarinus* (two experiments) separately. Four rounds of spray were made with a hand atomizer on 60-day old plants at weekly interval. Four one-plant replications were maintained for each treatment. The treatment were as follows: soft soap: 1-5 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, spinosad 45 SC 90 g ai/ha, avermectin 1.9 EC 5 g ai/ha and control without water spray. Aphids present on two leaves at shoot tip were counted at 3 and 7 DAT. The same procedure was followed for *B. tabaci*. The number of *P. solenopsis* (3 and 4 instars) found on the top 2-node shoots were counted at 3 and 7 DAT. The number of *T.*

cinnabarinus mites which occurred in a sq. cm leaf area was recorded at 3 and 7 DAT. All the above experiments were repeated once for confirmatory results.

3.2.3.2. Cotton

The soaps were evaluated against *A. gossypii* and *P. solenopsis* (two experiments each) on cotton plants in screenhouse by adopting methods similar to brinjal. The treatment details were: soft soap: 1,5,6,7 & 8 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, acephate 75 SP 750 g ai/ha, profenofos 50 EC 500 g ai/ha and no-spray control. The first spray was made when the plants were 45 days old and the second spray was given one week later.

3.2.3.3. Bhendi

The same methodology was followed to evaluate the soaps against *A. gossypii* and *T. cinnabarinus* (two experiments each) on 45-day old bhendi plants raised in pots. Four sprays were made at weekly interval with the following treatments: soft soap: 1-4 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, spinosad 45 SC 90 g ai/ha, avermectin 1.9 EC 5 g ai/ha and control without water spray.

3.2.3.4. Chillies

The soaps were tested against thrips, *S. dorsalis* and aphids, *M. persicae* and the broad mite, *P. latus* (two experiments each) with the typical infested plants in pots. The treatments comprised: soft soap: 1-4 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, spinosad 45 SC 90 g ai/ha, avermectin 1.9 EC 5 g ai/ha and no-spray control. A couple of sprays were given at weekly interval starting at 55 days after planting (DAP). The number of thrips found on two apical leaves were recorded 3 and 7 days after each application. Aphid population was assessed by counting the aphids present on the terminal shoots up to two fully

emerged leaves. The density of *P. latus* was assessed by recording the nymphs present on the lower surface of one of tiny terminal leaves (0.9 cm long) with a 10 x hand lens.

3.3. Field Experiments

All the field experiments were conducted on AC & RI, Killikulam Farm under the following conditions: 34.06 ± 2.35 °C; RH 81.98 ± 2.78 %.

3.3.1. Vegetables

Field experiments were conducted at two locations per crop of bhendi (cv. Arka Anamika), brinjal (cv. KKM1) and chillies (cv. KKM 1) raised by the breeders for seed purpose. The number of rounds of spray were as follows: 3 on bhendi [starting at 55 days after sowing (DAS)], 4 each on brinjal and chillies (starting at 70 DAP). A high volume sprayer was used to spray the soft soap solutions. The plots were of 5 x 4 m size. All the experiments were laid out in a randomized blocks design with three replications. The treatment details were as follows for chillies (aphids, thrips, mites) and brinjal (leafhoppers and mealybugs): soft soap: 1-5 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, spinosad 45 SC 90 g ai/ha, avermectin 1.9 EC 5 g ai/ha and untreated control; for bhendi leafhopper and whitefly: soft soap: 1-5 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, profenofos 50 EC 500 g ai/ha, avermectin 1.9 EC 5 g ai/ha and untreated control; for bhendi mealybug: soft soap: 1,5,6,7 & 8 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, acephate 75 SP 750 g ai/ ha, profenofos 50 EC 500 g ai /ha and no-spray control. Populations of aphids (*A. gossypii* and *M. persicae*), thrips *(S. dorsalis*), mealybug (*P. solenopsis*), whitefly (*B. tabaci*) and broad mite (*P. latus*) were recorded 3 and 7 days after each application by adopting the methodology followed in screenhouse. Leafhopper, *A. devastans* population was assessed on bhendi by counting the total number of

nymphs and adults present on the lower surface of the third leaf from top. Five plants were selected at random in each plot for population assessment. The number of mixed species of coccinellids present on the foliage of a randomly selected plant was recorded 3 and 7 days after each spray only on chilli.

3.3.2. Cotton

Two experiments were conducted at two locations using a local variety. The experimental conditions were similar to that of vegetables. The treatments were: soft soap 1,5,6,7 & 8 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, acephate 75 SP 750 g ai/ ha, profenofos 50 EC 500 g ai /ha and no-spray control. Two sprays were given at weekly interval starting at 60 DAS. Observations were made on aphids and mealybugs as per screenhouse methods from five plants per replication.

3.3.3. Mango

The soft soaps were evaluated against mangohoppers (*I. niveosparsus, I. clypealis, A. atkinsoni*) in the college orchard (Kalapad). One tree served as a replication and four replications were used for a treatment in an experiment. Two experiments were conducted simultaneously at two locations. The treatment details were: soft soap: 1,3 & 5 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, carbaryl 50 WDP 1.5 kg ai/ha + sulphur 80 WP 200 g ai/ha, avermectin 1.9 EC 5 g ai/ha and untreated control. Two rounds of spray were made with a rocker sprayer targeting the inflorescence. The hoppers present on the inflorescence stalk were recorded at 3 and 7 DAT.

3.3.4. Subabul

Soft soap solutions were sprayed on psyllid, *H. cubana* infested shoots of subabul plants (1 m tall) that had sprouted from the cut stumps on the college farm *in situ* at two locations. One infested shoot was taken as a replication and there were five shoots per treatment. The treatments were: soft soap: 1-5 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, triazophos 40 EC 400 g ai/ha, malathion 50 EC 500 g ai/ha and no-spray control. Two sprays were made at weekly interval and the counts on psyllid nymphs and adults were made at 3 and 7 DAT. The numbers of adults present on the terminal shoot (7 cm long) were counted while nymphs were counted from a single leaflet (0.6 cm).

3.3.5. Rice

Two field experiments were conducted in rice nursery (ADT 39) where two rounds of spray were made at weekly interval with a hand operated sprayer. The first spray was made at 12 DAS. The treatments included: soft soap 1-5 at 2.0 %, fish oil soap 2.5 %, imidacloprid 17.8 SL 50 g ai/ha, spinosad 45 SC 90 g ai/ha, avermectin 1.9 EC 5 g ai/ha and untreated control. Number of leafhoppers (mixed species) and mirid bug, *Cyrtorhinus lividipennis* Reuter were counted 3 and 7 days after each spray from a 10 sq. cm area. Five samples were drawn from each experiment representing five replications.

3.4. Statistical Analysis

The data on insect population samples were subjected to analysis of variance after square root transformation. Data on the percentage of BYVMD and *P. latus* infested plants were analysed after arcsine transformation. In the lab and screenhouse experiments, the natural mortality in control was corrected by using Abbott's (1925) formula.

4. EXPERIMENTAL RESULTS

4.1. Laboratory Experiments

4.1.1. Influence of TNAU-made soft soaps on the mortality of *T. ricini* eggs and nymphs

4.1.1.1. *T. ricini* Egg

Soft soaps caused significant egg mortality in *T. ricini* at laboratory conditions (Table 1). However, all were inferior to the chemical standards, imidacloprid and triazophos and the chemicals caused mortality ranging from 98.5–99.6 per cent as against 71.8–81.9 per cent in soft soaps. Soft soap: 3 with 63.3 per cent mortality was on a par with water-sprayed control (55.4 %). Soft soap: 1 & 5 were on a par with fish oil soap that killed 86.4 per cent eggs as against 71.8–73.4 per cent mortality by soft soap: 2 & 4 which were inferior to fish oil soap.

4.1.1.2. *T. ricini* nymph

Compared to fourth instar mortality in water-sprayed control (33.3 %), soft soaps caused significantly greater mortality (77.6–82.7 %) in the laboratory and on a par with fish oil soap (82.9 %) (Table 2). However, all were inferior to imidacloprid and triazophos that caused 92.4–97.1 per cent nymphal mortality.

4.2. Screenhouse Experiments

4.2.1. Influence of TNAU-made soft soaps on the adult mortality and recolonization of *T. ricini*

4.2.1.1. *T. ricini* Adult Mortality

The results indicated that soft soaps were on a par with the standards in causing mortality to adult *T. ricini* trapped in leaf cages (Table 3). Except in soft soap: 1, adult mortality was significantly more in all treatments than that in water-sprayed control. However, imidacloprid and triazophos killed all whiteflies (100.0 %) as against 42.5 per cent in water-sprayed control. Soft soaps caused 83.1–92.8 per cent whiteflies mortality.

4.2.1.2. *T. ricini* Adult Recolonization

The results on the mean number of *T. ricini* adults that settled on the treated second leaf over a period of 10 days after the spray indicated that soft soaps significantly reduced the number of *T. ricini* that settled on the treated second leaf (Table 4-6). However, only Soft soap: 2 was on a par with imidacloprid and fish oil soap (0.2–0.5/leaf section). Soft soap: 5 was on a par with Soft soap: 2 (0.6/leaf section). Soft soap: 3 & 4 were on a par with triazophos (0.7–1.08/leaf section) and they were inferior to the former treatments. Soft soap: 1 was least effective (1.3/leaf section) although it recorded 5 times fewer whiteflies than that on control plants (6.8/leaf section). The results also indicated that the number of whiteflies colonizing the treated second leaf decreased significantly with days in all the treatments, including control, as the new leaves emerged above. At 1 DAT imidacloprid was the most effective, followed by soft soap: 2 & 4 as did fish oil soap. Soft soap: 5 was on a par with triazophos. Both were inferior to the above but superior to soft soap: 1 & 3. Soft soaps continued to be effective even at 10 DAT and soft soap: 1 & 3 were on a par with imidacloprid. Soft soap: 2 was on a par with fish oil soap but both were inferior to the above but superior to triazophos. Soft soap: 4 was least effective.

The overall reduction in whitefly colonization was significantly higher on plants sprayed with soft soap: 2 (82.9 %) and it was on a par with fish oil soap and imidacloprid (83.4–87.4 %) (Table 7-9). Soft soap: 3 & 5 were on a par with soft soap: 2 and imidacloprid. Soft soap: 1 and

4 were least effective (71.9–76.3 %). However, they were on a par with triazophos (70.4 %) but inferior to Soft soap: 2, fish oil soap and imidacloprid. At 1 DAT, soft soap: 2 & 4 reduced the population as much as 95.2–96.0 per cent as it was in fish oil soap and imidacloprid (96.0–98.4 %). Soft soap: 5 was on a par with triazophos (87.4–86.7 %) and both were inferior to the above treatments. Soft soap: 1 caused least reduction (69.1 %). Soft soap: 3 (83.0 %) was superior to Soft soap: 1 but inferior to all other treatments. At 10 DAT Soft soap: 1 & 3 were most effective being on a par with imidacloprid (75.0 %). Soft soap: 2 was next in effect (62.5 %) and it was on a par with fish oil soap (65.75 %). Soft soap: 4 & 5 recorded lowest reduction (43.8–50.0 %) though on a par with triazophos (37.5 %).

The data on whitefly numbers infesting the treated second leaf one day after the sprays and the newly emerging first leaf one week later, indicated that soft soaps had significant influence on whitefly population density except soft soap: 1 (Table 10.) Soft soap: 2 & 4 were most effective (5.2–6.3/leaf section), on a par with fish oil soap, imidacloprid and triazophos (3.4–4.6/leaf section). Soft soap: 3 & 5 were inferior to soft soap: 2 & 4. However their efficacy was comparable to fish oil soap. Soft soap:1 was on a par with control.

4.2.2. Bio-efficacy of TNAU-made soft soaps on sucking pests of brinjal, chilli, bhendi and cotton

4.2.2.1. *B. tabaci* on Brinjal

After four rounds spray at weekly interval on brinjal, *B. tabaci* adult density differed significantly between control and treated plants (Table 11). Soft soap: 4 & 5 were on a par with not only fish oil soap but also imidacloprid with 80.0–100.0 per cent reduction in population when compared to control. Soft soap: 1 & 2 were on a par with Soft soap: 4 & 5 and spinosad.

Soft soap: 3 was least effective and on a par with soft soap: 2, spinosad and avermectin. There was no significant difference between avermectin treated and control plants. The whitefly present on two leaves in soft soap: 4 & 5, fish oil soap and imidacloprid treated was 0.0–0.3 plants as against 1.0 per two leaves on control plants.

4.2.2.2. *S. dorsalis* on Chilli

Compared to control plants, thrips *S. dorsalis* was significantly fewer only on plants sprayed with soft soap: 3 on a par with imidacloprid and avermectin (Table 12). However, they were all inferior to spinosad. Soft soap: 1 & 2 were on a par with soft soap: 3. Only 0.2 thrips were present on the three terminal leaves of spinosad treated plants as against 2.8 on control plants, equivalent to 92.9 per cent decrease. The population ranged from 1.5 to 1.9 per three leaves in soft soap: 3, imidacloprid and avermectin with 32.1–46.4 per cent reduction. Other soaps reduced thrips by only 3.6–14.3 per cent. Contrast to other sucking pests (aphids, mites), thrips population at 3 DAT was greater than that at 7 DAT with a significant difference between counts.

4.2.2.3. Aphids on Chillies

The results indicated that aphids were significantly fewer on all the treated plants than that on control plants (Table 13). Soft soap: 1 & 5 were on a par with imidacloprid and fish oil soap. Soft soap: 2 was on a par with the above treatments, except imidacloprid. Soft soap: 3 & 4 were inferior to all other soaps. Soft soap: 2 was on a par with spinosad while soft soap: 3 was on a par with both spinosad and avermectin. Soft soap: 1 & 5 and fish oil soap reduced the aphid population by 77.8 per cent as much as by imidacloprid (81.5 %). The reduction in other treatments ranged from 22.2 to 59.3 per cent. Aphid population at 3 DAT was significantly lower than that at 7 DAT.

4.2.2.4. *A. gossypii* on Bhendi

Soft soaps exhibited significantly moderate toxicity to *A. gossypii* infesting bhendi in screenhouse, while imidacloprid was superior to all other treatments (Table 14). Soft soap: 4 was second most effective, on a par with fish oil soap. Soft soap: 1 was superior to soft soap: 3 but inferior to soft soap: 4. Spinosad was on a par with soft soap: 3 whereas avermectin was on a par with soft soap: 5 & 2. As many as 7.0 aphids infested a leaf on control plants as against 2.0–4.5 on soap treated plants and 0.9/leaf on imidacloprid treated plants. Imidacloprid reduced the aphid population by 87.1 percent whereas soft soaps caused only 38.6–68.6 per cent reduction.

4.2.2.5. *A. gossypii* on Cotton

On cotton as well, soft soap sprays resulted in a significant reduction in *A. gossypii* population relative to population on control plants (Table 15). However, soft soaps were only moderately effective as they were all inferior to imidacloprid. Soft soap: 4 was second most effective as it was on a par with fish oil soap. Soft soap: 1 was superior to Soft soap: 5. Soft soap: 2 and 3 were inferior to all other treatments. Imidacloprid reduced the aphids by 78.4 per cent as against 16.9–37.1 by Soft soap: 2 & 4. There was no significant reduction in aphid population between 3 DAT and 7 DAT in both experiments.

4.2.2.6. *A. gossypii* on Brinjal

The results on *A. gossypii* infesting brinjal in screenhouse indicated that soft soaps were moderately effective against aphids and they were all inferior to imidacloprid (Table 16). Among them soft soap: 4 was superior to all other soaps, including fish oil soap. Soft soap: 1 & 5 were on a par. Soft soap: 3 was least effective. While imidacloprid reduced the aphid population by

90.0 per cent as against 58.6 percent by Soft soap: 4. Soft soap: 1 lowered the population by 47.1 per cent as much as by fish oil soap (55.7 %). The reduction was a moderate 51.4 per cent after soft soap: 5 spray. Aphid population was more at 7 DAT than at 3 DAT indicating that the efficacy of soaps lasted for a short period against *A. gossypii*.

4.2.2.7. *P. solenopsis* on Brinjal

After four rounds of spray on brinjal, the treatments significantly reduced *P. solenopsis* population when compared to control (Table 17). Soft soap: 3 & 5 were on a par with fish oil soap, spinosad and imidacloprid. Soft soap: 1 was on a par with soft soap: 4 & 5. Avermectin was least effective. Mealybugs were 3.5 per 2-node shoot on control plants as against 0.4-0.9 on soft soap: 5 plants. Mealybug population varied from 1.0 per 2 node shoot in soft soap: 1 to 1.8 in soft soap: 2, equaling 88.5 per cent reduction by imidacloprid to 48.6 per cent by soft soap: 2. Soft soap: 3 & 5 reduced the mealybugs by 74.29–77.14 percent. Mealybug numbers increased from 1.0 per 2-node shoot at 3 DAT to 1.4 per 2-node shoot at 7 DAT. This indicates that soft soaps had effect for a shorter period.

4.2.2.8. *P. solenopsis* on Cotton

In the second round of evaluation with three more new soaps (soft soap: 6-8) against *P. solenopsis* infesting cotton in screenhouse, except soft soap: 6 which was on a par with control, all other soaps showed a modest level of toxicity to *P. sopenopsis* (Table 18) and they were inferior to imidacloprid and acephate. However, soft soap: 7, which was on a par with fish oil soap, was superior to profenofos. Soft soap: 5 was also on a par with profenofos while soft soap: 1 & 8 were inferior to it. When compared to control, imidacloprid and acephate reduced mealybug population by 91.62–96.5 per cent. The reduction was 71.9–77.2 per cent in soft soap:

7 and fish oil soap, higher than that in soft soap: 5 and profenofos (59.7–70.2 %). Mealybugs were significantly fewer at 7 DAT than at 3 DAT that is the treatments sustained their effects up to a week.

4.2.2.9. *T. cinnabarinus* on Brinjal

Soaps were found to be significantly toxic to *T. cinnabarinus* on brinjal in screenhouse (Table 19). While avermectin was significantly most effective by reducing the mite numbers by 84.5 percent, soft soap: 1 was second most effective (60.8%), closely followed by fish oil soap (54.6%). Soft soap: 2 & 5 were on a par with each other (42.3 – 47.7%), superior to soft soap: 3 but inferior to fish oil soap. Soft soap: 4 and spinosad were on a par and least effective (8.3–22.7%). Mites on imidacloprid treated plants were 21.7 percent more numerous than on control plants, showing plant, showing resurgence.

4.2.2.10. *T. cinnabarinus* on Bhendi

On bhendi too, *T. cinnabarinus* was significantly fewer following application of soft soaps (Table 20). While avermectin recorded the lowest mite population (3.3/cm^2), closely followed by fish oil soap (3.5/cm^2), fewer mites were found on Soft Soap treated plants in the following order: Soft soap: 1 (4.3/cm^2) to soft soap: 3 (10.2/cm^2). More mites were recorded on imidacloprid treated plants (12.3/cm^2) than on control plants (11.3/cm^2). Mite populations decreased immediately after the spray at 3 DAT before increasing further at 7 DAT. While the reduction in mite population varied from 62.0 per cent by soft soap: 1 to 9.7 per cent by Soft soap: 3, avermectin caused mite numbers to decline by 70.8 per cent. Consistently, imidacloprid caused the mites to increase in number, 8.9 per cent more than that in control.

4.2.2.11. *P. latus* on Chilli

The results on *P. latus* infesting the terminal leaves of chilli indicated that Soft soaps were significantly effective against *P. latus* although they were inferior to avermectin (Table 21). Soft soap: 1 was more effective than Soft soap: 4. Soft soap: 2 & 3 were on a par with fish oil soap and they were inferior to Soft soap: 1 & 4 and avermectin. The mite population in soft soap: 5 was less than that in control, on a par with spinosad, but greater than that in imidacloprid. Compared to control, soft soap: 1 decreased the mite population by 69.3 per cent, closely followed by Soft soap: 4 (64.1 %) as against highest by avermectin (92.8 %). Soft soap: 2 & 3 and fish oil soap decreased the population by 56.2–64.1 per cent as against 40.5 by soft soap: 5.

4.3. Field experiments: Bioefficacy

4.3.1. *B. tabaci* on Bhendi

Soft soaps proved significantly more effective than imidacloprid against *B. tabaci* (Table 22). Soft soap: 1, 2 & 4 were the most effective, on a par with avermectin (0.2-0.5/leaf). Soft soap: 2 & 5 were on a par with profenofos (0.5-0.8/leaf). Soft Soaps: 3 and imidacloprid being on a par with control (1.3-1.4/leaf), had no effect on *B. tabaci*. Soft soap: 1, 2 & 4 reduced the whitefly numbers by 61.5–84.6 percent as against nil by imidacloprid.

B. tabaci transmitted yellow vein clearing mosaic virus (BYVMD) infected plants were significantly fewer in soft soap: 4 sprayed plots (6.3 %) and in avermectin plots (4.8 %) (Table 23). This was closely followed by Soft soap: 3 (7.5 %) and soft soap: 1 (9.8 %) and they were superior to imidacloprid (15.6 %). However, there was no significant difference in infection among the plants in control and soft soap: 2 & 5, fish oil soap, profenofos and plots (16.1-17.7%). While Soft soap: 4 decreased the viral infection by 64.4 percent, the diseased plants

were 3.2 percent more abundant in imidaclorpid plots and 4.5–8.5 per cent more in soft soap: 4 & 5 plots than in control plots.

4.3.2. *A. devastans* on Bhendi

The results indicated that imidacloprid was the most effective treatment against *A. devastans* with highest reduction in population (70.5%), followed by profenofos (34.4%) (Table 24). Soft soap: 3 & 4 lowered the population by 21.3 percent as did avermectin and fish oil soap. Soft soap: 1, 2 & 5 were not effective against *A. devastans.* being on a par with control.

4.3.3. *P. solenopsis* on Bhendi

Related to control population, imidacloprid was most effective reducing *P. solenopsis* numbers by 83.3 percent (Table 25), while acephate and soft soap: 5 were the next most effective as they caused 58.3 – 68.8 per cent reduction in population. Soft soap: 1 had no effect on mealybugs while, soft soap: 6 & 5 were on a par with profenofos.

4.3.4. Yield in Bhendi

Application of soft soap: 4 resulted in highest yield (1578 kg/ha/packing) in bhendi on a par with profenofos and avermectin (Table 26). It was superior to all other treatments, including imidacloprid.

4.3.5. *B. tabaci* on Brinjal

On brinjal *B. tabaci* population post-spray indicated that soft soaps were as significantly effective as imidacloprid (0.5/leaf), except soft soap: 1 (Table 27). Statistically, the population was lowest in fish oil soap plots, followed by soft soap: 4. The population on spinosad sprayed

plants was on a par with control (0.7/leaf). Soaps and imidacloprid reduced whitefly numbers by only 28.6 percent compared to that in control. Whitefly population density did not differ significantly between counts.

4.3.6. *A. devastans* on Brinjal

Soft soaps were not effective against *A. devastans* infesting brinjal as the leafhoppers were as numerous on soap sprayed plants as on control plants (2.7/leaf) (Table 28). Imidacloprid was superior to all other treatments which reduced *A. devastans* numbers by 51.9 percent compared to control population. Leafhoppers were 7.4 – 14.8 per cent more in soft soap: 4 & 5 and fish oil soap plots.

4.3.7. *P. solenopsis* on Brinjal

Soft soap: 4 was on a par in efficacy with imidacloprid and fish oil soap against *P. solenopsis* on brinjal (0.9-1.3/2-node shoot) (Table 29). Spinosad and avermectin were on a par with the above. Populations in other soft soap plots were on a par with that in control plots (1.3–2.1/2-node shoot). Both soft soap: 4 and imidacloprid caused 50.0 per cent decrease in *P. solenopsis* numbers.

4.3.8. Yield in Brinjal

Soft soap sprays did not influence the brinjal yield under field conditions (Table 30). Picking-wise, the marketable yield was significantly more only after spinosad spray (5331.1 kg/ha/picking) as against 2009.7–2134.7 kg/ha/picking in other plots, including control.

4.3.9. *S. dorsalis* on Chillies

Spinosad was found to be the most effective treatment against thrips, *S. dorsalis* on chilli (0.1/3 leaves), even superior to imidacloprid (0.5/3 leaves) (Table 31). Soft soap: 5 was on a par with avermectin and fish oil soap (0.5 -0.6/3 leaves) but inferior to Spinosad. Soft soap: 1-4 were inferior to soft soap: 5 and fish oil soap though thrips in these plots (0.7-0.8 / 3 leaves) were less abundant than in control plots (1.0/ 3 leaves). While spinosad reduced thrips population by 90.0 per cent and imidacloprid by 70.0 per cent, soaps reduced it by 20–40 per cent compared to that in control population.

4.3.10. *A. gossypii* and *M. persicae* on chilli

Soft soap caused significant reduction in aphid population (*A. gossypii* and *M. persicae*) after sprays when compared to that in control although they were all inferior to imidacloprid (Table 32). Soft soap: 1, 3, 4 & 5 were equally effective against aphids (0.8-1.0 /2 leaves). Soft soap: 1 & 5 were superior to avermectin (1.2/2 leaves). Soft soap: 2 was on a par with spinosad which was least effective (1.4/2 leaves). Soft soaps caused 37.5–50.0 per cent reduction in aphid numbers as against 81.3 by imidacloprid.

4.3.11. *P. latus* on chilli

The data on muranai mite, *P. latus* showed that avermectin plots was superior to all other treatments (1.4/leaf) (Table 33). Soft soap: 1 & 3 were second most effective (2.2-2.3/leaf) and they were on a par with fish oil soap and imidacloprid (2.0-2.2/ leaf). Population after soft soap: 2 spray was comparable to that in soft soap: 3, 4, & 5 and the latter two were on a par with control (2.9-3.2/leaf). Avermectin reduced *P. latus* population by 56.3 per cent, whereas soft soap: 1 & 3 reduced it by 28.1–31.3 per cent.

4.3.12. *P. latus* Injury to Chilli

The typical mite injured plants were nil in soft soap: 1, 2 & 5 treated plots as in avermectin plots (Table 34). They were superior to soft soap: 3 & 4 which were on a par with control (0.6-0.8 %). However, except soft soap: 4, soft soaps did not cause the mite to flare up because significantly 150–250 per cent more plants were damaged by mites in imidacloprid and spinosad plots than in control plots.

4.3.13. Coccinellids on Chilli

Mixed species of lady bird beetles (Coccinellidae) were significantly fewer after foliar sprays when compared to their numbers in control plots (Table 35). While no coccinellids were found in imidacloprid and avermectin treated plots, soft soaps and spinosad were found to be 50.0 per cent less harmful than the former two (0.1 beetle/plant). The beetle population was twice as many in control plots (0.2 beetles/plant) compared to other treatments.

4.3.14. Yield in Chilli

Picking-wise yield data indicated that the ripened fruit yield differed significantly among treatments after the sprays with highest yield in soft soap: 3 plots (909.1 kg/ha) (Table 36). This was followed by spinosad (852.5 kg/ha). Yield from all other soft soaps were on a par with that from control (738.5 kg/ha in soft soap: 1 to 786.1 kg/ha in soft soap: 5). Yield from both fish oil soap and imidacloprid were significantly less than that from the above treatments. Soft soap: 3 alone was found to be economical with a benefit-cost ratio of 1.42:1.

4.3.15. *A. gossypii* on Cotton

Though significantly different from control, Soft soaps were able to reduce *A. gossypii* numbers on cotton by only 9.4–28.3 per cent as against 79.2–86.8 per cent by imidacloprid, acephate and profenofos (Table 37).

4.3.16. *P. solenopsis* on Cotton

On cotton acephate proved to be most effective against *P. solenopsis* (Table 38). Soft soap: 7 and fish oil soap were on a par with imidacloprid and profenofos though inferior to acephate. Soft soap: 5 & 8 were on a par and moderately effective. Soft soap: 1 had no effect on mealybugs. While the standard insecticides reduced *P. solenopsis* by 65.6 – 84.4 per cent, soft soaps:7 decreased the mealybugs numbers by 62.5 per cent as much as by fish oil soap.

4.3.17. Mangohoppers

Soft soaps were moderately effective against mangohoppers, namely, *A. atkinsoni, I. niviosparsus, I. idioscopus* and they were inferior to both imidacloprid and carbaryl (Table 39). They reduced the population density compared to control by 38.3-46.8 per cent as against 87.2-93.6 per cent by the standard insecticides. Avermectin was inferior not only to the standards but also to soft soaps (23.4 %). Soft soaps were on a par with fish oil soap. The hopper population averaged 2.3–2.9 per infloroscence on soap sprayed infloroscence as against 4.7 on control inflorescence. As few as 0.3–0.6 hopper was observed on inflorescence sprayed with imidacloprid and carbaryl.

4.3.18. Hoppers in Rice Nursery

Data on the mixed species of leaf and planthopper on rice seedlings after two rounds of spray at weekly interval indicated that soft soaps were inferior to imidacloprid but superior to spinosad and avermectin (Table 40). While the latter two were on a par with control, soft soaps

and fish oil soap were not. Imidacloprid reduced the hopper population by 66.7 per cent whereas soaps decreased the hopper numbers by 25.0–38.9 per cent. Spinosad and avermectin were on a par with control with only 5.6–5.6 per cent reduction.

4.3.19. *C. lividipennis* in Rice Nursery

The results on the mirid *C. lividipennis* population in rice nursery indicated that imidacloprid was highly toxic to mirids while the soft soaps were moderately toxic. Soft soap: 2 & 3 were on a par with spinosad and control (Table 41). Compared to control, soft soaps, sipinosad and avermectin reduced the mirid population by 17.7 to 47.1 per cent as against 76.5 per cent by imidacloprid. There was no significant difference between the counts at 3 DAT and 7 DAT, that is the effects lasted a week's time.

4.3.20. *H. cubana* in Subabul

The results indicated that soft soaps were significantly effective against *H. cubana* nymphs although they were inferior to imidacloprid, triazophos and malathion which were on a par with each other (Table 42). While the standards caused the nymphal populations lower by 90.0-95.0 per cent, Soft soaps: 1-5 reduced it by 56.0-62.0 per cent. Soft soap: 4 & 5 were inferior to fish oil soap. While 0.5-1.0 nymph was found on a tender leaf of plants sprayed with the standards, as many as 3.4–4.4 nymphs occurred on plants protected with different soaps as against 10.0 per leaf on control plants.

Soft soaps exhibited the same level of efficacy against *H.cubana* adults as it was against the nymphs and they were inferior to the standards (Table 43). Adult psyllids were as few as 0.7–0.2/leaf on plants sprayed with standards, while 4.8–5.4 adults were found per leaf on soap protected plants. As many as 33.8 psyllids were found on a leaf on control plants. The

reduction in adult population ranged from 84.0 to 85.8 per cent due to soft soaps as against 96.5-97.9 per cent due to standards.

5. DISCUSSION

In recent years with climate change, sucking pests such as cotton mealybug, *P. solenopsis* and papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink have been on the rampage. Though several IPM measures are advocated to control these mealybugs and other sucking pests, hazardous pesticides continue to be the mainstay at the farmers' level. Thus we need to consider other alternative pest management methods such as insecticidal soaps, biologicals, botanicals, parasitoids and predators, traps, barriers and cultural techniques (Gehringer *et al.*, 1991) to suppress pest populations and conserve the natural enemies. For more than 200 years soft soaps, especially potassium salts, have been reported to exhibit insecticidal properties (Baldwin and Koehler, 2004), especially on soft-bodied arthropods such as scales (Riehl and Carman,1953), mites (Osborne, 1984), whiteflies (Butler *et al.,* 1993; Javed and Mathews, 2002), aphids (Pinnock *et al.,* 1974; Fournier and Brodeur, 2000), thrips (Oetting and Latimer, 1995), and mealybugs (Lindquist, 1981). An attempt was made in this study to find the suitability of TNAU-made soft soaps that can be used in place of fish oil soap against selected sucking pests.

Soaps and Whiteflies

Soaps had been extensively used against whiteflies infesting crops, especially *B. tabaci*. Fish oil rosin soap is a typical example (Rao *et al.,*1990b; Patil *et al.,*1991; Natarjan *et al.,* 1991; Prabhu *et al.,*1993; Patil *et al.,* 1993). In this study also the newly developed soft soaps proved toxic not only to *B. tabaci* but also to *T. ricini*. They exhibited significantly moderate efficacy against *T. ricini* in laboratory, though not comparable to imidacloprid, a systemic insecticide

effective against whiteflies (Chao *et al.,* 1997; Ali *et al.,* 2005). However, of late *B. tabaci* has developed resistance to imidacloprid (Horowitz *et al.,* 2004; He *et al.,* 2007; Fernandez *et al.,* 2009). Though not systemic in action, soft soaps exert a physical action on insect eggs by causing water imbalance (Tikku *et al*., 1981) and desiccation (Ware, 1994; Olkowski *et al.,* 1996). Under laboratory conditions, they caused egg mortality as high as 71.8 – 81.9 per cent in *T. ricini* although significantly less than that caused by imidacloprid and triazophos. However, their efficacy as ovicides may be significantly much less in the field where the spray droplets may not reach the whitefly eggs that are usually laid on the lower surface of leaves (Simmons, 1994), either inserted into the leaf stomata or leaf tissues by means of an egg pedicel (Paulson and Beardsley, 1985).

Similarly, soft soaps were significantly toxic to adult whiteflies as observed in the leaf cage studies with *T. ricini,* wherein a significant number of whiteflies were killed by the soap solutions. It may be noted that whiteflies occur in abundance on the lower surface of new leaves where they lay eggs (Ekbom and Rumei, 1990) and they are all disturbed when the spray is directed against them. This behaviour was observed not only on the treated plants but also on control plants. Thus the efficacy of soaps may be reduced after the spray as they leave no toxic residue on the treated leaf surface (Liu and Stansly, 1995a), the selection of which by *B. tabaci* varies with characters such as hairiness and thickness (Ayyasamy and Baskaran, 2005). However, a ten-day observation on whitefly infesting the sprayed plants indicated that soft soaps were as significantly effective as the standards for 7-10 days as they allowed the whiteflies to recolonize. Parry *et al*. (1989) reported that an insecticidal soap (Safer) did not delay the recolonization by aphids. Whitefly count on the most populated third leaf at 1 DAT and the freshly infested top leaves at 7 DAT and 14 DAT indicated that whiteflies probably avoided the treated leaves, fully or partly emerged, following the application of soft soaps. Liu

and Stansly, (1995b) recorded fewest eggs of *B. argentifolii*, formerly *B. tabaci* (Gennadius) biotype B, on young tomato leaves treated with an insectidal soap. The B biotype occurs in the southern parts of India (Lisha *et al.,* 2003; Shankarappa *et al.,* 2007).

On the other hand, whitefly nymphs are as sedentary as eggs, except first instar crawlers which move a few mm on the same leaf after hatching (Byrne and Bellows, 1991). Therefore soft soaps can be more toxic to whitefly nymphs than to adults and the laboratory studies have shown that soft soaps could kill the fourth instar *T. ricini* nymphs by 77.6 – 82.7 per cent even though inferior to both imidacloprid and triazophos (92.4 –97.1%). Generally, early instar nymphs are more susceptible to toxic sprays than later instars (Liu and Stansly, 1995a). Here also the absence of systemic or translaminar action of soft soaps may reduce the true potential of soft soaps at field conditions. In spite of these factors, both screenhouse and field experiments have shown that soft soaps were moderately toxic to *B. tabaci* on bhendi and brinjal. Especially, soft soap: 4 & 5 were as good as fish oil soap and imidacloprid on brinjal in screenhouse (Fig. 1), whereas at field conditions soft soap: 4 appeared comparable to imidacloprid. Moreover, soft soap: 1 & 4 were even superior to profenofos and imidacloprid on bhendi (Fig. 2). Consequently, *B. tabaci* transmitted *B*YVMD viral infection was also 2-3 times significantly less after sprays with soft soap: 4 (6.4 %) than in imidacloprid treated and control plots (15.6–17.7%) (Fig. 3). This indicates that imidacloprid did not have any impact on *B. tabaci* at field conditions, probably due to development of resistance in *B. tabaci* as observed all over the world (Nauen and Denholm, 2005; Roditakis *et al.,* 2008). Thus soft soaps, though moderately effective against *B. tabaci,* are preferable to insecticides that are usually toxic to the natural enemies of *B. tabaci* (Prabhaker *et al.,* 2007) against which Gerling *et al*. (2001) suggested selective insectides. Soaps are comparatively safe to them. For instance Manju and David (2004) reported that parasitism by the egg parasitoids, *Telenomus dignus* (Gahan) and

Ttetrastichus schoenobii (Ferreira) on egg masses of the rice yellow stem borer, *Scirpophaga incertulas* (Walker) was not effected by fish oil rosin soap 2.5 % sprays.

Soaps and Aphids

Soaps have been largely used against different species of aphids all over the world (Natarajan *et al.,*1991; Fournier and Brodeur, 2000; Edelson *et al.,* 2002; Karagounis *et al.,* 2006; Kourdoumbalos *et al.,* 2006). In this investigation soft soaps were evaluated against *A. gossypii* and *M. persicae* on cotton, bhendi, brinjal and chilli at screenhouse and on cotton and chilli at field conditions. It emerged that while they were inferior to imidacloprid on bhendi, brinjal and cotton at screenhouse, they proved as effective as imidacloprid on chilli (Fig. 4). Crop canopy pattern and the mode of infestation by aphid differ on crops plants. Compared to cotton, brinjal and bhendi, aphids are more vulnerable to sprays on chilli where most aphids occur in colonies on the terminal shoots. This may cause the aphids to succumb to soap sprays as observed by several workers (Fournier and Brodeur, 2000; Edelson *et al.,* 2002). However, under field conditions soft soaps were significantly less toxic to *A. gosspyii* and *M. persicae* than to imidacloprid. In cotton also they were inferior to imidacloprid, acephate and profenofos. Among them soft soap: 4 was consistently effective on different crops, followed by soft soap: 1 & 5. Coccinellids which actively prey on aphids were rare to find on imidacloprid treated plants while soaps, though not safe to coccinellids, allowed half the beetle population to survive (Fig. 5). Flying adult insects with a stronger integument such as ladybird beetles and bees are less affected by soaps (Puritch, 1981). Secondly, plants with characteristic mite injury were more after imidaclopird sprays than after soap sprays, probably because of the destruction of predatory mites which prey usually on *P. latus* on chilli. Osborne and Petitt (1985) reported that an insecticidal soap (Safer) did not affect the eclosion of predatory mite, *P. persimilis* on

greenhouse foliage plants infested by *T. urticae*. On both counts, soaps are better than imidaclopird on crops like chilli. Similarly, though spinosad was most effective on *S. dorsalis* on chilli as discussed next, it also was equally inimical to coccinellids after repeated sprays. Cisneros *et al. (*2002), reporting on the toxic effects of spinosad, concluded that spinosad can not be considered to have an environmental safety profile similar to most established biological insecticides (Bond *et al.,* 2004).

Soaps and Thrips

Soft soap: 3 was found to be on a par with imidacloprid but inferior to spinosad on screenhouse chillies (Fig. 6). However, at field conditions, soft soap: 5 alone was significantly more effective than all other soft soaps although inferior to both spinosad and imidacloprid (Fig. 7). That soaps have a limited scope against thrips has been documented earlier (Tomkins, 1996), Possibly due to low residual toxicity (Moore *et al.*, 1979). Usually, thrips take shelter inside the folds of the newly emerging leaves or flowers and they are swifter than other sucking pests such as aphids. These factors may cause them to be less vulnerable to soap formulations which have very little action once they go dry (Liu and Stansly, 1995a). On the other hand, compounds such as spinosad, a mixture of tetracyclic macrolide neurotoxins, spinosyn A and D, produced during the fermentation of the soil actinomycete *Saccharopolyspora spinosa,* may pesist much longer with significant residual action, outperforming the soaps. However, the finding that soft soap: 1 & 5 were on a par with imidacloprid under either screenhouse or field conditions indicates the scope for these products on chillies where sucking pests such as aphids and mites are serious problems, in view of the toxicity of spinosad to predatory insects (Cisneros *et al.,* 2002).

Soaps and Mealybugs

The effect of soft soaps on mealybugs was of mixed nature on crops. Parry *et al.* (1989) also reported on the mixed nature of toxicity of different soaps to an aphid species. They found that potassium (K) caprate, K oleate, K linoleate and insecticidal soap (Safer) were more toxic than K caproate, K caprylate, K laurate and K myristate. Soaps were also inferior to imidacloprid and acephate which reduced the population by 91.2–96.5 per cent on cotton in screenhouse. Among the soaps, soft soap: 7 was significantly comparable to fish oil soap (71.9-77.2%), even superior to profenofos (70.2%) (Fig. 8). On screenhouse brinjal, soft soap: 3 & 5 reduced the mealybug populations by 74.3–77.1 per cent as against 88.6 per cent by imidacloprid (Fig. 9). However, under field conditions, soft soap: 4 proved as effective as both fish oil soap and imidacloprid on brinjal (Fig. 10), whereas soft soap: 5 was as toxic as acephate and profenofos on bhendi (Fig. 11). Soft soap: 7 was as effective as imidacloprid and profenofos on cotton. Hollingsworth (2005) reported that an insecticidal soap was inferior to limonene, a citrus extract, in a series of bioassays with mealybugs. The above results suggest that soft soap: 4, 5 & 7 are significantly more potent than other soaps against *P. solenopsis* and they may be tried as potential alternative to fish oil soap. Earlier, soaps were used to control citrus mealybug, *P. citri* (Lindiquist, 1981). They can also be used in alternate rounds with acephate and imidacloprid to get better results. Nevertheless, though superior to soft soaps, the latter could be more harmful to natural enemies (Bacci *et al.,* 2007) than soft soaps which are comparatively less toxic to parasitoids and predators (Smith and Krischik, 2000; Tremblay *et al.,* 2008). Howsoever effective, mealybugs are particularly difficult to control as they, protected by wax cover, aggregate in cryptic habitats such as tightly closed bracts and leaf sheath (Hara *et al.*, 1996). Though soaps were able to remove the wax from *P. solenopsis* infesting cotton shoots, they survive post-sprays. The effect of soaps on mealybug eggs in ovisacs and crawlers also needs to be studied further. The third and fourth instar larvae of *P. solenopsis* which settle on the

internodes, shoots and fruits are more vulnerable not only to sprays but also to natural enemies than crawlers. As insecticides are comparatively more harmful to natural enemies than soaps as discussed earlier, soaps have an edge over chemicals, facilitating the parasitoids and predators to survive. Potassium soaps are considered to be environmentally friendly insecticides (Tradan *et al.*, 2006) and further research is required to collect data.

Soaps and Mites

Soft soaps are proven acaricides (Osborne, 1984; Osborne and Petitt, 1985). In this study soft soap: 1 was toxic to *T. cinnabarinus* on screenhouse brinjal by reducing the mite numbers by 60.8 per cent, secondly only to avermectin which reduced the mite population density by 84.5 per cent (Fig. 12). It was also consistently effective on bhendi as well in screenhouse with 62.0 per cent reduction as against 70.8 per cent by avermectin (Fig. 13). Similarly, soft soap: 1 & 4 effectively controlled *P. latus* on screenhouse chilli by controlling the mite numbers by 64.1–69.3 per cent as against 92.8 per cent by avermectin (Fig. 14). At field conditions as well, soft soap: 1 & 3 were more effective than other soaps (Fig. 15). Not all chilli plants exhibit pronounced mite injury under field conditions despite mite infestation. That, typical mite-damaged plants were also as significantly fewer in soft soap: 1, 2 & 5 plots as they were in avermectin plots (Fig. 16) shows that soft soaps hold more promise on chilli against *P. latus* because repeated use of imidacloprid, a systemic insecticide effective against both thrips and aphids, and of spinosad, a fermentation product from actinomycetes toxic to Thysanoptera and Lepidopetra, had led to three times more *P. latus* damaged plants than those control plots. As discussed earlier, these chemicals were also more harmful to coccinellids than soft soaps. Resurgence of mites usually follows application of certain pesticides. Pesticides such as monocrotophos, methyl-o-demeton, formothion, thiometon, and even neem cake extract cause

P. latus to resurge on chilli after repeated application (David, 1986). Soaps are better than pesticides in this context as well as they only suppressed mite number throughout this investigation.

Soaps and Hoppers

Soft soaps were tested against mixed species of hoppers in rice nursery (GLH, *N. nigropictus, N. virescens*; BPH, *N. lugens*, *A. devastans* on bhendi and brinjal, and three species of mangohoppers (*I. niveosparsus, I. clypealis, A. atkinsoni*). Compared to their efficacy against other sucking pests such as whiteflies, aphids and mites, soft soaps appeared only less toxic to hoppers. That is they decreased the hopper populations by only 25.0–38.9 per cent on rice, 21.3 per cent on bhendi, 38.3–46.8 per cent on mango, with no significant effect on brinjal. On the other hand, imidacloprid reduced rice hoppers by 66.6 per cent, bhendi hoppers by 70.5 per cent, brinjal hoppers by 51.9 per cent and mango hoppers by 87.2 per cent. This may be related to the fact that, being heteropterans (Cicadellidae, Delphacidae) they are more hard-bodied than aphids and mites as insects with a tough exoskeleton are less vulnerable to soaps (Puricth, 1981).

Soaps and Psyllids

Compared with hoppers, psyllids *H. cubana* were more significantly susceptible to soft soaps though not comparable with imidacloprid, triazophos and malathion. Both nymphs and adults were equally susceptible to soaps although adults are more susceptible (84.0-85.8%) (Fig. 17) than nymphs (56.0-62.0%) (Fig. 18). This implies that soft soaps can be more useful against psyllids, especially to suppress species like *Diaphorina citri,* the citrus psyllid which transmits the

greening disease in citrus (Villechanoux *et al*., 1992; Pillai *et al.,* 2007) more as biorational physical compounds.

Soaps and Phytotoxicity

Some plants are sensitive to oils and soaps depending on the dose (Lawson and Weires, 1991), especially under conditions of stress (Russell, 1991). Phytotoxicity was observed on two occasions in this study, one on castor and the other on subabul. Localized marginal scorching was observed on castor at 3 DAT at 2.0 % dose, whereas the leaflets were discoloured, followed by shedding, when the soaps were sprayed at 2.0 % on subabul. These aspects need to be examined further crop-wise using differential dosesand stress conditions. Islam *et al.* (2003) reported that detergent soaps caused phytotoxicty to guava leaves at 20, 30 and 40 g per litre but not at 10 g per litre. Insecticidal soaps have the disadvantage that large quantities are required to give the same mortality levels as organophosphate insecticides but they have the advantage of being environmentally acceptable (Puritch and Brooks, 1981). More refined soaps with reduced risk of phytotoxicity are recommended as alternative to conventional pesticides to reduce pesticide use (Baxendale and Johnson, 1988; Davidson *et al.*, 1990; Larew and Locke, 1990). A few plants may be test-verified before large scale application to avoid phytotoxicity.

Conclusions

The above discussion highlights that TNAU-made soft soaps have the potential against selected insects and mites and the extent of toxicity varies on crops. Soft soaps can cause significant reduction in population densities of whiteflies, aphids, psyllids and mites. Mealybugs, mangohoppers and rice hoppers are moderately susceptible to soft soaps, while *A. devastans* and *S. dorsalis* were significantly less susceptible to soaps. Their pontential to boost crop yield is

also yet to be fully studied. Tradan *et al.* (2006) observed in cabbage that plant and head weight increased after sprays with potassium soaps. However, soaps did not affect the yield of tomato plants significantly (Sclar, 1999). Soaps were less toxic to predators such as ladybird beetles and mirids than imidacloprid and spinosad. At 2.0 % dose, soaps caused phytotoxicity to leaves of castor and subabul. Therefore the lower dose of 1.0 per cent may be safe to all crops without any risk of phytotoxicity. Single application of soap insecticides is generally less effective than organophosphorus, carbamate and pyrethroid compounds (Musau and Parry, 1988) and they need to be sprayed at shorter intervals, at least once a week, as insecticidal soaps lose their efficacy faster than pesticides (Kourdoumbalos *et al.*, 2006).

6. SUMMARY

1. Soft soaps caused 71.8–81.9 per cent egg mortality in *T. ricini* in laboratory. They were on a par with fish oil soap (86.4 %) but inferior to imidacloprid and triazophos which caused 98.5–99.6 per cent egg mortality.

2. Similarly, soft soaps caused 77.6–82.7 per cent mortality in *T. ricini* fourth instar nymphs at laboratory, on a par with fish oil soap (82.9 %). They were all inferior to imidacloprid and triazophos which caused 92.4–97.1 percent mortality.

3. In leaf cage studies at screenhouse, soft soaps killed 83.1-92.8 per cent of *T. ricini* adults as against 100.0 per cent by imidacloprid and triazophos.

4. Soft soap: 2 significantly reduced the recolonization of *T. ricini* adults on the treated second leaf on castor shoot as much as fish oil soap and imidaclorpid (83.4-87.4 %) over a period of 10 days post-spray. Soft soap: 3 & 5 were inferior to soft soap: 2 (73.4–77.4 %), but on a par with triazophos (70.4 %).

5. Soft soap: 4 & 5 were on a par with fish oil soap and imidacloprid against *B. tabacci* infesting brinjal in screenhouse. They reduced the whitefly population by 80.0 per cent as against 100.0 per cent by imidacloprid.

6. Soft soap: 3 was on a par with imidacloprid and avermectin against *S. dorsalis* on chilli at screenhouse conditions, reducing thrips numbers by 32.1-46.4 per cent. However, they were all inferior to spinosad (92.9 %).

7. Soft soap:1 & 5 were as effective as imidacloprid and fish oil soap in reducing aphids *A. gossypii* and *M. persicae* numbers on chilli by as much as 77.8–81.5 per cent under screenhouse conditions.

8. On bhendi soft soaps were moderately effective against *A. gossypii,* being inferior to imidacloprid. While Soft soap: 4 effectively reduced the aphids by 68.6 % as much as by fish oil soap, imidacloprid caused highest reduction (87.1 %) under screenhouse condition.

9. On cotton as well, although soft soaps reduced *A. gossypii* population significantly, they were inferior to imidacloprid (78.4 %). Soft soap: 4 was more effective, on a par with fish oil soap (37.1–38.5 %).

10. Soft soap: 4 was superior to other soft soaps, including fish oil soap against *A. gossypii* infesting brinjal in screenhouse. Soft soap: 4 reduced aphid population by 58.6 per cent as against 90.0 per cent by imidacloprid.

11. Soft soap: 3 & 5 were on a par with fish oil soap and imidacloprid against *P. solenopsis* infesting brinjal in screenhouse and they reduced mealybug numbers by 74.29–77.14 per cent as against 88.5 per cent by imidacloprid.

12. Soft soap: 7 was as effective as fish oil soap even superior to profenofos, against *P. solenopsis* infesting cotton in screenhouse. All the soft soaps were inferior to imidacloprid and acephate which reduced the population by 91.2–96.5 per cent. Soft soap: 7 lowered the population by 77.2 per cent as much as by fish oil soap 71.93 per cent and profenofos (70.2 %).

13. Soft soaps were significantly toxic to *T. cinnabarins* on brinjal in screenhouse. Soft soap: 1 was most effective with 60.8 per cent reduction in mite numbers. However, it was inferior to avermectin (84.5%).

14. On bhendi too, soft soap: 1 reduced *T. cinnabarinus* population by 62.0 per cent as against 70.8 per cent by avermectin. Soft soap: 1 was more effective than other soft soaps, even though it was inferior to avermectin. Mites were five times more on imidacloprid treated plants (21.7 %) than on control plants.

15. Soft soaps were significantly effective against *P. latus* in chilli at screenhouse conditions though inferior to avermectin. Soft soap: 1 was most effective, followed by soft soap: 4 and they were superior to fish oil soap. Soft soap: 1 & 4 reduced the mite population by 64.1–69.3 percent as against 92.8 per cent by avermectin.

16. At field conditions soft soap: 1 & 4 were superior to profenofos, while soft soap: 2 & 5 were on a par with the latter. Soft soap: 1, 2 & 4 decreased whitefly numbers by 61.5–84.6 per cent as against nil by imidacloprid that had no effect on *B. tabaci* on bhendi.

17. *B. tabaci* vectored mosaic virus infected bhendi plants (BYVMD) were significantly fewer in soft soap: 4 plots (6.4 %), even superior to imidacloprid, which was on a par with control (15.6–17.7 %).

18. Soft soap: 3 & 4 reduced *A. devastans* numbers by 21.3 per cent on bhendi under field conditions and they were inferior to imidacloprid and profenofos (34.4–70.5 %).

19. At field conditions on bhendi, soft soap: 5 was on a par with acephate and profenofos, though inferior to imidacloprid (83.3 %), in reducing mealybug, *P. solenopsis* numbers (58.3–68.8 %).

20. Application of soft soap: 4 resulted in highest yield (1578.2 kg/ha/3 pickings) in bhendi on a par with profenofos and avermectin. It was superior to all other treatments, including imidacloprid.

21. Though as effective as imidacloprid against *B. tabaci* on brinjal at field conditions, soft soap: 4 and imidacloprid decreased whitefly by 28.6 per cent.

22. Soft soaps did not have significant effect on leafhoppers *A. devastans* infesting brinjal under field conditions with no significant difference in populations after soft soap sprays and control.

23. Soft soap: 4 was as effective as fish oil soap and imidacloprid against *P. solenopsis* infesting brinjal in the field. Both soft soap: 4 and imidacloprid decreased mealybugs by 50.0 per cent, compared to in control population.

24. Soft soap sprays did not influence the brinjal yield at field conditions. Picking-wise, the marketable yield was significantly more only in spinosad plots (5331.1 kg/ha/3 pickings) as against 2009.7–2134.7 kg/ha/3 pickings in other plots, including control.

25. Soft Soap: 5 was as effective as fish oil soap against *S. dorsails* on chilli under field conditions. However, it was inferior to spinosad and imidacloprid. All other soaps were inferior to soft soap: 5 (40.0 %), including fish oil soap.

26. Soft soaps were moderately effective against *A. gossypii* and *M. persicae* infesting chillies in the field. However, they were all inferior to imidacloprid. Soft soaps caused 37.5–50.0 per cent reduction in aphid numbers as against 81.3 by imidacloprid.

27. Soft Soap: 1 & 3 were significantly most effective against *P. latus* on chilli at field conditions. Although on a par with fish oil soap and imidacloprid, they were inferior to avermectin. While avermectin decreased *P. latus* population by 56.3 per cent, soft soap: 1 & 3 reduced it by 28.1–31.3 per cent. Typical mite-injured chilli plants were nil in soft soap: 1, 2 & 5 plots as in avermectin plots.

28. Soft soaps and spinosad were significantly less toxic to lady bird beetles found on chilli foliage than imidacloprid and avermectin at field conditions.

29. Soft soap: 3 registered highest yield in chilli (909.1 kg/ha/3 pickings) followed by spinosad (852.5 kg/ha/3 pickings).

30. Soft soaps were able to reduce *A. gossypii* numbers on cotton by only 9.4–28.3 per cent as against 79.2–86.8 per cent by imidacloprid, acephate and profenofos. While the standard insecticides reduced *P. solenopsis* by 65.6-84.4 per cent, soft soap: 7 decreased the mealybug numbers by 62.5 per cent as much as by fish oil soap.

31. Soft soap: 7 was on a par with fish oil soap, imidacloprid and profenofos against *P. solenopsis* infesting cotton in the field. Acephate was most effective.

32. Soft soaps were moderately effective against mango hoppers, (*I. clypealis*, *I. niveosparsus*, *A. atkinsoni*) being inferior to imidacloprid and carbaryl. Soft soaps reduced

the hopper population by 38.3–46.8 per cent as against 87.2–93.6 per cent by the standards. Soft soaps were on a par with fish oil soap in efficacy.

33. Soft soaps were inferior to imidacloprid against mixed species of hoppers on rice seedlings in the nursery with only 25.0-38.9 per cent reduction in hopper numbers as against 66.7 per cent by imidacloprid.

34. Soft soap sprays resulted in with 17.7–47.1 percent reduction in *C. lividipennis* population, while imidacloprid was most toxic with 76.5 per cent reduction.

35. Soft soaps were significantly toxic to subabul psyllid *H. cubana* although inferior to standard chemicals, namely imidacloprid, triazophos and malathion. Soft soap: 1–5 reduced the nymphal populations by 56.0–62.0 per cent and the adult populations by 84.0–85.8 per cent.

ABSTRACT

Rajkumar, K. 2009. Evaluation of TNAU-Made Soft Soaps against Sucking Pests of Crops (Dr. P.M.M. David, Professor)

Potassium salts of fatty acids, called soft soaps, possess selective insecticidal properties. Eight soft soaps developed by the Department of Plant Protection, Agricultural College and Research Institute, Killikulam were evaluated at laboratory, screenhouse and field conditions during 2008 – 2009 against selected insects/mites that include: mealybug, *Phenacoccus solenopsis* Tinsley on brinjal and cotton; whiteflies, *Bemisia tabaci* (Gennadius) on bhendi and brinjal and *Trialeurodes ricini* Misra on castor; aphids, *Aphis gossypii* Glover and *Myzus persicae* (Sulzer) on bhendi, cotton and chillies; psyllids, *Heteropsylla cubana* Crawford on subabul; hoppers, *Nilaparvata lugens* (Stal.), *Nephotettix nigropictus* (Stat.), *N. virescens* (Distant) on rice nursery; *Amrasca devastans* Ishida on bhendi and brinjal; *Idioscopus clypealis* (Lethierry), *I. niveosparsus* (Lethierry), *Amritodus atkinsoni* (Lethierry) on mango; thrips, *Scirotothrips dorsalis* Hood on chillies; mites, *Tetranychus cinnabarinus* (Boisd.) on bhendi and brinjal and *Polyphagotarsonemus latus* Banks on chillies. Soft soaps were sprayed at weekly interval at 2.0 % concentration in comparison with fish oil soap at 2.5 %, imidacloprid 17.8 SL at 50g ai/ha, spinosad 45 SC at 90g ai/ha, triazophos 40 EC at 400g ai/ha, malathion 50 EC at 500g ai/ha, avermectin 1.9 EC at 5g ai/ha, profenofos 50 EC at 500g ai/ha, carbaryl 50 WDP at 1.5 kg ai/ha and acephate 75 SP at 750 g ai/ha in different experiments. The results revealed that soft soaps were highly toxic to whiteflies, aphids, psyllids and mites, moderately toxic to mealybugs, mangohoppers,and rice hoppers and less toxic to *A. devastans* and *S. dorsalis*. The impact of soft soaps on selected predators and their toxicity to plants are also discussed.

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Table 1. Effect of TNAU-made soft soaps on mortality of castor whitefly *T. ricini* eggs in laboratory

Treatments	Dose	Egg mortality (%)		Pooled Mean
		Experiment – 1	Experiment - 2	
Soft Soap: 1	2.0 %	80.1 (63.82)	83.8 (66.31)	81.9 (65.06)
Soft Soap: 2	2.0 %	70.6 (57.52)	76.3 (61.19)	73.4 (59.36)
Soft Soap: 3	2.0 %	59.1 (50.38)	67.6 (55.50)	63.3 (52.94)
Soft Soap: 4	2.0 %	78.1 (62.42)	65.6 (54.21)	71.8 (58.31)
Soft Soap: 5	2.0%	80.8 (64.06)	74.0 (59.87)	77.4 (61.96)
Fish Oil Soap	2.5 %	92.8 (74.58)	80.1 (63.64)	86.4 (69.11)
Imidacloprid 17.8 SL	50 g ai/ha	99.6 (87.12)	99.7 (88.22)	99.6 (87.67)
Triazophos 40 EC	400 g ai/ha	99.6 (87.81)	97.4 (84.44)	98.5 (86.12)
Water Spray		66.9 (54.92)	44.0 (41.04)	55.4 (47.98)
Mean		80.8 (66.96)	76.5 (63.82)	

(Mean of 15 replications. Figures in parenthesis are angular transformed values)

		C D (P=0.05)
Between Treatments	:	7.16
Between Experiments	:	NS
Treatments x Experiments	:	NS

Table 2. Effect of TNAU-made soft soaps on mortality of fourth instar nymphs of castor whitefly *T. ricini* in laboratory

Treatments	Dose	4^{th} instar mortality (%)		Pooled Mean
		Experiment - 1	Experiment - 2	
Soft Soap: 1	2.0 %	95.1 (80.66)	69.7 (57.06)	82.4 (68.86)
Soft Soap: 2	2.0 %	91.1 (77.10)	72.4 (58.80)	81.7 (67.95)
Soft Soap: 3	2.0 %	89.4 (75.23)	65.8 (50.92)	77.6 (63.07)
Soft Soap: 4	2.0 %	94.3 (79.70)	71.2 (58.04)	82.7 (68.87)
Soft Soap: 5	2.0%	87.0 (74.02)	62.5 (52.68)	74.7 (63.35)
Fish Oil Soap	2.5 %	96.8 (83.66)	69.1 (56.48)	82.9 (70.07)
Imidacloprid 17.8 SL	50 g ai/ha	99.5 (87.97)	94.6 (81.22)	97.1 (84.59)
Triazophos 40 EC	400 g ai/ha	96.7 (84.99)	88.1 (74.92)	92.4 (79.96)
Water Spray		45.2 (42.25)	21.5 (25.26)	33.3 (33.76)
Mean		88.3 (76.17)	68.32 (57.27)	

(Mean of 15 replications. Figures in parenthesis are angular transformed values)

		C D (P=0.05)
Between Treatments	:	9.32
Between Experiments	:	4.39
Treatments x Experiments	:	NS

Table 3. Effect of TNAU-made soft soaps on mortality of castor whitefly *T. ricini* adults trapped in leaf cages in screenhouse

Treatments	Dose	*T. ricini* adult mortality (%)
Soft Soap: 1	2.0 %	83.1 (73.32)
Soft Soap: 2	2.0 %	89.8 (75.33)
Soft Soap: 3	2.0 %	88.7 (77.03)
Soft Soap: 4	2.0 %	88.6 (77.21)
Soft Soap: 5	2.0%	92.8 (82.44)
Fish Oil Soap	2.5 %	91.6 (81.79)
Imidacloprid 17.8 SL	50 g ai/ha	100.0 (89.72)
Triazophos 40 EC	400 g ai/ha	100.0 (89.72)
Water Spray		42.5 (55.52)
CD (P = 0.05)		19.72

(Mean of five replications. Figures in parenthesis are angular transformed values)

Table 11. Effect of TNAU-made soft soaps on whitefly *B. tabaci* on brinjal in screenhouse

Treatments	Dose	No. of whiteflies / 2 leaves		Mean	% reduction from control
		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	0.3 (0.87)	0.3 (0.89)	0.3 (0.88)	70.0
Soft Soap: 2	2.0 %	0.0 (0.71)	0.8 (1.14)	0.4 (0.92)	60.0
Soft Soap: 3	2.0 %	0.0 (0.71)	1.3 (1.31)	0.7 (1.01)	30.0
Soft Soap: 4	2.0 %	0.0 (0.71)	0.3 (0.89)	0.2 (0.80)	80.0
Soft Soap: 5	2.0%	0.3 (0.89)	0.0 (0.71)	0.2 (0.80)	80.0
Fish Oil Soap	2.5 %	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	100.0
Imidacloprid 17.8 SL	50 g ai/ha	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	100.0
Spinosad 45 SC	90 g ai/ha	0.8 (1.14)	0.0 (0.71)	0.4 (0.92)	60.0
Avermectin 1.9 EC	5 g ai/ha	0.5 (0.98)	0.8 (1.14)	0.7 (1.06)	30.0
Control		1.0 (1.18)	1.0 (1.18)	1.0 (1.18)	
Mean		0.3 (0.86)	0.5 (0.94)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.15

Between Counts : 0.07

Treatments x Counts : 0.21

Table 16. Effect of TNAU-made soft soaps on aphids *A. gossypii* on brinjal in screenhouse

Treatments	Dose	Number of aphids / 2 leaves			% reduction from control
		3 DAT	7 DAT	Mean	
Soft Soap: 1	2.0 %	1.8 (1.50)	5.5 (2.45)	3.7 (1.98)	47.1
Soft Soap: 2	2.0 %	2.3 (1.66)	10.3 (3.28)	6.3 (2.47)	10.0
Soft Soap: 3	2.0 %	3.8 (2.07)	9.5 (3.15)	6.7 (2.61)	4.3
Soft Soap: 4	2.0 %	3.0 (1.86)	2.8 (1.81)	2.9 (1.83)	58.6
Soft Soap: 5	2.0%	3.3 (1.94)	3.5 (1.99)	3.4 (1.97)	51.4
Fish Oil Soap	2.5 %	2.8 (1.81)	3.3 (1.94)	3.1 (1.87)	55.7
Imidacloprid 17.8 SL	50 g ai/ha	0.5 (1.00)	0.8 (1.14)	0.7 (1.07)	90.0
Spinosad 45 SC	90 g ai/ha	2.0 (1.56)	2.0 (1.56)	2.0 (1.56)	71.4
Avermectin 1.9 EC	5 g ai/ha	3.3 (1.94)	4.3 (2.18)	3.8 (2.06)	45.7
Control		6.5 (2.64)	7.5 (2.83)	7.0 (2.73)	
Mean		2.9 (1.80)	5.0 (2.23)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.08
Between Counts	:	0.03
Treatments x Counts	:	0.11

Table 17. Effect of TNAU-made soft soaps on mealybug *P. solenopsis* on brinjal in screenhouse

Treatments	Dose	No. of 3rd / 4th instars / 2-node shoot			% reduction from control
		3 DAT	7 DAT	Mean	
Soft Soap: 1	2.0 %	0.5 (1.00)	1.5 (1.39)	1.0 (1.20)	71.4
Soft Soap: 2	2.0 %	1.3 (1.31)	2.3 (1.66)	1.8 (1.49)	48.6
Soft Soap: 3	2.0 %	0.5 (0.98)	1.0 (1.18)	0.8 (1.08)	77.1
Soft Soap: 4	2.0 %	2.0 (1.56)	0.5 (0.98)	1.3 (1.27)	62.9
Soft Soap: 5	2.0%	0.3 (0.87)	1.5 (1.39)	0.9 (1.13)	74.3
Fish Oil Soap	2.5 %	0.5 (1.00)	0.5 (0.98)	0.5 (0.99)	85.7
Imidacloprid 17.8 SL	50 g ai/ha	0.5 (0.98)	0.3 (0.89)	0.4 (0.94)	88.6
Spinosad 45 SC	90 g ai/ha	0.8 (1.14)	0.0 (0.71)	0.4 (0.92)	88.6
Avermectin 1.9 EC	5 g ai/ha	1.3 (1.31)	1.8 (1.50)	1.6 (1.41)	54.3
Control		2.0 (1.56)	5.0 (2.34)	3.5 (1.95)	
Mean		1.0 (1.17)	1.4 (1.30)		

Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.22
Between Counts	:	0.09
Treatments x Counts	:	0.31

Table 23. Effect of TNAU-made soft soaps on yellow vein clearing mosaic viral infection (BYVMD) on bhendi transmitted by *B. tabaci*

Treatments	Dose	Virus infected plants (%)		Pooled Mean	% reduction from control
		Expt. - 1	Expt. - 2		
Soft Soap: 1	2.0 %	11.2 (19.53)	8.5 (16.91)	9.8 (18.22)	44.6
Soft Soap: 2	2.0 %	22.5 (28.27)	9.8 (18.24)	16.1 (23.25)	9.0
Soft Soap: 3	2.0 %	6.7 (15.02)	8.4 (16.79)	7.5 (15.91)	57.6
Soft Soap: 4	2.0 %	6.8 (10.71)	5.9 (14.01)	6.3 (12.36)	64.4
Soft Soap: 5	2.0%	20.4 (26.82)	16.7 (24.07)	18.5 (25.44)	4.5
Fish Oil Soap	2.5 %	22.7 (28.67)	15.7 (23.33)	19.2 (26.00)	8.5
Imidacloprid 17. 8 SL	50 g ai/ha	21.3 (27.47)	9.9 (13.81)	15.6 (20.65)	11.9
Profenofos 50 EC	500 g ai/ha	35.4 (36.88)	11.2 (19.51)	23.3 (28.20)	3.2
Avermectin 1.9 EC	5 g ai/ha	7.8 (16.23)	1.9 (7.71)	4.8 (11.97)	72.9
Control		21.1 (27.32)	14.4 (22.26)	17.7 (24.79)	
Mean		17.5 (23.69)	10.2 (17.66)	13.8 (20.68)	

(Mean of four replications. Figures in parenthesis are angular transformed values)

		C D (P=0.05)
Between Treatments	:	2.21
Between Experiments	:	0.98
Treatments x Experiments	:	3.13

Table 26. Effect of TNAU-made soft soaps on fruit yield in bhendi

Treatments	Dose	Yield (kg/ ha^3 pickings)		Pooled Mean
		Experiment - 1	Experiment - 2	
Soft Soap: 1	2.0 %	1405.6	1407.4	1406.5
Soft Soap: 2	2.0 %	1223.6	1178.9	1201.3
Soft Soap: 3	2.0 %	1265.5	1278.3	1271.9
Soft Soap: 4	2.0 %	1474.0	1682.3	1578.2
Soft Soap: 5	2.0 %	1366.0	1445.8	1405.9
Fish Oil Soap	2.0 %	1121.0	1367.2	1244.1
Imidacloprid 17.8 SL	2.5 %	1623.0	1360.1	1491.6
Profenofos 50 EC	50 g ai/ha	1614.5	1650.9	1632.7
Avermectin 1.9 EC	500 g ai/ ha	1478.6	1585.4	1532.0
Control	5 g ai /ha	1419.9	1314.8	1367.3
Mean		1399.2	1427.1	1413.1

(Mean of three replications)

		C D (P=0.05)
Between Treatments	:	137.66
Between Experiments	:	NS
Treatments x Experiments	:	194.68

Table 30. Effect of TNAU-made soft soaps on yield in brinjal

Treatments	Dose	Yield of borer free fruits kg/ ha / 3 pickings)		Pooled Mean
		Experiment - 1	Experiment - 2	
Soft Soap: 1	2.0 %	1030.3	1771.0	1400.7
Soft Soap: 2	2.0 %	1904.0	1588.2	1746.1
Soft Soap: 3	2.0 %	1479.0	1799.6	1639.3
Soft Soap: 4	2.0 %	1996.9	2272.0	2134.4
Soft Soap: 5	2.0 %	1718.8	1823.3	1271.0
Fish Oil Soap	2.5 %	1946.8	2409.7	2178.3
Imidacloprid 17.8 SL	50 g ai/ha	1894.5	1462.5	1678.5
Spinosad 45 SC	90 g ai/ha	4791.0	1871.3	5331.1
Avermectin 1.9 EC	5 g ai/ha	1213.1	1878.0	1520.6
Control		2148.6	1870.8	2009.7
Mean		2012.3	2269.6	2141.0

(Mean of three replications)

		C D (P=0.05)
Between Treatments	:	358.65
Between Experiments	:	160.39
Treatments x Experiments	:	507.21

Table 34. Effect of TNAU-made soft soaps on mite, *P. latus* damaged plants in chilli

Treatments	Dose	Mite damaged plants (%)		Pooled Mean	% reduction from control
		Expt. - 1	Expt. - 2		
Soft Soap: 1	2.0 %	0.0 (1.81)	0.0 (1.81)	0.0 (1.81)	100.0
Soft Soap: 2	2.0 %	0.0 (1.81)	0.0 (1.81)	0.0 (1.81)	100.0
Soft Soap: 3	2.0 %	0.5 (4.18)	0.7 (4.43)	0.6 (4.30)	0.0
Soft Soap: 4	2.0 %	1.2 (6.24)	0.5 (4.05)	0.8 (5.15)	33.3
Soft Soap: 5	2.0 %	0.0 (1.81)	0.0 (1.81)	0.0 (1.81)	100.0
Fish Oil Soap	2.5 %	0.0 (1.81)	0.5 (4.18)	0.2 (2.99)	6.7
Imidacloprid 17.8 SL	50 g ai/ha	1.9 (7.33)	2.3 (8.80)	2.1 (8.07)	250.0
Spinosad 45 SC	90 g ai/ha	1.4 (6.53)	1.6 (7.15)	1.5 (6.84)	150.0
Avermectin 1.9 EC	5 g ai/ha	0.0 (1.81)	0.0 (1.81)	0.0 (1.81)	100.0
Control		0.0 (1.81)	1.2 (6.27)	0.6 (4.04)	
Mean		0.5 (3.51)	0.7 (4.21)	0.6 (3.86)	

(Mean of three replications. Figures in parenthesis are angular transformed values)

		C D (P=0.05)
Between Treatments	:	0.89
Between Experiments	:	0.40
Treatments x Experiments	:	1.25

Table 36. Effect of TNAU-made soft soaps on yield in chilli

Treatments	Dose	Yield (kg/ ha/ picking)		Pooled Mean	B:C ratio (for 5 pickings)
		Experiment-1	Experiment-2		
Soft Soap: 1	2.0 %	725.2	751.8	738.5	- 0.05 : 1
Soft Soap: 2	2.0 %	765.5	730.4	747.9	- 0.03 : 1
Soft Soap: 3	2.0 %	876.9	941.3	909.1	1.42 : 1
Soft Soap: 4	2.0 %	678.9	872.7	775.8	0.27 : 1
Soft Soap: 5	2.0 %	756.9	815.2	786.1	0.36 : 1
Fish Oil Soap	2.5 %	581.1	750.1	665.7	- 0.39 : 1
Imidacloprid 17. 8 SL	50 g ai/ha	642.2	717.4	682.3	- 0.76 : 1
Spinosad 45 SC	90 g ai/ha	835.8	869.3	852.5	0.43 : 1
Avermectin 1.9 EC	5 g ai/ha	632.6	851.1	741.8	0.02 : 1
Control		707.2	780.9	744.1	
Mean		720.7	808.0	764.3	

(Mean of three replications)

		C D (P=0.05)
Between Treatments	:	55.57
Between Experiments	:	24.85
Treatments x Experiments	:	78.59

Table 4. Effect of TNAU-made soft soap on castor whitefly *T. ricini* adults recolonizing on the second leaf from top in screenhouse (Experiment – 1)

Treatments	Dose	No. of whiteflies / leaf section										Mean
		1 DAT	2 DAT	3 DAT	4 DAT	5 DAT	6 DAT	7 DAT	8 DAT	9 DAT	10 DAT	
Soft Soap: 1	2.0 %	4.5 (2.23)	4.3 (2.15)	0.5 (0.98)	0.5 (0.98)	0.5 (0.98)	0.8 (0.85)	0.3 (0.85)	0.5 (0.98)	0.3 (0.85)	0.0 (0.71)	1.2 (1.16)
Soft Soap: 2	2.0 %	0.5 (0.98)	4.3 (2.17)	0.5 (0.98)	0.8 (1.10)	0.3 (0.85)	0.3 (0.85)	0.5 (0.98)	0.0 (0.71)	0.0 (0.71)	0.3 (0.85)	0.8 (1.02)
Soft Soap: 3	2.0 %	1.5 (1.36)	4.3 (2.26)	0.0 (0.71)	0.0 (1.18)	1.0 (0.98)	0.5 (0.98)	0.0 (0.71)	0.8 (1.10)	0.5 (0.91)	0.0 (0.71)	0.9 (1.09)
Soft Soap: 4	2.0 %	0.5 (0.98)	0.3 (0.85)	0.0 (0.71)	0.0 (0.71)	0.5 (1.04)	0.3 (0.85)	0.3 (0.85)	0.8 (1.10)	0.5 (0.98)	0.8 (1.10)	0.4 (0.92)
Soft Soap: 5	2.0 %	1.8 (0.98)	2.8 (1.80)	1.0 (1.18)	0.5 (0.98)	0.3 (0.85)	0.0 (0.71)	0.3 (0.85)	0.5 (0.98)	0.3 (0.85)	0.0 (0.71)	0.8 (0.99)
Fish Oil Soap	2.5 %	0.5 (0.98)	0.0 (0.71)	0.5	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.3 (0.85)	0.5 (0.98)	0.0 (0.71)	0.3 (0.85)	0.2 (0.82)

				(0.98)								
Imidacloprid 17.8 SL	50 g ai/ha	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.3 (0.85)	0.5 (0.98)	0.3 (0.85)	0.3 (0.85)	0.0 (0.71)	0.3 (0.85)	0.0 (0.71)	0.2 (0.79)
Triazophos 40 EC	400 g ai/ha	1.8 (1.49)	1.5 (1.36)	1.5 (1.40)	0.3 (0.85)	0.8 (1.10)	0.5 (0.98)	0.8 (1.10)	0.8 (1.10)	0.5 (0.98)	0.3 (0.85)	0.9 (1.12)
Control		8.0 (2.91)	6.5 (2.63)	5.0 (2.32)	4.3 (2.18)	3.0 (1.85)	2.8 (1.79)	1.0 (1.22)	1.3 (1.31)	1.0 (1.22)	1.3 (1.31)	3.4 (1.88)
Mean		2.1 (1.40)	2.7 (1.63)	1.0 (1.11)	0.7 (1.06)	0.8 (1.04)	0.6 (0.95)	0.4 (0.92)	0.6 (0.99)	0.4 (0.90)	0.3 (0.87)	

Table 5. Effect of TNAU-made soft soap on recolonization of castor whitefly *T. ricini* adults recolonizing on the second leaf from top in screenhouse (Experiment – 2)

Treatments	Dose	No. of whiteflies / leaf section										Mean
		1 DAT	2 DAT	3 DAT	4 DAT	5 DAT	6 DAT	7 DAT	8 DAT	9 DAT	10 DAT	
Soft Soap: 1	2.0 %	0.8 (1.10)	5.8 (2.48)	2.5 (1.73)	4.0 (2.12)	0.3 (0.85)	0.3 (0.85)	0.5 (0.98)	0.3 (0.85)	0.0 (0.71)	0.0 (0.71)	1.5 (1.24)
Soft Soap: 2	2.0 %	0.3 (0.85)	0.0 (0.71)	0.5 (0.98)	0.0 (0.71)	0.3 (0.85)	0.3 (0.85)	0.0 (0.71)	0.3 (0.85)	0.0 (0.71)	0.0 (0.71)	0.2 (0.79)
Soft Soap: 3	2.0 %	2.5 (1.73)	1.8 (1.49)	1.3 (1.31)	1.0 (0.71)	0.5 (1.18)	0.5 (0.98)	0.0 (0.71)	0.8 (1.10)	0.0 (0.71)	0.0 (0.71)	0.8 (1.06)
Soft Soap: 4	2.0 %	0.5 (0.98)	7.0 (2.53)	2.5 (1.72)	1.0 (1.18)	0.5 (0.98)	0.5 (0.98)	0.0 (0.71)	0.8 (1.10)	0.8 (1.10)	0.3 (0.85)	1.4 (1.21)
Soft Soap: 5	2.0 %	0.5 (1.49)	0.0 (0.71)	0.3 (0.85)	0.8 (1.10)	1.0 (1.18)	0.5 (0.98)	0.0 (0.71)	0.5 (0.98)	0.3 (0.85)	0..0 (0.71)	0.4 (0.96)
Fish Oil Soap	2.5 %	0.3 (0.85)	0.3 (0.85)	0.0 (0.71)	0.3 (0.85)	0.0 (0.71)	0.5 (0.98)	0.0 (0.71)	0.3 (0.98)	0.3 0.85()	0..0 (0.71)	0.2 (0.82)

Imidacloprid 17.8 SL	50 g ai/ha	0.5 (0.98)	1.0 (1.22)	0.0 (0.71)	0.0 (0.71)	0.5 (0.98)	1.0 (1.18)	0.3 (0.85)	0.3 (0.85)	0.8 (1.10)	0.0 (0.71)	0.4 (0.93)
Triazophos 40 EC	400 g ai/ha	0.8 (1.10)	1.3 (1.31)	0.0 (0.71)	0.0 (0.71)	0.3 (0.85)	1.3 (1.31)	0.3 (0.85)	0.3 (0.85)	1.3 (1.26)	0.3 (0.85)	0.6 (0.98)
Control		16.8 (4.15)	23.5 (4.88)	21.5 (4.69)	16.5 (4.11)	10.5 (3.29)	8.5 (2.99)	2.8 (1.80)	0.8 (1.10)	0.8 (1.10)	0.3 (0.85)	10.2 (2.90)
Mean		2.6 (1.47)	4.5 (1.80)	3.2 (1.49)	2.6 (1.35)	1.5 (1.29)	1.5 (1.24)	0.4 (0.89)	0.5 (0.96)	0.5 (0.93)	0.1 (0.76)	

Table 6. Effect of TNAU-made soft soap on recolonization of castor whitefly *T. ricini* adults recolonizing on the second leaf from top in screenhouse after pooled analysis

Treatments	Dose	Mean No. of whiteflies / leaf section from Experiment – 1 & 2										Pooled Mean	% reduction from control
		1 DAT	2 DAT	3 DAT	4 DAT	5 DAT	6 DAT	7 DAT	8 DAT	9 DAT	10 DAT		
Soft Soap: 1	2.0 %	2.7 (1.66)	5.1 (2.32)	1.5 (1.35)	2.3 (1.55)	0.4 (0.92)	0.6 (0.85)	0.4 (0.92)	0.4 (0.91)	0.2 (0.78)	0.0 (0.71)	1.3 (1.20)	80.8
Soft Soap: 2	2.0 %	0.4 (0.92)	2.2 (1.44)	0.5 (.98)	0.4 (0.90)	0.3 (0.85)	0.3 (0.85)	0.3 (0.85)	0.2 (0.78)	0.0 (0.70)	0.2 (0.78)	0.5 (0.91)	92.6
Soft Soap: 3	2.0 %	2.0 (1.54)	3.1 (1.87)	0.7 (1.01)	0.5 (0.95)	0.8 (1.08)	0.5 (0.98)	0.0 (0.71)	0.8 (1.10)	0.3 (0.81)	0.0 (0.71)	0.9 (1.08)	86.7
Soft Soap: 4	2.0 %	0.5 (0.98)	3.7 (1.69)	1.3 (1.22)	0.5 (0.95)	0.5 (1.01)	0.4 (0.92)	0.2 (0.78)	0.8 (1.10)	0.7 (1.04)	0.6 (0.97)	0.9 (1.07)	86.7
Soft Soap: 5	2.0 %	1.2 (1.24)	1.4 (1.25)	0.7 (1.01)	0.7 (1.04)	0.7 (1.02)	0.3 (0.85)	0.2 (0.78)	0.5 (0.98)	0.3 (0.85)	0.0 (0.70)	0.6 (0.97)	91.1
Fish Oil Soap	2.5 %	0.4 (0.92)	0.2 (0.78)	0.3 (0.85)	0.2 (0.78)	0.0 (0.71)	0.3 (0.85)	0.2 (0.78)	0.4 (0.90)	0.2 (0.78)	0.2 (0.78)	0.2 (0.82)	97.0
Imidacloprid 17.8 SL	50 g ai/ha	0.3	0.5	0.0	0.2	0.5 (0.98)	0.7 (1.02)	0.3 (0.85)	0.2 (0.78)	0.6 (0.97)	0.0 (0.70)	0.3 (0.86)	95.5

		(0.85)	(0.97)	(0.71)	(0.78)								
Triazophos 40 EC	400 g ai/ha	1.3 (1.29)	1.4 (1.34)	0.8 (1.06)	0.2 (0.78)	0.6 (0.97)	0.9 (1.15)	0.6 (0.97)	0.6 (0.97)	0.9 (1.12)	0.3 (0.85)	0.7 (1.05)	89.7
Control		12.4 (3.53)	15.0 (3.75)	13.3 (3.50)	10.4 (3.14)	6.8 (2.57)	5.7 (2.39)	1.9 (1.51)	1.1 (1.20)	0.9 (1.16)	0.8 (1.08)	6.8 (2.39)	
Mean		2.3 (1.44)	3.6 (1.71)	2.1 (1.30)	1.7 (1.21)	1.2 (1.12)	1.1 (1.10)	0.4 (0.91)	0.5 (0.97)	0.4 (0.91)	0.2 (0.81)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments	:	0.06
Between Counts	:	0.06
Between Experiments	:	0.03
Treatments x Counts	:	0.19
Counts x Experiments	:	0.09
Treatments x Experiments	:	0.09
Treatments x Counts x Experiments	:	0.27

Table 7. Effect of TNAU-made soft soap on per cent reduction in recolonization of *T. ricini* adults on the second leaf of castor shoot in screenhouse (Experiment – 1)

Treatments	Dose	Percent reduction from control in no. of whiteflies / leaf section										Mean
		1 DAT	2 DAT	3 DAT	4 DAT	5 DAT	6 DAT	7 DAT	8 DAT	9 DAT	10 DAT	
Soft Soap: 1	2.0 %	42.9 (40.81)	35.5 (33.21)	86.5 (71.72)	87.5 (72.08)	87.5 (72.08)	89.6 (76.33)	75.0 (67.36)	56.3 (49.13)	75.0 (67.36)	100.0 (89.72)	73.6 (63.98)
Soft Soap: 2	2.0 %	93.6 (77.51)	27.4 (24.81)	86.5 (71.72)	81.3 (67.43)	90.6 (77.18)	89.6 (76.33)	50.0 (45.38)	100.0 (89.72)	100.0 (89.72)	75.0 (67.36)	79.4 (68.72)
Soft Soap: 3	2.0 %	81.6 (67.71)	28.3 (28.88)	100.0 (89.72)	100.0 (89.72)	87.5 (74.86)	83.3 (68.90)	100.0 (89.72)	37.5 (34.59)	25.0 (45.38)	100.0 (89.72)	74.3 (67.92)
Soft Soap: 4	2.0 %	93.6 (77.51)	95.7 (81.36)	100.0 (89.72)	100.0 (89.72)	68.8 (57.15)	89.6 (76.33)	75.0 (67.36)	37.5 (34.59)	50.0 (45.38)	37.5 (34.59)	74.8 (65.36)
Soft Soap: 5	2.0 %	78.0 (62.22)	55.9 (48.45)	81.9 (68.05)	87.5 (72.08)	90.6 (77.18)	100.0 (89.72)	75.0 (67.36)	56.3 (49.13)	75.0 (67.36)	100.0 (89.72)	80.0 (69.12)
Fish Oil Soap	2.5 %	93.6 (77.51)	100.0 (89.72)	90.6 (74.51)	100.0 (89.72)	100.0 (89.72)	100.0 (89.72)	75.0 (67.36)	56.3 (49.13)	100.0 (89.72)	81.3 (71.11)	89.7 (78.82)
Imidacloprid 17.8 SL	50 g ai/ha	100.0 (89.72)	100.0 (89.72)	100.0 (89.72)	93.8 (79.51)	84.4 (69.75)	89.6 (76.33)	75.0 (67.36)	100.0 (89.72)	75.0 (67.36)	100.0 (89.72)	91.8 (80.89)
Triazophos 40 EC	400 g ai/ha	78.0 (62.22)	77.3 (64.99)	67.3 (55.54)	94.4 (80.07)	68.8 (59.93)	83.3 (68.90)	25.0 (23.79)	37.5 (34.59)	50.0 (45.38)	75.0 (67.36)	65.7

												(54.08)
Mean		82.7 (69.40)	65.0 (57.64)	89.1 (76.33)	93.1 (80.03)	84.8 (72.23)	90.6 (77.81)	68.8 (59.21)	60.2 (53.82)	68.8 (64.70)	83.6 (74.90)	

Table 8. Effect of TNAU-made soft soap on per cent reduction in recolonization of *T. ricini* adults on the second leaf of castor shoot in screenhouse (Experiment – 2)

Treatments	Dose	Percent reduction from control in No. of whiteflies / leaf section in Experiment - 2										Mean
		1 DAT	2 DAT	3 DAT	4 DAT	5 DAT	6 DAT	7 DAT	8 DAT	9 DAT	10 DAT	
Soft Soap: 1	2.0 %	95.3 (79.01)	75.3 (60.31)	87.1 (69.06)	81.8 (65.74)	97.1 (82.93)	97.3 (83.19)	81.3 (67.59)	50.0 (4.38)	75.0 (67.74)	50.0 (45.76)	70.2 (66.67)
Soft Soap: 2	2.0 %	98.4 (84.76)	100.0 (89.72)	97.6 (82.32)	100.0 (89.72)	96.9 (82.77)	96.7 (82.39)	100.0 (89.72)	50.0 (4.38)	75.0 (67.74)	50.0 (45.76)	86.5 (76.03)
Soft Soap: 3	2.0 %	84.3 (67.21)	70.0 (74.21)	94.2 (76.23)	94.0 (77.93)	69.1 (78.08)	93.8 (77.71)	100.0 (89.72)	0.0 (1.81)	75.0 (67.74)	50.0 (45.76)	73.0 (65.64)
Soft Soap: 4	2.0 %	96.8 (81.08)	74.3 (59.68)	88.2 (70.06)	93.1 (76.98)	94.4 (78.58)	93.8 (77.71)	100.0 (89.72)	0.0 (1.81)	0.0 (1.81)	50.0 (45.76)	69.1 (58.32)
Soft Soap: 5	2.0 %	96.8 (81.08)	100.0 (89.72)	98.9 (85.50)	95.7 (79.53)	88.1 (72.39)	93.3 (77.71)	100.0 (89.72)	25.0 (23.41)	50.0 (45.38)	0.0 (1.81)	74.8 (64.57)
Fish Oil Soap	2.5 %	98.4 (84.76)	98.9 (85.71)	100.0 (89.72)	98.2 (84.35)	100.0 (89.72)	93.9 (77.83)	100.0 (89.72)	62.5 (56.56)	50.0 (45.38)	50.0 (45.76)	85.2 (74.95)
Imidacloprid 17.8 SL	50 g	96.8	95.6	100.0	100.0	69.4	87.1	89.6	62.5	0.0	50.0	75.1

	ai/ha	(81.08)	(77.94)	(89.72)	(89.72)	(56.60)	(71.70)	(76.33)	(56.56)	(1.81)	(45.76)	(64.72)
Triazophos 40 EC	400 g ai/ha	95.3 (79.01)	94.8 (76.81)	100.0 (89.72)	100.0 (89.72)	97.9 (83.89)	85.6 (67.78)	89.6 (76.33)	62.5 (56.56)	25.0 (23.79)	0.0 (1.81)	75.1 (64.54)
Mean		95.3 (79.74)	88.6 (76.76)	95.8 (81.54)	95.4 (81.71)	89.1 (78.12)	92.6 (76.93)	95.1 (83.60)	39.1 (35.93)	43.8 (40.17)	37.5 (34.77)	

Table 9. Effect of TNAU-made soft soap on per cent reduction in recolonization of *T. ricini* adults on the second leaf of castor shoot in screenhouse after pooled analysis

Treatments	Dose	Percent reduction from control in No. of whiteflies / leaf section from Experiment 1 & 2										Pooled
		1 DAT	2 DAT	3 DAT	4 DAT	5 DAT	6 DAT	7 DAT	8 DAT	9 DAT	10 DAT	Mean
Soft Soap: 1	2.0 %	69.1 (59.91)	55.4 (46.76)	86.8 (70.38)	84.7 (68.91)	92.3 (77.50)	93.5 (79.76)	78.2 (67.47)	53.2 (47.25)	75.0 (67.54)	75.0 (67.74)	76.3 (65.33)
Soft Soap: 2	2.0 %	96.0	63.7	92.1	90.7	93.8	93.2	75.0	75.0	87.5	62.5	82.9

		(81.13)	(57.26)	(77.02)	(78.57)	(79.97)	(79.36)	(67.54)	(67.54)	(78.72)	(56.56)	(72.37)
Soft Soap: 3	2.0 %	83.0 (67.46)	49.2 (51.54)	97.1 (82.97)	97.0 (83.82)	78.3 (76.47)	88.6 (73.30)	100.0 (89.71)	18.8 (18.19)	50.0 (56.56)	75.0 (67.74)	73.7 (66.78)
Soft Soap: 4	2.0 %	95.2 (79.29)	85.0 (70.51)	94.1 (79.88)	96.6 (83.34)	81.6 (67.86)	91.7 (77.01)	87.5 (78.53)	18.8 (19.19)	25.0 (23.59)	43.8 (40.17)	71.9 (61.84)
Soft Soap: 5	2.0 %	87.4 (71.64)	78.0 (69.08)	90.4 (76.77)	91.6 (75.80)	89.4 (74.78)	96.7 (83.44)	87.5 (78.53)	40.7 (36.26)	62.5 (56.37)	50.0 (45.76)	77.4 (66.85)
Fish Oil Soap	2.5 %	96.0 (81.13)	99.5 (87.71)	95.3 (82.11)	99.1 (87.03)	100.0 (89.71)	97.0 (83.77)	87.5 (78.53)	59.4 (52.84)	75.0 (67.54)	65.7 (58.43)	87.4 (76.89)
Imidacloprid 17.8 SL	50 g ai/ha	98.4 (85.39)	97.8 (83.82)	100.0 (89.71)	96.9 (84.61)	76.9 (63.17)	88.4 (74.01)	82.3 (71.84)	81.3 (73.13)	37.5 (34.58)	75.0 (67.74)	83.4 (72.81)
Triazophos 40 EC	400 g ai/ha	86.7 (70.61)	86.1 (70.90)	83.7 (72.63)	97.2 (84.89)	83.4 (71.91)	84.5 (68.34)	57.3 (39.07)	50.0 (45.57)	37.5 (34.58)	37.5 (34.58)	70. 4 (59.31)
Mean		89.0 (74.57)	76.8 (67.20)	92.4 (78.94)	94.2 (80.88)	86.9 (75.18)	91.7 (77.38)	81.9 (71.41)	49.6 (44.88)	56.3 (52.44)	60.6 (54.84)	

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	6.44
Between Counts	:	7.20
Between Experiments	:	NS
Treatments x Counts	:	20.37
Counts x Experiments	:	10.18
Treatments x Experiments	:	9.11
Treatments x Counts x Experiments	:	28.81

Table 10. Effect of TNAU-made soft soap on castor whitefly *T. ricini* adults infesting newly emerging leaves after spray in screenhouse

Treatments	Dose	No. of whiteflies / leaf section										
		Experiment - 1			Mean	Experiment - 2			Mean	Mean			Pooled Mean
		1 DAT	7 DAT	14 DAT		1 DAT	7 DAT	14 DAT		1 DAT	7 DAT	14 DAT	
Soft Soap: 1	2.0 %	4.5 (5.03)	3.0 (2.14)	7.3 (1.09)	4.9 (2.76)	0.8 (6.69)	5.3 (2.23)	6.3 (1.86)	4.1 (3.60)	2.7 (5.86)	4.2 (2.19)	6.8 (1.48)	4.5 (3.18)
Soft Soap: 2	2.0 %	0.5 (2.38)	4.5 (2.58)	8.8 (0.85)	4.6 (1.94)	0.3 (2.77)	8.8 (0.98)	8.5 (2.23)	5.9 (2.00)	0.4 (2.58)	6.7 (1.78)	8.7 (1.54)	5.2 (1.97)
Soft Soap: 3	2.0 %	1.5 (3.042)	5.0 (2.99)	10.3 (1.73)	5.6 (2.59)	2.5 (3.03)	4.3 (1.40)	10.0 (2.34)	5.6 (2.25)	2.0 (3.03)	4.7 (2.20)	10.2 (2.03)	5.6 (2.42)
Soft Soap: 4	2.0 %	0.5 (2.16)	6.0 (1.73)	12.3 (0.98)	6.3 (1.62)	0.5 (3.27)	7.3 (0.98)	11.3 (2.55)	6.4 (2.27)	0.5 (2.71)	6.7 (1.35)	11.8 (1.77)	6.3 (1.95)
Soft Soap: 5	2.0 %	1.8 (2.77)	5.5 (3.42)	10.5 (0.98)	5.9 (2.39)	0.5 (3.57)	7.8 (1.49)	9.3 (2.44)	5.9 (2.50)	1.2 (3.17)	6.7 (2.45)	9.9 (1.71)	5.9 (2.45)
Fish Oil Soap	2.5 %	0.5 (2.87)	1.8 (3.11)	2.8 (0.85)	1.7 (2.28)	0.3 (3.31)	10.5 (0.98)	7.8 (1.49)	6.2 (1.93)	0.4 (3.09)	6.2 (2.05)	5.3 (1.17)	4.0 (2.10)
Imidacloprid 17.8 SL	50 g ai/ha	0.0 (3.31)	3.5 (2.87)	6.8 (0.98)	3.4 (2.38)	0.5 (1.80)	1.3 (0.70)	8.3 (2.00)	3.4 (1.50)	0.3 (2.56)	2.4 (1.79)	7.6 (1.49)	3.4 (1.94)

Triazophos 40 EC	400 g ai/ha	1.8 (1.27)	4.0 (2.95)	7.5 (1.09)	4.4 (1.77)	0.8 (2.69)	6.8 (1.49)	6.8 (2.11)	4.8 (2.10)	1.3 (1.98)	5.4 (2.22)	7.2 (1.61)	4.6 (1.94)
Cotrol		8.0 (2.68)	10.0 (2.68)	17.8 (4.15)	11.9 (3.17)	16.8 (2.82)	18.3 (2.91)	7.0 (3.23)	14.0 (2.99)	12.4 (2.75)	14.2 (2.80)	12.4 (3.69)	13.0 (3.08)
Mean		2.1 (2.84)	4.8 (2.72)	9.3 (1.41)	5.4 (2.32)	2.6 (3.33)	7.8 (1.47)	8.4 (2.25)	6.2 (2.35)	2.3 (3.08)	6.3 (2.09)	8.9 (1.83)	

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.42
Between Counts	:	0.24
Between Experiments	:	NS
Treatments x Counts	:	0.72
Counts x Experiments	:	0.34
Treatments x Experiments	:	0.59
Treatments x Counts x Experiments	:	1.02

C D (P=0.05)

Between Treatments : 0.17

Table 12. Effect of TNAU-made soft soap on thrips *S. dorsalis* on chilli in screenhouse

Treatments	Dose	Numbers / apical three leaves								Mean	% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean			
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	2.3 (1.66)	1.8 (1.50)	2.1 (1.58)	3.5 (1.99)	1.8 (1.50)	2.7 (1.74)	2.9 (1.83)	1.8 (1.50)	2.4 (1.66)	14.3
Soft Soap: 2	2.0 %	3.8 (1.07)	2.0 (1.45)	2.9 (1.76)	4.3 (1.98)	0.8 (1.25)	2.6 (1.62)	4.1 (2.02)	1.4 (1.35)	2.7 (1.69)	3.6
Soft Soap: 3	2.0 %	2.0 (1.59)	1.8 (1.47)	1.9 (1.53)	2.3 (1.62)	1.5 (1.43)	1.9 (1.53)	2.2 (1.61)	1.7 (1.45)	1.9 (1.53)	32.1
Soft Soap: 4	2.0 %	2.0 (1.67)	2.5 (1.72)	2.3 (1.69)	3.5 (1.93)	3.5 (1.99)	3.5 (1.96)	2.8 (1.80)	3.0 (1.86)	2.9 (1.83)	3.6
Soft Soap: 5	2.0 %	2.5 (1.59)	1.5 (1.39)	2.0 (1.49)	3.8 (2.07)	2.8 (1.81)	3.3 (1.94)	3.2 (1.83)	2.2 (1.60)	2.7 (1.71)	3.6
Fish Oil Soap	2.5 %	4.5 (2.23)	1.3 (1.34)	2.9 (1.79)	3.0 (1.86)	1.5 (1.39)	2.3 (1.63)	3.8 (2.05)	1.4 (1.37)	2.6 (1.71)	7.1
Imidacloprid 17.8 SL	50 g ai/ha	2.5 (1.72)	1.0 (1.23)	1.8 (1.48)	1.3 (1.34)	1.0 (1.22)	1.2 (1.28)	1.9 (1.53)	1.0 (1.23)	1.5 (1.38)	46.4
Spinosad 45 SC	90 g ai/ha	0.0 (0.71)	0.3 (0.87)	0.2 (0.79)	0.3 (0.89)	0.3 (0.87)	0.3 (0.88)	0.2 (0.80)	0.3 (0.80)	0.2 (0.84)	92.9
Avermectin 1.9 EC	5 g ai/ha	2.0 (1.56)	1.3 (1.34)	1.7 (1.45)	1.5 (1.39)	1.8 (1.50)	1.7 (1.44)	1.8 (1.48)	1.6 (1.42)	1.7 (1.45)	39.3
Control		4.5 (2.23)	2.0 (1.56)	3.3 (1.90)	2.0 (1.56)	2.8 (1.71)	2.4 (1.64)	3.3 (1.90)	2.4 (1.64)	2.8 (1.77)	
Mean		2.6 (1.70)	1.6 (1.39)	2.1 (1.55)	2.6 (1.66)	1.8 (1.47)	2.2 (1.57)	2.6 (1.68)	1.7 (1.43)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

Between Counts	:	0.07
Between Experiments	:	NS
Treatments x Counts	:	0.24
Counts x Experiments	:	NS
Treatments x Experiments	:	0.24
Treatments x Counts x Experiments	:	0.33

Table 13. Effect of TNAU-made soft soap on aphids *A. gossypii* and *M. persicae* on chillies screenhouse

Treatments	Dose	Numbers / 2 leaves									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	0.4 (0.95)	1.0 (1.18)	0.7 (1.07)	0.5 (1.18)	0.5 (0.98)	0.5 (1.08)	0.5 (1.07)	0.8 (1.08)	0.6 (1.08)	77.8
Soft Soap: 2	2.0 %	0.4 (0.95)	1.3 (1.31)	0.9 (1.13)	1.4 (1.31)	1.4 (1.35)	1.4 (1.33)	0.9 (1.13)	1.4 (1.33)	1.1 (1.23)	59.3
Soft Soap: 3	2.0 %	1.6 (1.43)	3.5 (1.99)	2.6 (1.71)	1.3 (1.34)	1.3 (1.31)	1.3 (1.33)	1.5 (1.38)	2.4 (1.65)	1.9 (1.52)	29.6
Soft Soap: 4	2.0 %	4.4 (2.21)	1.8 (1.50)	3.1 (1.85)	1.0 (1.35)	1.0 (1.22)	1.0 (1.29)	2.7 (1.78)	1.4 (1.36)	2.1 (1.57)	22.2
Soft Soap: 5	2.0 %	0.6 (1.05)	1.0 (1.18)	0.8 (1.12)	0.3 (1.35)	0.3 (0.87)	0.3 (1.11)	0.5 (1.20)	0.7 (1.03)	0.6 (1.11)	77.8
Fish Oil Soap	2.5 %	0.8 (1.14)	0.5 (0.98)	0.7 (1.06)	0.5 (1.35)	0.5 (0.98)	0.5 (1.17)	0.7 (1.25)	0.5 (0.98)	0.6 (1.11)	77.8
Imidacloprid 17.8 SL	50 g ai/ha	0.5 (0.98)	0.3 (0.87)	0.4 (0.93)	0.5 (1.18)	0.5 (0.98)	0.5 (1.08)	0.5 (1.08)	0.4 (0.93)	0.5 (1.01)	81.5
Spinosad 45 SC	90 g ai/ha	1.8 (1.50)	2.0 (1.56)	1.9 (1.53)	0.4 (1.56)	0.4 (0.95)	0.4 (1.26)	1.1 (1.53)	1.2 (1.26)	1.2 (1.39)	55.6
Avermectin 1.9 EC	5 g ai/ha	2.0 (1.56)	3.0 (1.86)	2.5 (1.71)	0.5 (1.31)	0.5 (1.00)	0.5 (1.16)	1.3 (1.44)	1.8 (1.43)	1.5 (1.43)	44.4
Control		3.8 (2.07)	3.5 (1.99)	3.7 (2.03)	1.8 (1.71)	1.8 (1.50)	1.8 (1.61)	2.8 (1.89)	2.7 (1.74)	2.7 (1.82)	
Mean		1.6 (1.38)	1.8 (1.44)	1.7 (1.41)	0.8 (1.37)	0.8 (1.12)	0.8 (1.24)	1.2 (1.38)	1.3 (1.28)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.17
Between Counts	:	0.08
Between Experiments	:	0.08
Treatments x Counts	:	0.24

Counts x Experiments	:	0.11
Treatments x Experiments	:	0.24
Treatments x Counts x Experiments	:	0.34

Table 14. Effect of TNAU-made soft soap on aphids *A. gossypii* on bhendi in screenhouse

Treatments	Dose	Number of aphids / leaf									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	2.3 (1.66)	4.5 (2.23)	3.4 (1.94)	1.3 (1.31)	2.5 (1.72)	1.9 (1.52)	1.8 (1.49)	3.5 (1.98)	2.7 (1.73)	61.4
Soft Soap: 2	2.0 %	5.3 (2.40)	3.0 (1.86)	4.2 (2.13)	3.5 (1.99)	5.3 (2.40)	4.4 (2.20)	4.4 (2.20)	4.2 (2.13)	4.3 (2.17)	38.6
Soft Soap: 3	2.0 %	3.0 (1.86)	3.8 (2.07)	3.4 (1.96)	2.8 (1.82)	3.3 (1.94)	3.1 (1.88)	2.9 (1.84)	3.6 (2.00)	3.2 (1.92)	54.3
Soft Soap: 4	2.0 %	2.0 (1.56)	4.5 (2.23)	3.3 (1.90)	0.8 (1.14)	1.3 (1.34)	1.1 (1.24)	1.4 (1.35)	2.9 (1.79)	2.2 (1.57)	68.6
Soft Soap: 5	2.0 %	8.5 (2.87)	3.3 (1.94)	5.9 (2.40)	2.5 (1.72)	3.8 (2.07)	3.2 (1.89)	5.5 (2.29)	3.6 (2.00)	4.5 (2.15)	35.7
Fish Oil Soap	2.5 %	2.0 (1.56)	2.3 (1.66)	2.2 (1.61)	2.3 (1.66)	1.3 (1.34)	1.8 (1.50)	2.2 (1.61)	1.8 (1.50)	2.0 (1.56)	71.4
Imidacloprid 17.8 SL	50 g ai/ha	0.5 (1.00)	1.0 (1.18)	0.8 (1.09)	1.3 (1.31)	0.8 (1.13)	1.1 (1.22)	0.9 (1.16)	0.9 (1.16)	0.9 (1.16)	87.1
Spinosad 45 SC	90 g ai/ha	3.8 (2.07)	3.5 (1.95)	3.7 (2.01)	3.5 (1.99)	2.5 (1.72)	3.0 (1.86)	3.7 (2.03)	3.0 (1.84)	3.3 (1.93)	52.9
Avermectin 1.9 EC	5 g ai/ha	3.9 (1.87)	4.8 (2.29)	4.3 (2.08)	5.8 (2.51)	4.3 (2.18)	5.1 (2.35)	4.8 (2.19)	4.6 (2.24)	4.7 (2.21)	32.9
Control		5.8 (2.51)	8.5 (2.99)	7.2 (2.75)	7.3 (2.79)	6.3 (2.60)	6.8 (2.70)	6.6 (2.65)	7.4 (2.80)	7.0 (2.72)	
Mean		3.7 (1.94)	3.9 (2.04)	3.8 (1.99)	3.1 (1.82)	3.1 (1.85)	3.1 (1.83)	3.4 (1.88)	3.5 (1.94)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.14

Between Counts : 0.06

Between Experiments : 0.06

Treatments x Counts	:	0.20
Counts x Experiments	:	NS
Treatments x Experiments	:	0.20
Treatments x Counts x Experiments	:	0.28

Table 15. Effect of TNAU-made soft soap on aphids *A. gossypii* on cotton in screenhouse

Treatments	Dose	Number of aphids / 2 leaves									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	7.7 (2.88)	11.2 (3.42)	9.5 (3.15)	11.2 (3.42)	16.7 (4.16)	14.0 (3.79)	9.5 (3.15)	14.0 (3.79)	11.7 (3.47)	45.1
Soft Soap: 2	2.0 %	13.2 (3.70)	12.2 (3.56)	12.7 (3.63)	27.2 (5.26)	18.2 (4.32)	22.7 (4.79)	20.2 (4.48)	15.2 (3.94)	17.7 (4.21)	16.9
Soft Soap: 3	2.0 %	6.8 (2.70)	12.0 (3.53)	9.4 (3.12)	29.4 (5.47)	23.0 (4.85)	26.2 (5.16)	18.1 (4.08)	17.5 (4.19)	17.8 (4.14)	16.4
Soft Soap: 4	2.0 %	9.0 (1.64)	4.0 (2.11)	6.5 (1.88)	25.0 (5.05)	15.5 (3.99)	20.3 (4.52)	17.0 (3.34)	9.8 (3.06)	13.4 (3.20)	37.1
Soft Soap: 5	2.0 %	8.2 (2.94)	12.7 (3.63)	10.5 (3.28)	22.2 (4.76)	16.0 (4.06)	19.1 (4.41)	15.2 (3.85)	14.4 (3.85)	14.8 (3.85)	30.5
Fish Oil Soap	2.5 %	12.0 (1.86)	7.0 (2.73)	9.5 (2.30)	15.5 (4.00)	17.7 (4.28)	16.6 (4.14)	13.8 (2.93)	12.4 (3.50)	13.1 (3.22)	38.5
Imidacloprid 17.8 SL	50 g ai/ha	1.5 (1.39)	1.7 (1.54)	1.6 (1.46)	8.8 (3.05)	6.2 (2.58)	7.5 (2.82)	5.15 (2.22)	4.0 (2.06)	4.6 (2.14)	78.4
Spinosad 45 SC	90 g ai/ha	15.0 (3.94)	3.6 (2.02)	9.3 (2.97)	19.2 (4.44)	26.5 (5.19)	22.9 (4.81)	17.1 (4.18)	15.1 (3.60)	16.1 (3.89)	24.4
Avermectin 1.9 EC	5 g ai/ha	11.0 (3.39)	10.0 (3.24)	10.5 (3.31)	11.7 (3.49)	21.2 (4.66)	16.5 (4.07)	11.4 (3.44)	15.6 (3.95)	13.5 (3.69)	36.6
Control		12.2 (3.56)	16.0 (4.06)	14.1 (3.81)	30.7 (5.59)	26.2 (5.17)	28.5 (5.38)	21.5 (4.57)	21.1 (4.61)	21.3 (4.59)	
Mean		9.7 (2.80)	9.0 (2.98)	9.4 (2.89)	20.1 (4.44)	18.7 (4.33)	19.4 (4.39)	14.9 (3.66)	13.9 (3.63)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.11
Between Counts	:	NS
Between Experiments	:	0.05
Treatments x Counts	:	0.16
Counts x Experiments	:	0.07
Treatments x Experiments	:	0.16
Treatments x Counts x Experiments	:	0.22

Table 18. Effect of TNAU-made soft soap on mealy bug *P. solenopsis* on cotton in screenhouse

Treatments	Dose	No. of 3rd/ 4th instars / 2-node shoot									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	2.5 (1.72)	1.0 (1.22)	1.8 (1.47)	5.2 (2.38)	5.8 (2.45)	5.5 (2.42)	3.9 (2.05)	3.4 (1.84)	3.6 (1.94)	36.8
Soft Soap: 5	2.0 %	4.5 (2.22)	2.8 (1.81)	3.7 (2.01)	1.0 (1.18)	1.0 (1.18)	1.0 (1.18)	2.8 (1.70)	1.9 (1.50)	2.3 (1.60)	59.7
Soft Soap: 6	2.0 %	9.5 (3.16)	5.8 (2.51)	7.7 (2.85)	5.5 (2.45)	3.0 (1.86)	4.3 (2.15)	7.5 (2.80)	4.4 (2.18)	6.0 (2.49)	5.3
Soft Soap: 7	2.0 %	1.3 (1.31)	3.0 (1.86)	2.2 (1.59)	0.0 (0.71)	0.8 (1.10)	0.4 (0.90)	0.7 (1.01)	1.9 (1.48)	1.3 (1.25)	77.2
Soft Soap: 8	2.0 %	3.5 (1.94)	5.0 (2.34)	4.3 (2.14)	1.8 (1.49)	1.3 (1.31)	1.6 (1.41)	2.7 (1.72)	3.2 (1.82)	2.9 (1.77)	49.1

Fish Oil Soap	2.5 %	2.5 (1.72)	2.5 (1.72)	2.5 (1.72)	0.8 (1.10)	0.5 (0.98)	0.7 (1.04)	1.7 (1.41)	1.5 (1.35)	1.6 (1.38)	71.9
Imidacloprid 17.8 SL	50 g ai/ha	0.3 (0.87)	0.3 (0.89)	0.3 (0.88)	0.0 (0.71)	0.3 (0.89)	0.2 (0.80)	0.2 (0.79)	0.3 (0.89)	0.2 (0.84)	96.5
Acephate 75 SP	750 g ai/ha	0.3 (0.87)	0.8 (1.07)	0.6 (0.97)	0.5 (0.98)	0.3 (0.92)	0.4 (0.95)	0.4 (0.93)	0.6 (0.99)	0.5 (0.96)	91.2
Profenofos 50 EC	500 g ai/ha	2.3 (1.66)	1.0 (1.18)	1.7 (1.42)	1.5 (1.39)	1.8 (1.47)	1.7 (1.43)	1.9 (1.52)	1.4 (1.33)	1.7 (1.43)	70.2
Control		6.8 (2.69)	5.3 (2.12)	6.1 (2.41)	5.5 (2.42)	5.3 (2.40)	5.4 (2.41)	6.2 (2.56)	5.3 (2.26)	5.7 (2.41)	
Mean		3.4 (1.82)	2.8 (1.67)	3.1 (1.74)	2.2 (1.48)	2.0 (1.46)	2.1 (1.47)	2.8 (1.65)	2.4 (1.57)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.17
Between Counts	:	0.07
Between Experiments	:	0.07
Treatments x Counts	:	0.24
Counts x Experiments	:	NS
Treatments x Experiments	:	0.24
Treatments x Counts x Experiments	:	0.33

Table 19. Effect of TNAU-made soft soap on red spider mite *T. cinnabarinus* on brinjal in screenhouse

Treatments	Dose	Number of mites / 1 cm^2 area									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	3.8 (2.07)	3.2 (1.94)	3.5 (2.00)	4.0 (2.11)	4.3 (2.18)	4.2 (2.15)	3.9 (2.09)	3.8 (2.06)	3.8 (2.08)	60.8
Soft Soap: 2	2.0 %	5.0 (2.55)	5.0 (2.34)	5.0 (2.44)	5.8 (2.51)	4.5 (2.23)	5.2 (2.37)	5.4 (2.53)	4.8 (2.28)	5.1 (2.41)	47.7
Soft Soap: 3	2.0 %	6.8 (2.45)	6.7 (2.70)	6.8 (2.57)	5.8 (2.51)	5.8 (2.51)	5.8 (2.51)	6.3 (2.48)	6.3 (2.60)	6.3 (2.54)	35.1
Soft Soap: 4	2.0 %	8.0 (2.99)	8.0 (2.91)	8.0 (2.96)	8.0 (2.91)	6.0 (2.55)	7.0 (2.73)	8.0 (2.95)	7.0 (2.73)	7.5 (2.84)	22.7
Soft Soap: 5	2.0 %	6.0 (2.55)	6.0 (2.55)	6.0 (2.55)	6.3 (2.60)	4.0 (2.11)	5.2 (2.36)	6.2 (2.57)	5.0 (2.33)	5.6 (2.45)	42.3
Fish Oil Soap	2.5 %	4.5 (2.23)	4.5 (2.23)	4.5 (2.23)	4.0 (2.11)	4.5 (2.23)	4.3 (2.17)	4.3 (2.17)	4.5 (2.23)	4.4 (2.20)	54.6
Imidacloprid 17.8 SL	50 g ai/ha	13.0 (3.93)	13.0 (3.67)	13.0 (3.80)	11.0 (3.53)	10.0 (3.24)	10.5 (3.38)	12.0 (3.73)	11.5 (3.46)	11.8 (3.59)	21.7
Spinosad 45 SC	90 g ai/ha	10.8 (2.69)	10.8 (3.35)	10.8 (3.03)	6.0 (2.55)	8.0 (2.91)	7.0 (2.73)	8.4 (2.62)	9.4 (3.14)	8.9 (2.88)	8.3
Avermectin 1.9 EC	5 g ai/ha	1.5 (1.31)	1.5 (1.39)	1.5 (1.35)	1.0 (1.16)	2.0 (1.56)	1.5 (1.36)	1.3 (1.23)	1.8 (1.48)	1.5 (1.36)	84.5
Control		9.5 (3.24)	9.5 (3.16)	9.5 (3.20)	9.0 (3.08)	10.8 (3.36)	9.9 (3.22)	9.3 (3.16)	10.2 (3.26)	9.7 (3.21)	
Mean		6.9 (2.60)	6.8 (2.63)	6.9 (2.61)	6.1 (2.51)	6.0 (2.49)	6.0 (2.50)	6.5 (2.55)	6.4 (2.56)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.08
Between Counts	:	NS
Between Experiments	:	0.04
Treatments x Counts	:	0.11
Counts x Experiments	:	NS
Treatments x Experiments	:	0.11
Treatments x Counts x Experiments	:	0.16

Table 20. Effect of TNAU-made soft soap on red spider mites *T. cinnabarinus* on bhendi in screenhouse

Treatments	Dose	Number of mites / 1 cm^2 area									% reduction From control
		Experiment – 1		from control	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	3.0 (1.86)	4.0 (2.11)	3.5 (1.99)	2.8 (1.80)	7.3 (2.79)	5.2 (2.30)	2.9 (1.83)	5.7 (2.45)	4.3 (2.14)	62.0
Soft Soap: 2	2.0 %	4.5 (2.23)	4.8 (2.30)	4.7 (2.26)	5.3 (2.40)	8.0 (2.91)	6.7 (2.66)	4.9 (2.32)	6.4 (2.61)	5.7 (2.46)	49.6
Soft Soap: 3	2.0 %	9.0 (3.08)	11.0 (2.39)	10.0 (3.23)	9.5 (3.16)	11.3 (3.43)	10.4 (3.30)	9.3 (3.12)	11.2 (3.41)	10.2 (3.27)	9.7
Soft Soap: 4	2.0 %	5.0 (2.34)	8.8 (3.04)	6.9 (2.69)	15.0 (3.94)	10.3 (3.28)	12.7 (3.61)	10.0 (3.14)	9.6 (3.17)	9.8 (3.15)	13.3
Soft Soap: 5	2.0 %	2.5 (1.72)	6.0 (2.55)	4.3 (2.13)	10.0 (3.24)	8.3 (2.96)	9.2 (3.10)	6.3 (2.48)	7.2 (2.75)	6.7 (2.62)	40.7
Fish Oil Soap	2.5 %	1.3 (1.31)	1.5 (1.39)	1.4 (1.35)	6.0 (2.55)	5.3 (2.40)	5.7 (2.47)	3.7 (1.92)	3.4 (1.90)	3.5 (1.91)	69.0
Imidacloprid 17.8 SL	50 g ai/ha	8.0 (2.91)	18.5 (4.36)	13.3 (3.64)	10.3 (3.29)	12.3 (3.58)	11.3 (3.43)	9.2 (3.09)	15.4 (3.97)	12.3 (3.53)	8.9
Spinosad 45 SC	90 g ai/ha	5.8 (2.51)	11.3 (3.43)	8.6 (2.97)	4.0 (2.11)	8.3 (2.91)	6.2 (2.51)	4.9 (2.31)	9.8 (3.17)	7.4 (2.74)	34.5
Avermectin 1.9 EC	5 g ai/ha	0.8 (1.13)	2.0 (1.56)	1.4 (1.35)	1.0 (1.22)	9.5 (3.16)	5.3 (2.19)	0.9 (1.18)	5.8 (2.36)	3.3 (1.77)	70.8
Control		7.0 (2.74)	8.0 (2.91)	7.5 (2.82)	14.5 (3.87)	15.8 (4.04)	15.2 (3.95)	10.8 (3.30)	11.9 (3.47)	11.3 (3.39)	
Mean		4.7 (2.18)	7.6 (2.71)	6.2 (2.44)	7.8 (2.76)	9.6 (2.15)	8.7 (2.95)	6.3 (2.47)	8.6 (2.93)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments	:	0.08
Between Counts	:	0.03
Between Experiments	:	0.03
Treatments x Counts	:	0.11

Counts x Experiments	:	0.05
Treatments x Experiments	:	0.11
Treatments x Counts x Experiments	:	0.15

Table 21.Effect of TNAU-made soft soap on muranai mite *P. latus* on chillies in screenhouse

Treatments	Dose	Number of mites/leaf									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	3.4 (1.97)	6.8 (2.70)	5.1 (2.33)	2.6 (1.75)	6.1 (2.57)	4.4 (2.16)	3.0 (1.86)	6.5 (2.63)	4.7 (2.24)	69.3
Soft Soap: 2	2.0 %	4.5 (2.22)	9.8 (3.21)	7.2 (2.71)	3.3 (1.94)	9.0 (3.08)	6.2 (2.51)	3.9 (2.08)	9.4 (3.14)	6.7 (2.61)	56.2
Soft Soap: 3	2.0 %	4.4 (2.21)	9.0 (3.08)	6.7 (2.64)	1.9 (1.53)	10.6 (3.33)	6.3 (2.43)	3.2 (1.87)	9.8 (3.20)	6.5 (2.54)	57.5
Soft Soap: 4	2.0 %	3.8 (2.07)	5.9 (2.53)	4.9 (2.30)	3.1 (1.89)	9.1 (3.10)	6.1 (2.49)	3.5 (1.98)	7.5 (2.81)	5.5 (2.39)	64.1
Soft Soap: 5	2.0 %	4.4 (2.21)	13.6 (3.75)	9.0 (2.98)	3.1 (1.89)	15.4 (3.98)	9.3 (2.93)	3.8 (2.05)	14.5 (3.87)	9.1 (2.96)	40.5
Fish Oil Soap	2.5 %	3.1 (2.19)	9.6 (3.18)	6.4 (2.68)	3.1 (1.95)	8.5 (2.99)	5.8 (2.47)	3.1 (2.07)	9.05 (3.09)	6.1 (2.58)	60.1
Imidacloprid 17.8 SL	50 g ai/ha	4.4 (2.30)	10.3 (3.28)	7.4 (2.79)	6.0 (2.55)	9.5 (3.16)	7.8 (2.85)	5.2 (2.42)	9.9 (3.22)	7.6 (2.82)	50.3
Spinosad 45 SC	90 g ai/ha	4.8 (2.30)	15.3 (3.97)	10.1 (3.14)	4.4 (2.21)	12.1 (3.55)	8.3 (2.88)	4.6 (2.25)	13.7 (3.76)	9.2 (3.01)	39.9
Avermectin 1.9 EC	5 g ai/ha	0.5 (0.98)	1.6 (1.43)	1.1 (1.21)	0.3 (0.87)	2.0 (1.56)	1.1 (1.22)	0.4 (0.93)	1.8 (1.50)	1.1 (1.21)	92.8
Control		7.5 (2.83)	20.9 (4.63)	14.2 (3.73)	11.3 (3.43)	21.6 (4.70)	16.5 (4.07)	9.4 (3.13)	21.3 (4.66)	15.3 (3.90)	
Mean		4.1 (2.13)	10.3 (3.18)	7.2 (2.65)	3.9 (2.00)	10.4 (3.20)	7.1 (2.60)	4.0 (2.06)	10.3 (3.19)		

(Mean of four replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.10
Between Counts	:	0.05
Between Experiments	:	0.05
Treatments x Counts	:	0.15
Counts x Experiments	:	0.06
Treatments x Experiments	:	0.15
Treatments x Counts x Experiments	:	0.21

Table 22. Effect of TNAU-made soft soap on whiteflies *B. tabaci* on bhendi in field

Treatments	Dose	Whiteflies (Numbers / leaf)									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	0.0 (0.71)	0.3 (0.88)	0.2 (0.79)	0.7 (1.05)	0.0 (0.71)	0.4 (0.88)	0.4 (0.88)	0.2 (0.79)	0.3 (0.84)	76.9
Soft Soap: 2	2.0 %	0.0 (0.71)	0.3 (0.88)	0.2 (0.79)	1.7 (1.46)	0.0 (0.71)	0.9 (1.08)	0.9 (1.08)	0.2 (0.79)	0.5 (0.94)	61.5
Soft Soap: 3	2.0 %	1.0 (1.58)	1.7 (1.46)	1.4 (1.52)	1.0 (1.17)	1.7 (1.46)	1.4 (1.32)	1.0 (1.38)	1.7 (1.46)	1.4 (1.42)	7.7
Soft Soap: 4	2.0 %	0.0 (0.71)	0.3 (0.88)	0.2 (0.79)	0.3 (0.88)	0.3 (0.88)	0.3 (0.88)	0.2 (0.79)	0.3 (0.88)	0.2 (0.84)	84.6
Soft Soap: 5	2.0 %	1.7 (1.46)	0.3 (0.88)	1.0 (1.17)	0.7 (1.05)	1.0 (1.22)	0.9 (1.14)	1.2 (1.26)	0.7 (1.05)	0.9 (1.15)	30.8
Fish Oil Soap	2.5 %	0.0 (0.71)	1.3 (1.34)	0.7 (1.03)	0.7 (1.05)	1.3 (1.34)	1.0 (1.20)	0.4 (0.88)	1.3 (1.34)	0.8 (1.11)	38.5
Imidacloprid 17.8 SL	50 g ai/ha	1.0 (1.22)	1.0 (1.34)	1.0 (1.28)	2.0 (1.58)	1.0 (1.17)	1.5 (1.38)	1.5 (1.40)	1.0 (1.26)	1.3 (1.33)	0.0
Profenofos 50 EC	500 g ai/ha	0.3 (0.88)	0.0 (0.71)	0.2 (0.79)	2.0 (1.56)	1.0 (1.17)	1.5 (1.37)	1.2 (1.22)	0.5 (0.94)	0.8 (1.08)	38.5
Avermectin 1.9 EC	5 g ai/ha	0.3 (0.88)	0.7 (1.05)	0.5 (0.97)	1.3 (1.34)	0.3 (0.88)	0.8 (1.11)	0.8 (1.11)	0.5 (0.97)	0.7 (1.04)	46.2
Control		0.3 (0.88)	0.7 (1.05)	0.5 (0.97)	1.7 (1.46)	2.3 (1.68)	2.0 (1.57)	1.0 (1.17)	1.5 (1.37)	1.3 (1.27)	
Mean		0.5 (0.97)	0.7 (1.05)	0.6 (1.01)	1.2 (1.26)	0.9 (1.12)	1.1 (1.19)	0.8 (1.12)	0.8 (1.09)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.20

Between Counts : NS

Between Experiments : 0.09

Treatments x Counts	:	0.28
Counts x Experiments	:	0.13
Treatments x Experiments	:	0.28
Treatments x Counts x Experiments	:	0.40

Table 24. Effect of TNAU-made soft soap on leafhopper *A. devastans* on bhendi in field

Treatments	Dose	Leafhopper (Numbers / leaf)									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	5.2 (2.37)	6.3 (2.61)	5.8 (2.49)	5.6 (2.46)	5.0 (2.40)	5.3 (2.43)	5.4 (2.42)	5.7 (2.51)	5.5 (2.42)	9.8
Soft Soap: 2	2.0 %	5.0 (2.34)	5.2 (2.38)	5.1 (2.36)	5.3 (2.42)	6.0 (2.54)	5.7 (2.48)	5.2 (2.38)	5.6 (2.46)	5.4 (2.41)	13.0
Soft Soap: 3	2.0 %	4.2 (2.16)	5.2 (2.38)	4.7 (2.27)	4.6 (2.26)	5.0 (2.33)	4.8 (2.29)	4.4 (2.21)	5.1 (2.36)	4.8 (2.28)	21.3
Soft Soap: 4	2.0 %	5.2 (2.38)	4.6 (2.22)	4.9 (2.30)	4.3 (2.18)	4.9 (2.32)	4.6 (2.52)	4.8 (2.28)	4.8 (2.67)	4.8 (2.28)	21.3
Soft Soap: 5	2.0 %	5.1 (2.36)	5.6 (2.48)	5.4 (2.42)	6.8 (2.71)	4.0 (2.13)	5.4 (2.42)	6.0 (2.53)	4.8 (2.30)	5.4 (2.42)	1.1
Fish Oil Soap	2.5 %	4.3 (2.18)	5.0 (2.35)	4.7 (2.26)	4.8 (2.30)	4.9 (2.32)	4.9 (2.31)	4.6 (2.24)	5.0 (2.33)	4.8 (2.29)	21.3
Imidacloprid 17.8 SL	50 g ai/ha	1.0 (2.20)	2.3 (1.68)	1.7 (1.44)	1.1 (1.23)	2.7 (1.71)	1.9 (1.47)	1.1 (1.22)	2.5 (1.70)	1.8 (1.46)	70.5
Profenofos 50 EC	500 g ai/ha	3.5 (1.99)	3.6 (2.03)	3.6 (2.01)	4.4 (2.22)	4.6 (2.26)	4.5 (2.24)	4.0 (2.10)	4.1 (2.15)	4.0 (2.13)	34.4
Avermectin 1.9 EC	5 g ai/ha	4.1 (2.16)	5.7 (2.48)	4.9 (2.32)	4.4 (2.21)	4.3 (2.20)	4.4 (2.21)	4.3 (1.89)	5.0 (2.34)	4.6 (2.26)	24.6
Control		6.8 (2.08)	5.8 (2.52)	6.3 (2.30)	6.7 (2.67)	5.1 (2.36)	5.9 (2.52)	6.8 (2.38)	5.5 (2.44)	6.1 (2.46)	
Mean		4.4 (2.12)	4.9 (2.31)	4.7 (2.22)	4.8 (2.27)	4.7 (2.26)	4.7 (2.26)	4.6 (2.19)	4.8 (2.29)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.10

Between Counts : 0.04

Between Experiments	:	0.04
Treatments x Counts	:	0.14
Counts x Experiments	:	0.06
Treatments x Experiments	:	0.14
Treatments x Counts x Experiments	:	0.20

Table 25. Effect of TNAU-made soft soap on mealybug *P. solenopsis* on bhendi in field

Treatments	Dose	Mealybug (Numbers/ 2- node shoot)									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	5.3 (2.39)	2.7 (2.06)	4.0 (2.22)	3.9 (2.05)	5.0 (2.34)	4.5 (2.19)	4.6 (2.22)	3.9 (2.20)	4.2 (2.21)	12.5
Soft Soap: 5	2.0 %	1.6 (1.41)	2.5 (1.73)	2.1 (1.57)	2.0 (1.56)	1.7 (1.47)	1.9 (1.51)	1.8 (1.48)	2.1 (1.60)	2.0 (1.54)	58.3
Soft Soap: 6	2.0 %	3.2 (1.91)	3.0 (1.88)	3.1 (1.90)	3.0 (1.87)	2.2 (1.63)	2.6 (1.74)	3.1 (1.89)	2.6 (1.75)	2.9 (1.82)	13.6
Soft Soap: 7	2.0 %	3.0 (1.87)	3.1 (1.89)	3.1 (1.88)	3.3 (1.94)	3.0 (1.86)	3.2 (1.90)	3.2 (1.90)	3.1 (1.88)	3.1 (1.89)	35.4
Soft Soap: 8	2.0 %	6.6 (2.60)	3.3 (1.93)	5.0 (2.27)	2.7 (1.75)	2.4 (1.69)	2.6 (1.72)	4.7 (1.18)	2.9 (1.81)	3.8 (1.99)	20.8
Fish Oil Soap	2.5 %	4.7 (2.27)	1.4 (1.37)	3.1 (1.82)	4.3 (2.12)	3.3 (1.94)	3.8 (2.03)	4.5 (1.20)	2.4 (1.65)	3.4 (1.92)	0.3
Imidacloprid 17.8 SL	50 g ai/ha	0.6 (1.04)	1.1 (1.40)	0.9 (1.22)	0.3 (0.88)	1.1 (1.26)	0.7 (1.07)	0.5 (0.96)	1.1 (1.33)	0.8 (1.14)	83.3
Acephate 75 SP	750 g ai/ ha	2.0 (1.57)	0.9 (1.15)	1.5 (1.36)	1.7 (1.49)	1.3 (1.34)	1.5 (1.41)	1.9 (1.53)	1.1 (1.24)	1.5 (1.39)	68.8
Profenofos 50 EC	500 g ai /ha	2.7 (1.79)	2.6 (1.75)	2.7 (1.77)	2.4 (1.71)	1.8 (1.52)	2.1 (1.61)	2.6 (1.75)	2.2 (1.63)	2.4 (1.69)	50.0
Control		5.1 (2.37)	4.2 (2.18)	4.7 (2.27)	5.0 (2.34)	4.9 (2.32)	5.0 (2.33)	5.1 (2.35)	4.6 (1.25)	4.8 (2.30)	
Mean		3.5 (1.92)	2.5 (1.73)	3.0 (1.83)	2.9 (1.77)	2.7 (1.74)	2.8 (1.75)	3.2 (1.85)	2.6 (1.73)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.15

Between Counts : 0.07

Between Experiments : 0.07

Treatments x Counts	:	0.21
Counts x Experiments	:	0.09
Treatments x Experiments	:	0.21
Treatments x Counts x Experiments	:	0.29

Table 27. Effect of TNAU-made soft soap on whitefly *B. tabaci* on brinjal in field

Treatments	Dose	Number of whiteflies / apical three leaves									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	0.5 (1.16)	0.5 (1.05)	0.5 (1.10)	0.5 (1.00)	0.6 (1.03)	0.6 (1.02)	0.5 (1.08)	0.6 (1.04)	0.5 (1.06)	28.6
Soft Soap: 2	2.0 %	0.5 (1.03)	0.6 (1.06)	0.6 (1.05)	0.5 (0.98)	0.5 (1.01)	0.5 (1.00)	0.5 (1.01)	0.6 (1.04)	0.5 (1.02)	28.6
Soft Soap: 3	2.0 %	0.2 (0.86)	0.3 (0.93)	0.3 (0.89)	1.1 (1.25)	0.6 (1.03)	0.9 (1.14)	0.7 (1.05)	0.5 (0.98)	0.6 (1.01)	14.3
Soft Soap: 4	2.0 %	0.2 (0.86)	0.5 (1.02)	0.4 (0.94)	0.6 (1.05)	0.5 (1.00)	0.6 (1.02)	0.4 (0.95)	0.5 (1.01)	0.5 (0.98)	28.6
Soft Soap: 5	2.0 %	0.6 (1.08)	0.6 (1.08)	0.6 (1.08)	0.2 (0.86)	0.6 (1.06)	0.4 (0.96)	0.4 (0.97)	0.6 (1.07)	0.5 (1.02)	28.6
Fish Oil Soap	2.5 %	0.2 (0.82)	0.5 (1.02)	0.4 (0.92)	0.8 (1.15)	0.3 (0.91)	0.6 (1.03)	0.5 (0.98)	0.4 (0.96)	0.5 (0.97)	28.6
Imidacloprid 17.8 SL	50 g ai/ha	0.3 (0.89)	0.5 (1.02)	0.4 (0.95)	0.4 (1.01)	0.9 (1.17)	0.7 (1.09)	0.4 (0.95)	0.7 (1.09)	0.5 (1.02)	28.6
Spinosad 45 SC	90 g ai/ha	0.7 (1.09)	0.9 (1.17)	0.8 (1.13)	0.8 (1.15)	0.5 (1.01)	0.7 (1.08)	0.8 (1.12)	0.7 (1.09)	0.7 (1.11)	0.0
Avermectin 1.9 EC	5 g ai/ha	0.3 (0.91)	0.6 (1.05)	0.5 (0.98)	0.6 (1.03)	0.4 (0.95)	0.5 (0.99)	0.5 (0.97)	0.5 (1.00)	0.5 (0.99)	28.6
Control		0.5 (1.02)	1.0 (1.21)	0.8 (1.11)	0.8 (1.14)	0.6 (1.05)	0.7 (1.09)	0.7 (1.08)	0.8 (1.13)	0.7 (1.10)	
Mean		0.4 (0.97)	0.6 (1.06)	0.5 (1.02)	0.6 (1.06)	0.6 (1.06)	0.6 (1.04)	0.5 (1.02)	0.6 (1.04)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.06

Between Counts : NS

Between Experiments : NS

Treatments x Counts	:	0.09
Counts x Experiments	:	0.04
Treatments x Experiments	:	0.09
Treatments x Counts x Experiments	:	0.13

Table 28. Effect of TNAU-made soft soap on leafhopper *A. devastans* on brinjal in field

Treatments	Dose	Number of hopper /apical three leaves									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	2.7 (1.86)	2.2 (1.64)	2.5 (1.75)	2.6 (1.78)	2.3 (1.68)	2.5 (1.73)	2.7 (1.82)	2.3 (1.66)	2.5 (1.74)	7.4
Soft Soap: 2	2.0 %	3.1 (1.91)	2.7 (1.78)	2.9 (1.85)	2.3 (1.66)	1.7 (1.49)	2.0 (1.57)	2.7 (1.79)	2.2 (1.63)	2.5 (1.71)	7.4
Soft Soap: 3	2.0 %	2.7 (1.80)	2.7 (1.80)	2.7 (1.80)	2.2 (1.65)	1.6 (1.44)	1.9 (1.55)	2.5 (1.73)	2.2 (1.62)	2.3 (1.67)	14.8
Soft Soap: 4	2.0 %	3.1 (1.89)	3.3 (1.95)	3.2 (1.92)	2.8 (1.82)	2.5 (1.72)	2.7 (1.77)	3.0 (1.85)	2.9 (1.83)	2.9 (1.84)	7.4
Soft Soap: 5	2.0 %	3.0 (1.87)	3.3 (1.97)	3.2 (1.92)	2.5 (1.72)	2.8 (1.82)	2.7 (1.77)	2.8 (1.79)	3.1 (1.89)	2.9 (1.84)	7.4
Fish Oil Soap	2.5 %	2.6 (1.77)	4.4 (2.21)	3.5 (1.99)	3.6 (1.91)	1.9 (1.53)	2.8 (1.72)	3.1 (1.84)	3.2 (1.87)	3.1 (1.86)	14.8
Imidacloprid 17.8 SL	50 g ai/ha	2.0 (1.57)	1.0 (1.22)	1.5 (1.39)	0.8 (1.87)	1.5 (1.42)	1.2 (1.65)	1.4 (1.72)	1.3 (1.32)	1.3 (1.52)	51.9
Spinosad 45 SC	90 g ai/ha	3.4 (1.97)	3.4 (1.97)	3.4 (1.97)	3.0 (1.87)	2.9 (1.85)	3.0 (1.86)	3.2 (1.92)	3.2 (1.91)	3.2 (1.91)	0.5
Avermectin 1.9 EC	5 g ai/ha	3.0 (1.86)	2.6 (1.75)	2.8 (1.80)	1.8 (1.52)	2.2 (1.63)	2.0 (1.57)	2.4 (1.69)	2.4 (1.69)	2.4 (1.69)	11.1
Control		3.4 (1.98)	3.1 (1.89)	3.3 (1.94)	1.9 (1.54)	2.2 (1.66)	2.1 (1.60)	2.7 (1.76)	2.7 (1.78)	2.7 (1.78)	
Mean		2.9 (1.85)	2.9 (1.82)	2.9 (1.83)	2.4 (1.74)	2.2 (1.62)	2.3 (1.68)	2.6 (1.79)	2.5 (1.72)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.11
Between Counts	:	0.05
Between Experiments	:	0.05
Treatments x Counts	:	0.16
Counts x Experiments	:	NS
Treatments x Experiments	:	0.16
Treatments x Counts x Experiments	:	0.22

Table 29. Effect of TNAU-made soft soap on mealybugs *P. solenopsis* on brinjal in field

Treatments	Dose	Number of mealybugs / 2-node shoot									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	2.4 (1.71)	2.4 (1.68)	2.4 (1.70)	2.0 (1.57)	1.6 (1.37)	1.8 (1.47)	2.2 (1.64)	2.0 (1.53)	2.1 (1.58)	16.7
Soft Soap: 2	2.0 %	1.6 (1.46)	1.4 (1.36)	1.5 (1.41)	1.6 (1.44)	1.3 (1.37)	1.5 (1.40)	1.6 (1.45)	1.4 (1.36)	1.5 (1.41)	16.7
Soft Soap: 3	2.0 %	1.7 (1.48)	1.0 (1.11)	1.4 (1.29)	2.1 (1.59)	0.8 (1.15)	1.5 (1.37)	1.9 (1.54)	0.9 (1.13)	1.4 (1.33)	0.2
Soft Soap: 4	2.0 %	0.8 (1.14)	0.7 (1.09)	0.8 (1.12)	1.0 (1.19)	1.2 (1.29)	1.1 (1.24)	0.9 (1.16)	1.0 (1.19)	0.9 (1.18)	50.0
Soft Soap: 5	2.0 %	1.5 (1.43)	1.0 (1.24)	1.3 (1.34)	1.6 (1.43)	1.0 (1.22)	1.3 (1.33)	1.6 (1.43)	1.0 (1.23)	1.3 (1.33)	27.8
Fish Oil Soap	2.5 %	1.8 (1.51)	0.9 (1.20)	1.4 (1.35)	1.3 (1.33)	1.1 (1.26)	1.2 (1.30)	1.6 (1.42)	1.0 (1.23)	1.3 (1.32)	27.8
Imidacloprid 17.8 SL	50 g ai/ha	1.0 (1.18)	0.8 (1.14)	0.9 (1.16)	1.1 (1.26)	0.7 (1.08)	0.9 (1.17)	1.1 (1.22)	0.8 (1.11)	0.9 (1.17)	50.0
Spinosad 45 SC	90 g ai/ha	1.0 (1.22)	0.8 (1.14)	0.9 (1.18)	1.3 (1.32)	0.7 (1.11)	1.0 (1.21)	1.2 (1.27)	0.8 (1.12)	1.0 (1.20)	44.4
Avermectin 1.9 EC	5 g ai/ha	1.1 (1.24)	0.8 (1.13)	1.0 (1.19)	0.9 (1.16)	1.6 (1.44)	1.3 (1.30)	1.0 (1.20)	1.2 (1.28)	1.1 (1.24)	38.9
Control		1.9 (1.55)	1.6 (1.44)	1.8 (1.49)	2.1 (1.62)	1.4 (1.36)	1.8 (1.49)	2.0 (1.58)	1.5 (1.40)	1.8 (1.49)	
Mean		1.5 (1.39)	1.1 (1.25)	1.3 (1.32)	1.5 (1.39)	1.1 (1.27)	1.3 (1.33)	1.5 (1.39)	1.1 (1.26)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.16

Between Counts : 0.07

Between Experiments : NS

Treatments x Counts	:	NS
Counts x Experiments	:	NS
Treatments x Experiments	:	NS
Treatments x Counts x Experiments	:	NS

Table 31. Effect of TNAU-made soft soap on thrips *S. dorsalis* on chilli in field

Treatments	Dose	Thrips (Numbers / apical three leaves)									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	0.7 (1.11)	0.6 (1.08)	0.7 (1.09)	0.7 (1.11)	0.7 (1.13)	0.7 (1.12)	0.7 (1.11)	0.7 (1.10)	0.7 (1.11)	30.0
Soft Soap: 2	2.0 %	0.8 (1.14)	0.7 (1.11)	0.8 (1.13)	0.7 (1.09)	0.7 (1.12)	0.7 (1.11)	0.8 (1.12)	0.7 (1.12)	0.7 (1.12)	30.0
Soft Soap: 3	2.0 %	0.7 (1.09)	0.7 (1.09)	0.7 (1.09)	0.9 (1.16)	0.7 (1.09)	0.7 (1.13)	0.8 (1.13)	0.7 (1.09)	0.8 (1.11)	20.0
Soft Soap: 4	2.0 %	0.8 (1.14)	0.7 (1.08)	0.8 (1.11)	0.7 (1.12)	0.6 (1.06)	0.7 (1.09)	0.8 (1.13)	0.7 (1.07)	0.7 (1.10)	30.0
Soft Soap: 5	2.0 %	0.5 (1.00)	0.6 (1.06)	0.6 (1.03)	0.6 (1.03)	0.6 (1.03)	0.6 (1.03)	0.6 (1.02)	0.6 (1.05)	0.6 (1.03)	40.0
Fish Oil Soap	2.5 %	0.4 (0.93)	0.6 (1.06)	0.5 (1.01)	0.7 (1.09)	0.6 (1.05)	0.6 (1.07)	0.6 (1.01)	0.6 (1.06)	0.6 (1.03)	40.0
Imidacloprid 17.8 SL	50 g ai/ha	0.2 (0.88)	0.3 (0.93)	0.3 (0.90)	0.2 (0.85)	0.3 (0.89)	0.3 (0.87)	0.2 (0.86)	0.3 (0.91)	0.3 (0.89)	70.0
Spinosad 45 SC	90 g ai/ha	0.1 (0.75)	0.1 (0.80)	0.1 (0.77)	0.1 (0.77)	0.1 (0.80)	0.1 (0.78)	0.1 (0.76)	0.1 (0.80)	0.1 (0.78)	90.0
Avermectin 1.9 EC	5 g ai/ha	0.6 (1.08)	0.6 (1.03)	0.6 (1.06)	0.5 (1.02)	0.4 (0.98)	0.5 (1.01)	0.6 (1.05)	0.5 (1.01)	0.5 (1.03)	50.0
Control		1.0 (1.22)	1.0 (1.21)	1.0 (1.22)	1.0 (1.24)	1.0 (1.21)	1.0 (1.22)	1.0 (1.23)	1.0 (1.21)	1.0 (1.22)	
Mean		0.6 (1.03)	0.6 (1.05)	0.6 (1.04)	0.6 (1.05)	0.6 (1.04)	0.6 (1.04)	0.6 (1.04)	0.6 (1.04)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.04

Between Counts : NS

Between Experiments : NS

Treatments x Counts	:	NS
Counts x Experiments	:	NS
Treatments x Experiments	:	NS
Treatments x Counts x Experiments	:	NS

Table 32. Effect of TNAU-made soft soap on aphids *A. gossypii* and *M. persicae* on chilli in field

Treatments	Dose	Aphids (Numbers / 2 leaves)									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	1.3 (1.33)	0.4 (0.96)	0.9 (1.14)	1.1 (1.28)	0.4 (0.95)	0.8 (1.11)	1.2 (1.30)	0.4 (0.95)	0.8 (1.13)	50.0
Soft Soap: 2	2.0 %	1.8 (1.52)	0.4 (0.98)	1.1 (1.25)	1.2 (1.33)	0.5 (1.01)	0.9 (1.17)	1.5 (1.42)	0.5 (1.00)	1.0 (1.21)	37.5
Soft Soap: 3	2.0 %	1.2 (1.30)	0.5 (1.00)	0.9 (1.15)	1.3 (1.35)	0.6 (1.04)	1.0 (1.20)	1.3 (1.33)	0.6 (1.02)	1.0 (1.17)	37.5
Soft Soap: 4	2.0 %	1.6 (1.46)	0.6 (1.06)	1.1 (1.26)	1.7 (1.49)	0.7 (1.08)	1.2 (1.28)	1.2 (1.48)	0.7 (1.06)	1.0 (1.17)	37.5
Soft Soap: 5	2.0 %	1.1 (1.26)	0.5 (0.98)	0.8 (1.12)	0.8 (1.15)	0.5 (0.98)	0.7 (1.06)	1.3 (1.21)	0.5 (0.98)	0.9 (1.10)	43.8
Fish Oil Soap	2.5 %	1.3 (1.35)	0.6 (1.03)	1.0 (1.19)	1.2 (1.29)	0.5 (1.01)	0.9 (1.15)	1.3 (1.32)	0.6 (1.02)	1.0 (1.17)	37.5
Imidacloprid 17.8 SL	50 g ai/ha	0.3 (0.91)	0.1 (0.77)	0.2 (0.84)	0.2 (0.82)	0.3 (0.89)	0.3 (0.86)	0.3 (0.86)	0.2 (0.83)	0.3 (0.85)	81.3
Spinosad 45 SC	90 g ai/ha	1.9 (1.55)	0.7 (1.09)	1.3 (1.32)	1.5 (1.41)	0.5 (1.12)	1.0 (1.22)	1.7 (1.48)	1.1 (1.05)	1.4 (1.27)	12.5
Avermectin 1.9 EC	5 g ai/ha	1.6 (1.44)	1.0 (1.19)	1.3 (1.32)	1.3 (1.33)	0.5 (1.02)	0.9 (1.17)	1.5 (1.39)	0.8 (1.10)	1.2 (1.24)	25.0
Control		2.6 (1.76)	1.0 (1.24)	1.8 (1.50)	1.6 (1.45)	0.9 (1.18)	1.3 (1.32)	2.1 (1.60)	1.0 (1.20)	1.6 (1.41)	
Mean		1.5 (1.39)	0.6 (1.03)	1.0 (1.21)	1.2 (1.29)	0.5 (1.02)	0.9 (1.15)	1.3 (1.34)	0.6 (1.02)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.08
Between Counts	:	0.04
Between Experiments	:	0.04
Treatments x Counts	:	0.12
Counts x Experiments	:	0.05
Treatments x Experiments	:	NS
Treatments x Counts x Experiments	:	NS

Table 33. Effect of TNAU-made soft soap on mites *P. latus* on chilli in field

Treatments	Dose	Mites (Numbers / leaf)									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	2.4 (1.70)	2.3 (1.65)	2.4 (1.68)	1.9 (1.54)	2.3 (1.68)	2.1 (1.61)	2.2 (1.62)	2.3 (1.67)	2.2 (1.64)	31.3
Soft Soap: 2	2.0 %	3.1 (1.89)	2.8 (1.81)	3.0 (1.85)	2.5 (1.72)	2.3 (1.66)	2.4 (1.69)	2.8 (1.80)	2.6 (1.73)	2.7 (1.77)	15.6
Soft Soap: 3	2.0 %	2.2 (1.64)	2.1 (1.59)	2.2 (1.61)	2.1 (1.62)	2.7 (1.81)	2.4 (1.71)	2.3 (1.63)	2.4 (1.70)	2.3 (1.66)	28.1
Soft Soap: 4	2.0 %	2.6 (1.75)	2.4 (1.68)	2.5 (1.72)	3.3 (1.93)	3.3 (1.92)	3.3 (1.93)	3.0 (1.84)	2.9 (1.80)	2.9 (1.82)	9.4
Soft Soap: 5	2.0 %	2.9 (1.84)	2.7 (1.79)	2.8 (1.82)	2.4 (1.71)	2.7 (1.81)	2.6 (1.76)	2.7 (1.78)	2.7 (1.80)	2.7 (1.79)	15.6
Fish Oil Soap	2.5 %	2.2 (1.64)	2.1 (1.62)	2.2 (1.63)	2.0 (1.60)	2.5 (1.75)	2.3 (1.68)	2.1 (1.62)	2.3 (1.69)	2.2 (1.65)	34.3
Imidacloprid 17.8 SL	50 g ai/ha	2.4 (1.69)	2.2 (1.64)	2.3 (1.67)	1.7 (1.48)	1.8 (1.52)	1.8 (1.50)	2.1 (1.58)	2.0 (1.58)	2.0 (1.58)	37.5
Spinosad 45 SC	90 g ai/ha	3.2 (1.90)	2.8 (1.83)	3.0 (1.87)	3.0 (1.76)	2.7 (1.78)	2.9 (1.77)	3.1 (1.83)	2.8 (1.81)	2.9 (1.82)	9.4

Avermectin 1.9 EC	5 g ai/ha	1.3 (1.35)	1.2 (1.32)	1.3 (1.34)	1.5 (1.42)	1.6 (1.41)	1.6 (1.41)	1.4 (1.39)	1.4 (1.36)	1.4 (1.37)	56.3
Control		3.2 (1.91)	3.0 (1.85)	3.1 (1.88)	2.6 (1.76)	3.8 (1.10)	3.2 (1.93)	2.9 (1.84)	3.4 (1.97)	3.2 (1.91)	
Mean		2.6 (1.73)	2.4 (1.68)	2.5 (1.71)	2.3 (1.65)	2.6 (1.74)	2.4 (1.70)	2.4 (1.70)	2.5 (1.71)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.11
Between Counts	:	NS
Between Experiments	:	NS
Treatments x Counts	:	NS
Counts x Experiments	:	0.07
Treatments x Experiments	:	0.15
Treatments x Counts x Experiments	:	NS

Table 35. Effect of TNAU-made soft soap on coccinellids on chilli in field

Treatments	Dose	Number of coccinellids / plant									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	0.2 (0.86)	0.1 (0.75)	0.2 (0.80)	0.1 (0.80)	0.1 (0.75)	0.1 (0.77)	0.2 (0.83)	0.1 (0.75)	0.1 (0.79)	50.0
Soft Soap: 2	2.0 %	0.1 (0.80)	0.0 (0.71)	0.1 (0.75)	0.1 (0.75)	0.0 (0.73)	0.1 (0.74)	0.1 (0.77)	0.0 (0.72)	0.1 (0.75)	50.0
Soft Soap: 3	2.0 %	0.3 (0.89)	0.0 (0.71)	0.2 (0.80)	0.1 (0.75)	0.1 (0.75)	0.1 (0.75)	0.2 (0.82)	0.1 (0.73)	0.1 (0.76)	50.0
Soft Soap: 4	2.0 %	0.1 (0.77)	0.0 (0.71)	0.1 (0.74)	0.1 (0.75)	0.0 (0.73)	0.1 (0.74)	0.1 (0.76)	0.0 (0.71)	0.1 (0.74)	50.0

Soft Soap: 5	2.0 %	0.1 (0.80)	0.1 (0.75)	0.1 (0.77)	0.1 (0.77)	0.0 (0.71)	0.1 (0.74)	0.1 (0.78)	0.1 (0.72)	0.1 (0.76)	50.0
Fish Oil Soap	2.5 %	0.2 (0.81)	0.0 (0.73)	0.1 (0.77)	0.0 (0.75)	0.1 (0.77)	0.1 (0.76)	0.1 (0.78)	0.1 (0.75)	0.1 (0.77)	50.0
Imidacloprid 17.8 SL	50 g ai/ha	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	100.0
Spinosad 45 SC	90 g ai/ha	0.1 (0.77)	0.0 (0.73)	0.1 (0.75)	0.1 (0.77)	0.0 (0.71)	0.1 (0.74)	0.1 (0.77)	0.0 (0.72)	0.1 (0.75)	50.0
Avermectin 1.9 EC	5 g ai/ha	0.1 (0.77)	0.0 (0.73)	0.1 (0.75)	0.0 (0.71)	0.0 (0.73)	0.0 (0.72)	0.1 (0.74)	0.0 (0.73)	0.0 (0.73)	100.0
Control		0.3 (0.89)	0.1 (0.77)	0.2 (0.83)	0.3 (0.91)	0.2 (0.85)	0.3 (0.88)	0.3 (0.90)	0.2 (0.81)	0.2 (0.86)	
Mean		0.15 (0.81)	0.03 (0.73)	0.09 (0.77)	0.09 (0.77)	0.05 (0.74)	0.07 (0.76)	0.12 (0.79)	0.04 (0.74)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.04
Between Counts	:	0.02
Between Experiments	:	NS
Treatments x Counts	:	NS
Counts x Experiments	:	0.03
Treatments x Experiments	:	NS
Treatments x Counts x Experiments	:	NS

Table 37. Effect of TNAU-made soft soap on aphid *A. gossypii* on cotton in field

Treatments	Dose	Aphids (Numbers / two leaves)									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	5.7 (2.48)	3.3 (1.96)	4.5 (2.22)	5.0 (2.34)	5.0 (2.33)	5.0 (2.33)	5.4 (2.41)	4.2 (2.14)	4.8 (2.78)	9.4
Soft Soap: 5	2.0 %	4.8 (2.27)	3.5 (2.11)	4.2 (2.19)	4.7 (2.25)	3.7 (2.04)	4.2 (2.14)	4.8 (2.26)	3.6 (2.07)	4.2 (2.17)	20.8
Soft Soap: 6	2.0 %	5.0 (2.32)	3.5 (2.00)	4.3 (2.16)	4.7 (2.29)	5.2 (2.40)	5.0 (2.34)	4.9 (2.30)	4.4 (2.20)	4.6 (2.25)	13.2
Soft Soap: 7	2.0 %	4.3 (2.17)	3.8 (2.05)	4.1 (2.11)	3.8 (2.06)	3.4 (1.97)	3.6 (2.02)	4.1 (2.11)	3.6 (2.01)	3.8 (2.06)	28.3
Soft Soap: 8	2.0 %	4.8 (2.29)	3.7 (2.04)	4.3 (2.16)	3.3 (1.94)	3.9 (2.09)	3.6 (2.01)	4.1 (2.11)	3.8 (2.06)	4.0 (2.08)	24.5
Fish Oil Soap	2.5 %	4.2 (2.24)	3.7 (2.03)	4.0 (2.13)	3.1 (1.91)	3.9 (2.08)	3.5 (2.00)	3.7 (2.07)	3.8 (2.06)	3.7 (2.06)	30.2
Imidacloprid 17.8 SL	50 g ai/ha	0.6 (1.03)	0.9 (1.17)	0.8 (1.10)	0.6 (1.03)	0.8 (1.15)	0.7 (1.09)	0.6 (1.03)	0.9 (1.16)	0.7 (1.09)	86.8
Acephate 75 SP	750 g ai/ ha	1.2 (1.30)	1.0 (1.12)	1.1 (1.21)	1.2 (1.30)	0.9 (1.17)	1.1 (1.23)	1.2 (1.30)	1.0 (1.44)	1.1 (1.22)	79.2
Profenofos 50 EC	500 g ai /ha	1.1 (1.25)	1.2 (1.30)	1.2 (1.27)	1.0 (1.22)	1.0 (1.23)	1.0 (1.23)	1.1 (1.24)	1.1 (1.26)	1.1 (1.25)	79.2
Control		6.2 (2.59)	5.0 (2.33)	5.6 (2.45)	5.0 (2.33)	4.9 (2.32)	5.0 (2.32)	5.6 (2.46)	5.0 (2.32)	5.3 (2.40)	
Mean		3.8 (2.00)	3.0 (1.80)	3.4 (1.90)	3.3 (1.87)	3.3 (1.88)	3.3 (1.87)	3.5 (1.93)	3.1 (1.84)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.13

Between Counts : 0.06

Between Experiments : NS

Treatments x Counts : NS

Counts x Experiments	:	0.08
Treatments x Experiments	:	NS
Treatments x Counts x Experiments	:	NS

Table 38. Effect of TNAU-made soft soap mealybug *P. solenopsis* on cotton in field

Treatments	Dose	Mealybug (Numbers /2-node shoot)									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	4.0 (2.12)	2.7 (1.78)	3.4 (1.95)	2.8 (1.80)	2.4 (1.71)	2.6 (1.76)	3.4 (1.96)	2.6 (1.74)	3.0 (1.85)	6.3
Soft Soap: 5	2.0 %	5.5 (1.03)	2.3 (1.67)	3.9 (1.85)	2.3 (1.68)	1.9 (1.54)	2.1 (1.61)	3.9 (1.86)	2.1 (1.61)	3.0 (1.73)	62.5
Soft Soap: 6	2.0 %	2.4 (1.71)	1.6 (1.45)	2.0 (1.58)	2.2 (1.63)	1.7 (1.48)	2.0 (1.55)	2.3 (1.67)	1.7 (1.46)	2.0 (1.57)	37.5
Soft Soap: 7	2.0 %	0.4 (0.92)	1.9 (1.53)	1.2 (1.23)	0.6 (1.05)	1.7 (1.47)	1.2 (1.26)	0.5 (0.99)	1.8 (1.50)	1.2 (1.24)	62.5
Soft Soap: 8	2.0 %	2.5 (1.72)	3.0 (1.86)	2.8 (1.79)	2.0 (1.55)	2.3 (1.66)	2.2 (1.60)	2.3 (1.64)	2.7 (1.76)	2.5 (1.70)	21.8
Fish Oil Soap	2.5 %	1.2 (1.14)	1.7 (1.49)	1.5 (1.31)	1.0 (1.22)	1.4 (1.37)	1.2 (1.29)	1.1 (1.18)	1.6 (1.43)	1.3 (1.30)	59.4
Imidacloprid 17.8 SL	50 g ai/ha	1.3 (1.33)	0.9 (1.16)	1.1 (1.25)	0.6 (1.06)	0.8 (1.13)	0.7 (1.09)	1.0 (1.19)	0.9 (1.15)	0.9 (1.17)	71.9
Acephate 75 SP	750 g ai/ ha	0.3 (0.87)	0.5 (1.01)	0.4 (0.94)	0.7 (1.05)	0.5 (1.00)	0.6 (1.02)	0.5 (0.96)	0.5 (1.01)	0.5 (0.98)	84.4
Profenofos 50 EC	500 g ai /ha	0.5 (0.98)	1.5 (1.38)	1.0 (1.18)	0.7 (1.08)	1.8 (1.51)	1.3 (1.29)	0.6 (1.03)	1.7 (1.45)	1.1 (1.24)	65.6
Control		3.1 (1.90)	3.6 (2.01)	3.4 (1.96)	3.4 (1.98)	2.8 (1.81)	3.1(1.89)	3.3 (1.94)	3.2 (1.91)	3.2 (1.92)	
Mean		2.1 (1.47)	2.0 (1.54)	2.0 (1.50)	1.6 (1.41)	1.7 (1.47)	1.7 (1.43)	1.9 (1.44)	1.9 (1.50)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.13
Between Counts	:	0.06
Between Experiments	:	0.06
Treatments x Counts	:	0.19
Counts x Experiments	:	NS
Treatments x Experiments	:	NS
Treatments x Counts x Experiments	:	NS

Table 39. Effect of TNAU-made soft soap on mangohoppers

Treatments	Dose	Number of hoppers/ inflorescence									% reduction from control
		Experiment - 1		Mean	Experiment – 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	2.4 (1.68)	3.3 (1.93)	2.9 (1.81)	2.5 (1.63)	2.1 (1.58)	2.3 (1.60)	2.5 (1.65)	2.7 (1.76)	2.6 (1.71)	44.7
Soft Soap: 3	2.0 %	3.1 (1.79)	3.1 (1.89)	3.1 (1.84)	2.3 (1.61)	2.9 (1.77)	2.6 (1.69)	2.7 (1.70)	3.0 (1.83)	2.9 (1.77)	38.3
Soft Soap: 5	2.0 %	2.3 (1.64)	2.9 (1.83)	2.6 (1.73)	2.1 (1.61)	2.6 (1.76)	2.4 (1.69)	2.2 (1.63)	2.8 (1.79)	2.5 (1.71)	46.8
Fish Oil Soap	2.5 %	1.8 (1.49)	2.9 (1.81)	2.4 (1.65)	1.9 (1.53)	2.4 (1.65)	2.2 (1.59)	1.9 (1.51)	2.7 (1.73)	2.3 (1.62)	51.1
Imidacloprid 17.8 SL	50 g ai/ha	0.5 (0.97)	0.8 (1.09)	0.7 (1.03)	0.1 (0.78)	0.8 (1.09)	0.5 (0.93)	0.3 (0.87)	0.8 (1.09)	0.6 (0.98)	87.2
Carbaryl 50 WDP + Sulphur 80 WP	1.5 kg ai/ha + 200 g ai / ha	0.0 (0.71)	0.4 (0.93)	0.2 (0.82)	0.3 (0.84)	0.5 (0.96)	0.4 (0.90)	0.2 (0.77)	0.5 (0.94)	0.3 (0.86)	93.6
Avermectin 1.9 EC	5 g ai/ha	3.4 (1.96)	2.9 (1.83)	3.2 (1.89)	3.6 (2.01)	4.3 (2.17)	4.0 (2.09)	3.5 (1.99)	3.6 (1.10)	3.6 (1.99)	23.4
Control		3.9 (2.06)	5.0 (2.34)	4.5 (2.20)	4.6 (2.24)	5.1 (2.34)	4.9 (2.29)	4.3 (2.15)	5.1 (2.34)	4.7 (2.25)	
Mean		2.2 (1.54)	2.7 (1.71)	2.4 (1.62)	2.2 (1.53)	2.6 (1.66)	2.4 (1.60)	2.2 (1.53)	2.6 (1.68)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.21
Between Counts	:	0.11
Between Experiments	:	NS

Treatments x Counts	:	NS
Counts x Experiments	:	NS
Treatments x Experiments	:	NS
Treatments x Counts x Experiments	:	NS

Table 40. Effect of TNAU-made soft soap on mixed species of hoppers in rice nursery

Treatments	Dose	Number of hoppers/ 10 cm^2 nursery area									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	1.5 (1.39)	2.9 (1.74)	2.2 (1.57)	2.3 (1.66)	3.3 (1.94)	2.8 (1.80)	1.9 (1.52)	3.1 (1.84)	2.5 (1.68)	30.6
Soft Soap: 2	2.0 %	1.8 (1.50)	3.0 (1.86)	2.4 (1.68)	2.6 (1.75)	3.5 (1.99)	3.1 (1.87)	2.2 (1.62)	3.3 (1.93)	2.7 (1.77)	25.0
Soft Soap: 3	2.0 %	1.3 (1.31)	3.3 (1.92)	2.3 (1.62)	1.6 (1.43)	3.5 (1.99)	2.6 (1.71)	1.5 (1.37)	3.4 (1.96)	2.4 (1.66)	33.3
Soft Soap: 4	2.0 %	1.3 (1.31)	2.8 (1.81)	2.1 (1.56)	2.0 (1.56)	3.4 (1.97)	2.7 (1.77)	1.7 (1.44)	3.1 (1.89)	2.4 (1.66)	33.3
Soft Soap: 5	2.0 %	0.8 (1.10)	2.5 (1.72)	1.7 (1.41)	2.3 (1.66)	3.1 (1.89)	2.7 (1.77)	1.6 (1.38)	2.8 (1.80)	2.2 (1.59)	38.9
Fish Oil Soap	2.5 %	1.1 (1.23)	3.1 (1.89)	2.1 (1.56)	1.6 (1.43)	3.1 (1.89)	2.4 (1.66)	1.4 (1.33)	3.1 (1.89)	2.2 (1.61)	38.9
Imidacloprid 17.8 SL	50 g ai/ha	0.4 (0.95)	1.6 (1.43)	1.0 (1.19)	0.8 (1.10)	1.9 (1.53)	1.4 (1.32)	0.6 (1.02)	1.8 (1.48)	1.2 (1.25)	66.7
Spinosad 45 SC	90 g ai/ha	2.1 (1.60)	3.4 (1.97)	2.8 (1.78)	3.6 (1.95)	4.3 (2.18)	4.0 (2.07)	2.9 (1.77)	3.9 (2.08)	3.4 (1.92)	5.6
Avermectin 1.9 EC	5 g ai/ha	2.9 (1.83)	4.6 (2.25)	3.8 (2.04)	3.1 (1.89)	3.1 (1.89)	3.1 (1.89)	3.0 (1.86)	3.9 (2.07)	3.4 (1.97)	5.6
Control		3.0 (1.86)	4.3 (2.19)	3.7 (2.03)	3.4 (1.97)	3.8 (2.07)	3.6 (2.02)	3.2 (1.91)	4.1 (2.13)	3.6 (2.02)	
Mean		1.6 (1.41)	3.2 (1.88)	2.4 (1.64)	2.3 (1.64)	3.3 (1.93)	2.8 (1.79)	2.0 (1.52)	3.2 (1.91)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

		C D (P=0.05)
Between Treatments	:	0.18
Between Counts	:	0.08
Between Experiments	:	0.08
Treatments x Counts	:	NS
Counts x Experiments	:	0.11
Treatments x Experiments	:	NS
Treatments x Counts x Experiments	:	NS

Table 41. Effect of TNAU-made soft soap on mirid *C. lividipennis* in rice nursery

Treatments	Dose	Numbers / 10 cm^2 nursery area									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	0.5 (0.98)	1.1 (1.23)	0.8 (1.11)	1.3 (1.31)	0.9 (1.18)	1.1 (1.25)	0.9 (1.15)	1.0 (1.21)	0.9 (1.18)	47.1
Soft Soap: 2	2.0 %	0.9 (1.18)	1.5 (1.39)	1.2 (1.29)	1.5 (1.39)	1.6 (1.43)	1.6 (1.41)	1.2 (2.29)	1.6 (1.41)	1.4 (1.35)	17.7
Soft Soap: 3	2.0 %	0.8 (1.10)	1.6 (1.43)	1.2 (1.26)	0.9 (1.18)	1.6 (1.43)	1.3 (1.31)	0.9 (1.14)	1.6 (1.43)	1.2 (1.28)	29.4
Soft Soap: 4	2.0 %	0.4 (0.95)	1.3 (1.31)	0.9 (1.13)	1.0 (1.18)	1.4 (1.35)	1.2 (1.27)	0.7 (1.07)	1.4 (1.33)	1.0 (1.20)	41.2
Soft Soap: 5	2.0 %	0.8 (1.10)	1.3 (1.35)	1.1 (1.22)	1.1 (1.23)	1.1 (1.23)	1.1 (1.23)	1.0 (1.16)	1.2 (1.29)	1.1 (1.23)	35.3
Fish Oil Soap	2.5 %	1.0 (1.19)	1.5 (1.39)	1.3 (1.29)	1.0 (1.18)	0.9 (1.14)	1.0 (1.16)	1.0 (1.19)	1.2 (1.26)	1.1 (1.23)	35.3
Imidacloprid 17.8 SL	50 g ai/ha	0.3 (0.87)	0.4 (0.95)	0.4 (0.91)	0.3 (0.87)	0.6 (1.05)	0.5 (0.96)	0.3 (0.87)	0.5 (1.00)	0.4 (0.94)	76.5
Spinosad 45 SC	90 g ai/ha	0.8 (1.10)	1.0 (1.18)	0.9 (1.14)	2.8 (1.81)	1.1 (1.23)	2.0 (1.52)	1.8 (1.45)	1.1 (1.21)	1.4 (1.33)	17.7
Avermectin 1.9 EC	5 g ai/ha	0.6 (1.05)	1.0 (1.18)	0.8 (1.12)	1.3 (1.31)	1.0 (1.22)	1.2 (1.27)	1.0 (1.18)	1.0 (1.21)	0.9 (1.19)	47.1
Control		1.6 (1.43)	1.6 (1.43)	1.6 (1.43)	1.9 (1.53)	1.6 (1.43)	1.8 (1.48)	1.8 (1.48)	1.6 (1.43)	1.7 (1.45)	
Mean		0.8 (1.10)	1.2 (1.28)	1.0 (1.19)	1.3 (1.30)	1.2 (1.27)	1.2 (1.28)	1.0 (1.20)	1.2 (1.28)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.19

Between Counts : NS

Between Experiments : 0.09

Treatments x Counts	:	NS
Counts x Experiments	:	0.12
Treatments x Experiments	:	NS
Treatments x Counts x Experiments	:	NS

Table 42. Effect of TNAU-made soft soap on the nymphs of subabul psyllid *H. cubana*

Treatments	Dose	Number of nymphs / tender leaf									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	4.3 (2.18)	3.4 (1.96)	3.9 (2.07)	4.3 (2.18)	3.3 (1.94)	3.8 (2.06)	4.3 (2.18)	3.4 (1.95)	3.8 (2.07)	62.0
Soft Soap: 2	2.0 %	3.6 (2.01)	4.0 (2.08)	3.8 (2.05)	4.3 (2.18)	3.8 (2.06)	4.1 (2.12)	4.0 (2.10)	3.9 (2.07)	3.9 (2.09)	61.0
Soft Soap: 3	2.0 %	5.0 (2.34)	3.9 (2.06)	4.5 (2.20)	3.3 (1.94)	4.0 (2.11)	3.7 (2.03)	4.2 (2.14)	4.0 (2.09)	4.1 (2.11)	59.0
Soft Soap: 4	2.0 %	4.3 (2.18)	3.8 (2.06)	4.1 (2.12)	4.1 (2.14)	4.5 (2.23)	4.3 (2.18)	4.2 (2.16)	4.2 (2.15)	4.2 (2.15)	58.0
Soft Soap: 5	2.0 %	4.8 (2.30)	4.0 (2.09)	4.4 (2.19)	5.0 (2.34)	3.9 (2.06)	4.5 (2.20)	4.9 (2.32)	4.0 (2.08)	4.4 (2.20)	56.0
Fish Oil Soap	2.5 %	3.1 (1.88)	2.9 (1.80)	3.0 (1.84)	4.1 (2.14)	3.3 (1.91)	3.7 (2.02)	3.6 (2.01)	3.1 (1.86)	3.4 (1.93)	66.0
Imidacloprid 17.8 SL	50 g ai/ha	0.6 (1.05)	0.3 (0.89)	0.5 (0.97)	0.5 (1.00)	0.5 (0.98)	0.5 (0.99)	0.6 (1.02)	0.4 (0.94)	0.5 (0.98)	95.0
Triazophos 40 EC	400 g ai/ha	0.6 (1.05)	0.8 (1.14)	0.7 (1.09)	0.4 (0.93)	1.0 (1.17)	0.7 (1.05)	0.5 (1.00)	0.9 (1.16)	0.7 (1.07)	93.0
Malathion 50 EC	500 g ai/ha	1.1 (1.22)	0.9 (1.18)	1.0 (1.20)	0.9 (1.18)	1.1 (1.26)	1.0 (1.22)	1.0 (1.20)	1.0 (1.22)	1.0 (1.21)	90.0
Control		8.8 (3.04)	10.6 (3.32)	9.7 (3.18)	10.3(3.28)	10.4(3.30)	10.4(3.29)	10.0(3.16)	10.5(3.31)	10.0 (3.23)	
Mean		3.6 (1.93)	3.5 (1.86)	3.5 (1.89)	3.7 (1.93)	3.6 (1.90)	3.7 (1.92)	3.7 (1.93)	3.5 (1.88)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

C D (P=0.05)

Between Treatments : 0.19

Between Counts : NS

Between Experiments : NS

Treatments x Counts	:	NS
Counts x Experiments	:	NS
Treatments x Experiments	:	NS
Treatments x Counts x Experiments	:	NS

Table 43.Effect of TNAU-made soft soap on the adults of subabul psyllid *H. cubana*

Treatments	Dose	Numbers / shoot									% reduction from control
		Experiment - 1		Mean	Experiment - 2		Mean	Pooled Mean		Mean	
		3 DAT	7 DAT		3 DAT	7 DAT		3 DAT	7 DAT		
Soft Soap: 1	2.0 %	3.6 (3.11)	5.3 (2.40)	4.5 (2.76)	6.0 (2.53)	4.3 (1.84)	5.2 (2.36)	4.8 (2.82)	4.8 (2.29)	4.8 (2.56)	85.8
Soft Soap: 2	2.0 %	6.1 (2.57)	4.7 (2.28)	5.4 (2.42)	5.7 (2.49)	3.5 (2.00)	4.6 (2.34)	5.9 (2.53)	4.1 (2.13)	5.0 (2.33)	85.2
Soft Soap: 3	2.0 %	5.3 (2.40)	4.5 (2.23)	4.9 (2.32)	5.4 (2.42)	6.5 (2.64)	6.0 (2.53)	5.4 (2.41)	5.5 (2.44)	5.4 (2.43)	84.0
Soft Soap: 4	2.0 %	8.5 (3.00)	4.2 (2.16)	6.4 (2.58)	3.2 (1.91)	4.0 (2.11)	3.6 (2.01)	5.9 (2.46)	4.1 (2.14)	5.0 (2.30)	85.2
Soft Soap: 5	2.0 %	3.8 (2.07)	4.6 (2.25)	4.2 (2.16)	6.0 (2.55)	5.4 (2.42)	5.7 (2.49)	4.9 (2.31)	5.0 (2.34)	5.0 (2.32)	85.2
Fish Oil Soap	2.5 %	3.0 (1.86)	2.4 (1.69)	2.7 (1.78)	3.1 (1.89)	4.2 (3.20)	3.7 (2.54)	3.1 (1.87)	3.3 (2.45)	3.2 (2.16)	90.5
Imidacloprid 17.8 SL	50 g ai/ha	0.6 (1.03)	0.7 (0.92)	0.7 (0.97)	0.9 (1.18)	0.6 (1.03)	0.8 (1.11)	0.8 (1.11)	0.7 (0.97)	0.7 (1.04)	97.9
Triazophos 40 EC	400 g ai/ha	0.3 (0.89)	1.2 (1.27)	0.8 (1.08)	1.1 (1.23)	0.4 (0.94)	0.8 (1.08)	0.7 (1.06)	0.8 (1.10)	0.8 (1.08)	97.6
Malathion 50 EC	500 g ai/ha	0.9 (1.18)	1.1 (1.23)	1.0 (1.21)	1.8 (1.40)	0.9 (1.18)	1.4 (1.29)	1.4 (1.29)	1.0 (1.21)	1.2 (1.25)	96.5
Control		42.5 (6.56)	37.0 (9.34)	39.8(7.95)	24.9(5.03)	30.9(6.00)	27.9(5.31)	33.7(5.79)	34.0 (7.47)	33.8(6.63)	
Mean		7.5 (2.47)	6.6 (2.58)	7.0 (2.52)	5.8 (2.26)	6.1 (2.33)	5.9 (2.30)	6.6 (2.37)	6.3 (2.45)		

(Mean of three replications. Figures in parenthesis are square root (x + 0.5) transformed values; DAT, Days After Treatment)

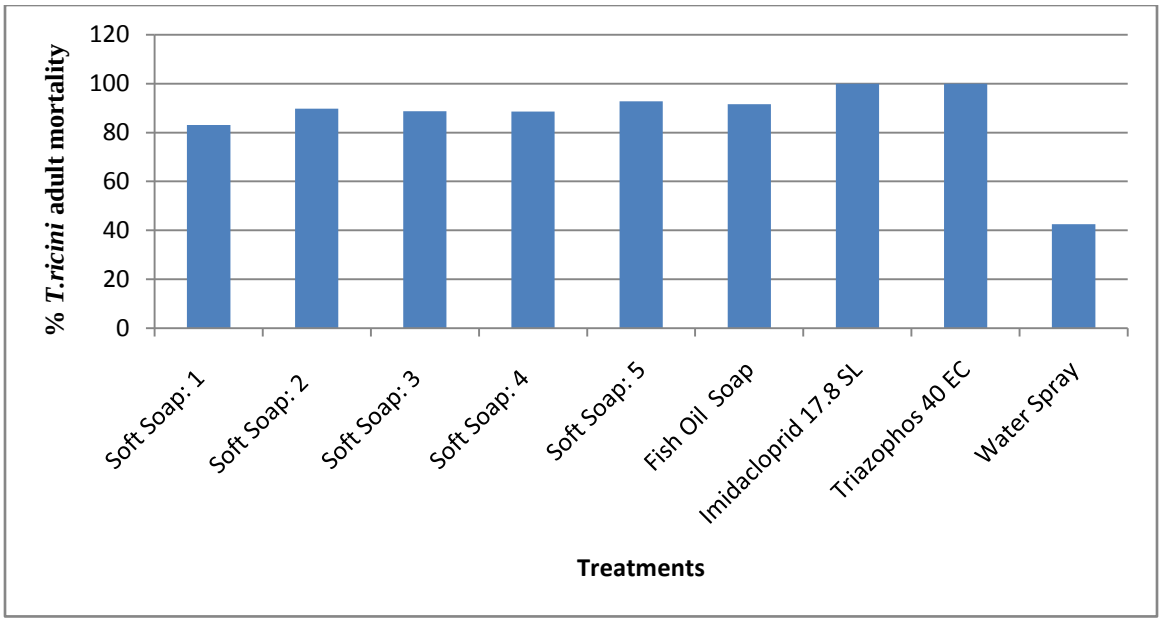
C D (P=0.05)

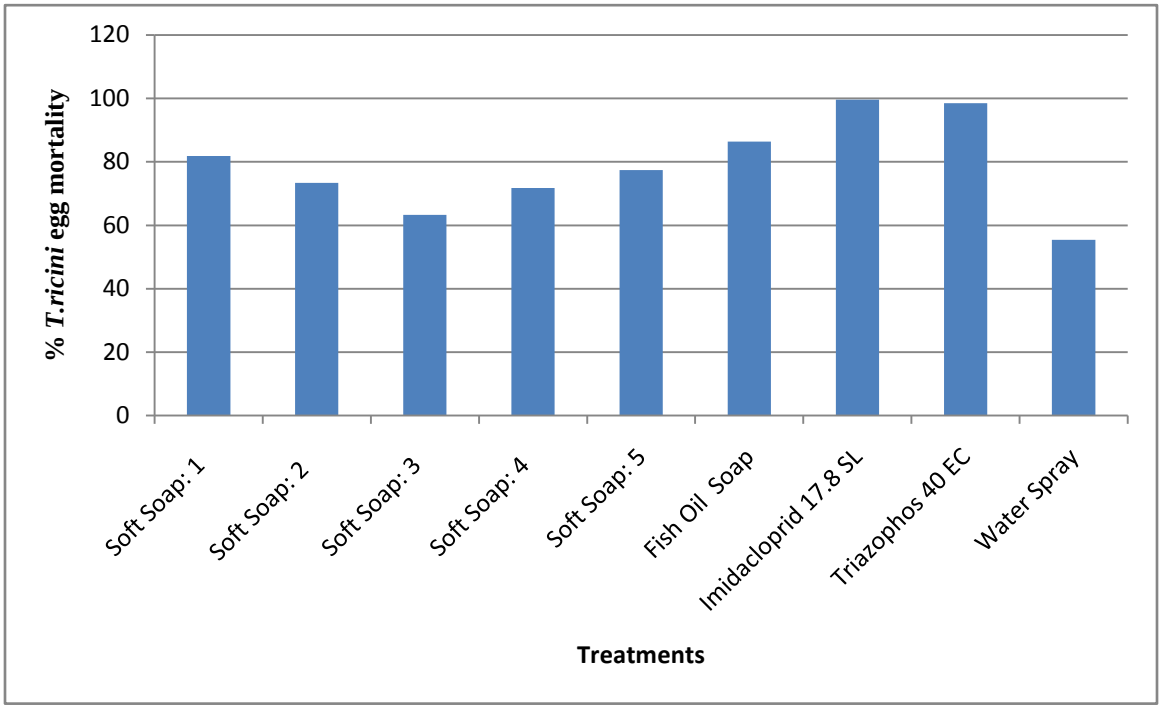
Between Treatments : 0.79

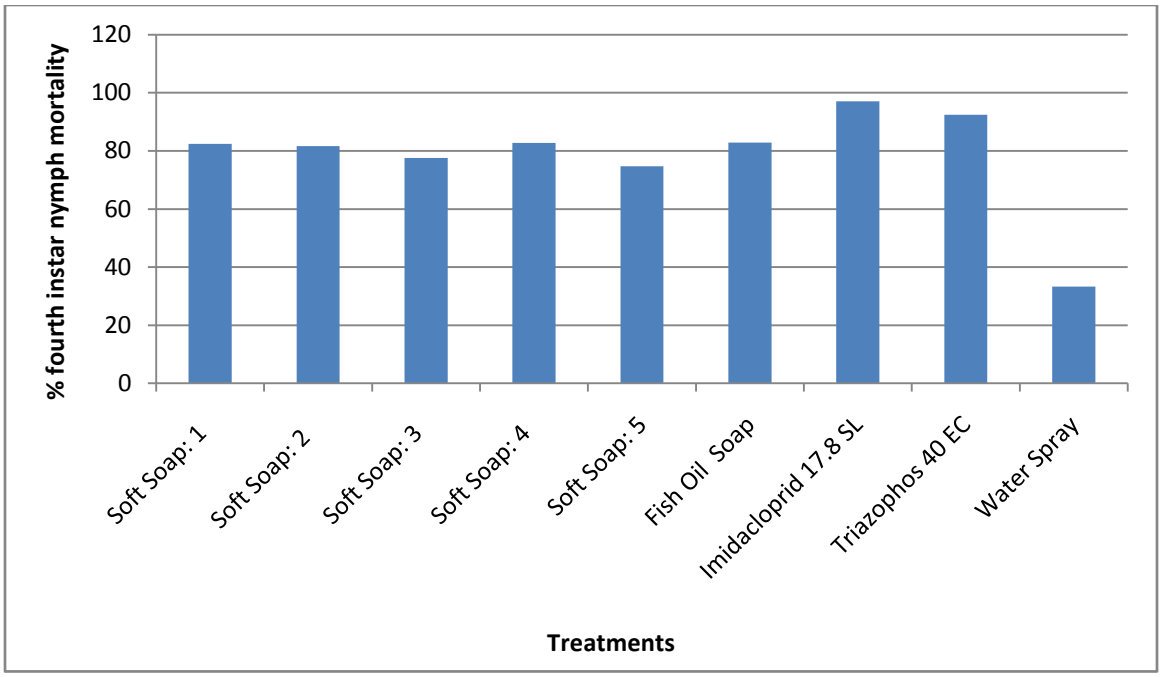
Between Counts : NS

Between Experiments : NS

Treatments x Counts	:	NS
Counts x Experiments	:	NS
Treatments x Experiments	:	1.12
Treatments x Counts x Experiments	:	NS


120
100
80
60
40
20
0
% T.ricini adult mortality
Soft Soap: 1
Soft Soap: 2
Soft Soap: 3
Soft Soap: 4
Soft Soap: 5
Fish Oil Soap
Imidacloprid 17.8 SL
Triazophos 40 EC
Water Spray
Treatments


120
100
80
60
40
20
0
% T.ricini egg mortality
Soft Soap: 1
Soft Soap: 2
Soft Soap: 3
Soft Soap: 4
Soft Soap: 5
Fish Oil Soap
Imidacloprid 17.8 SL
Triazophos 40 EC
Water Spray
Treatments


% fourth instar nymph mortality
120
100
80
60
40
20
0
Soft Soap: 1
Soft Soap: 2
Soft Soap: 3
Soft Soap: 4
Soft Soap: 5
Fish Oil Soap
Imidacloprid 17.8 SL
Triazophos 40 EC
Water Spray
Treatments

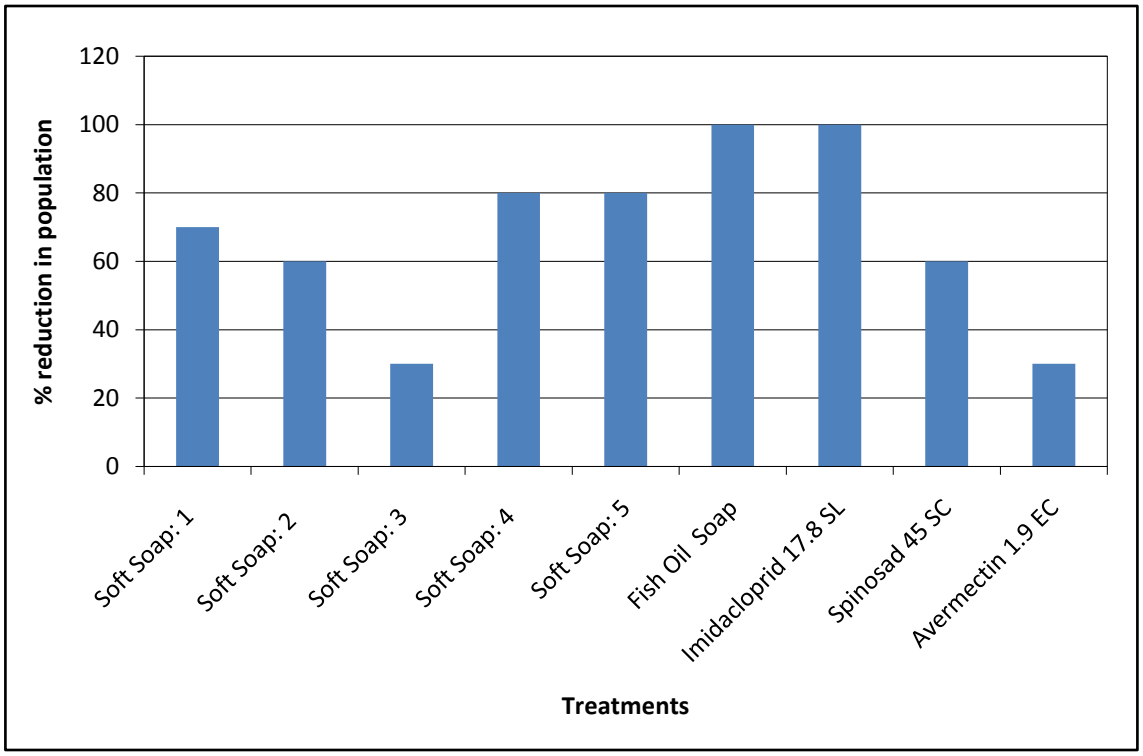


Fig. 1. Comparative efficacy of soft soaps in reducing *B. tabaci* populations on brinjal in screenhouse when compared to that in control.

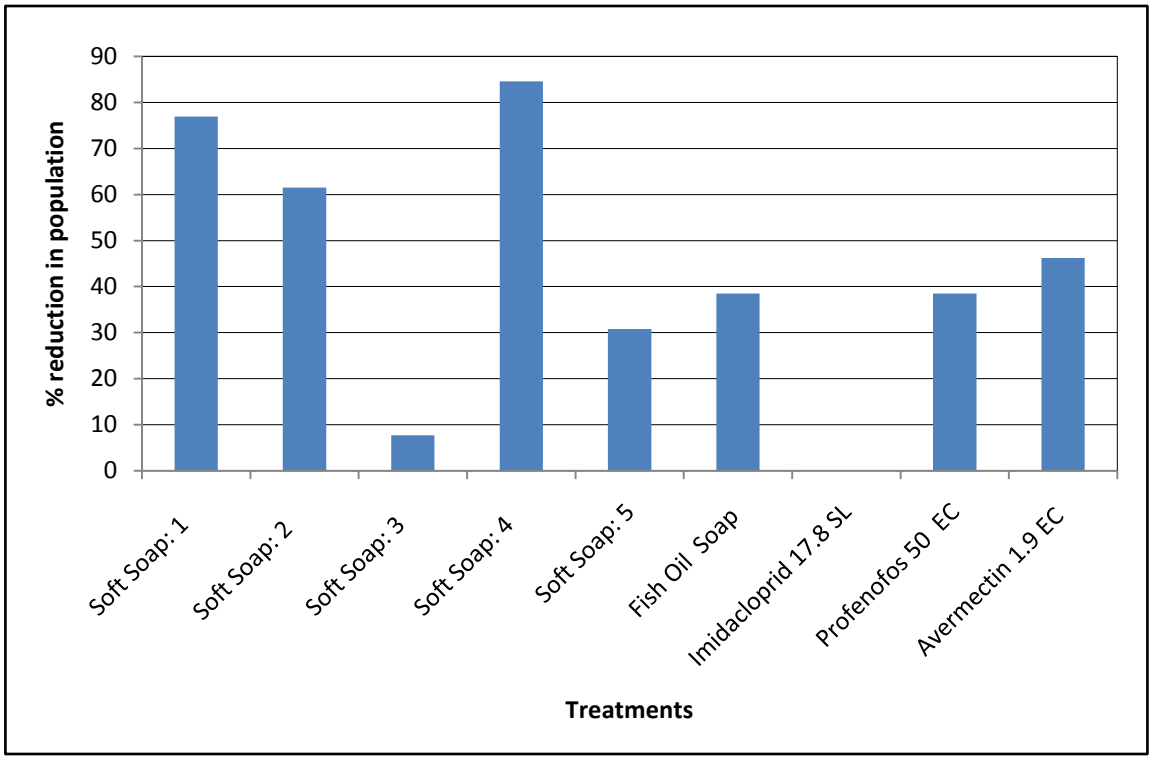


Fig. 2. Comparative efficacy of soft soaps in reducing *B. tabaci* populations on bhendi in field when compared to that in control.

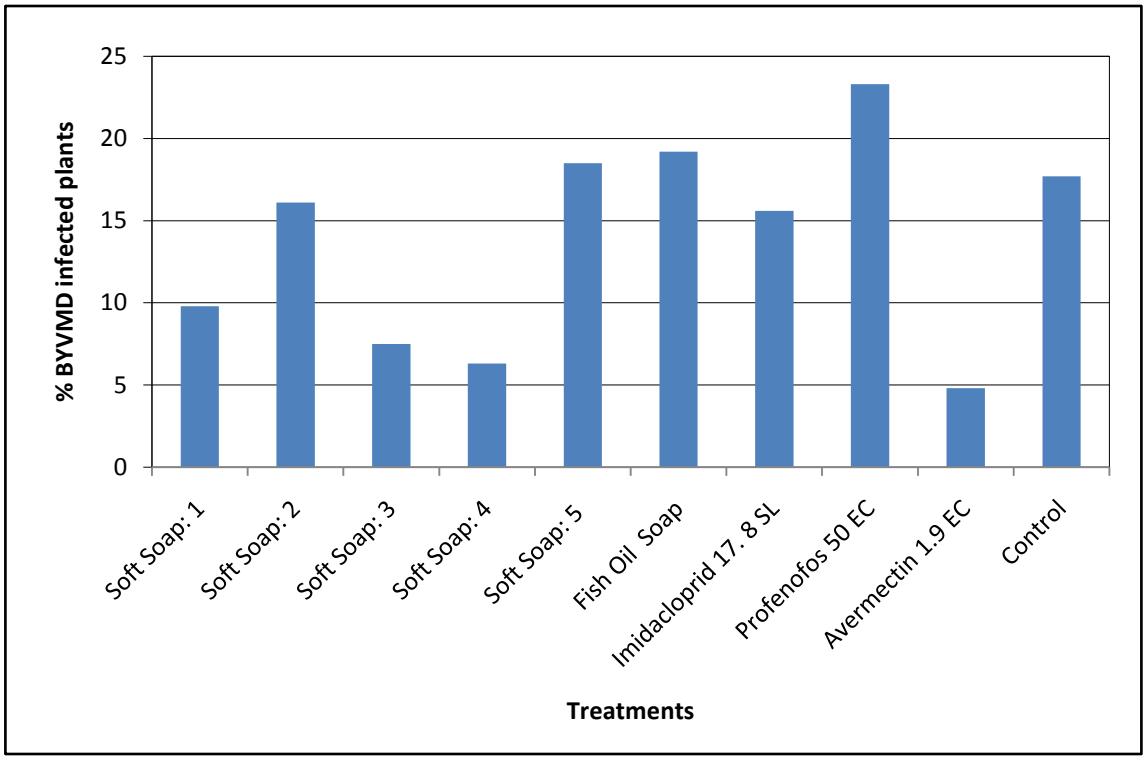


Fig. 3. Comparative efficacy of soft soaps in reducing BYVMD infected plants in bhendi transmitted by *B. tabaci*.

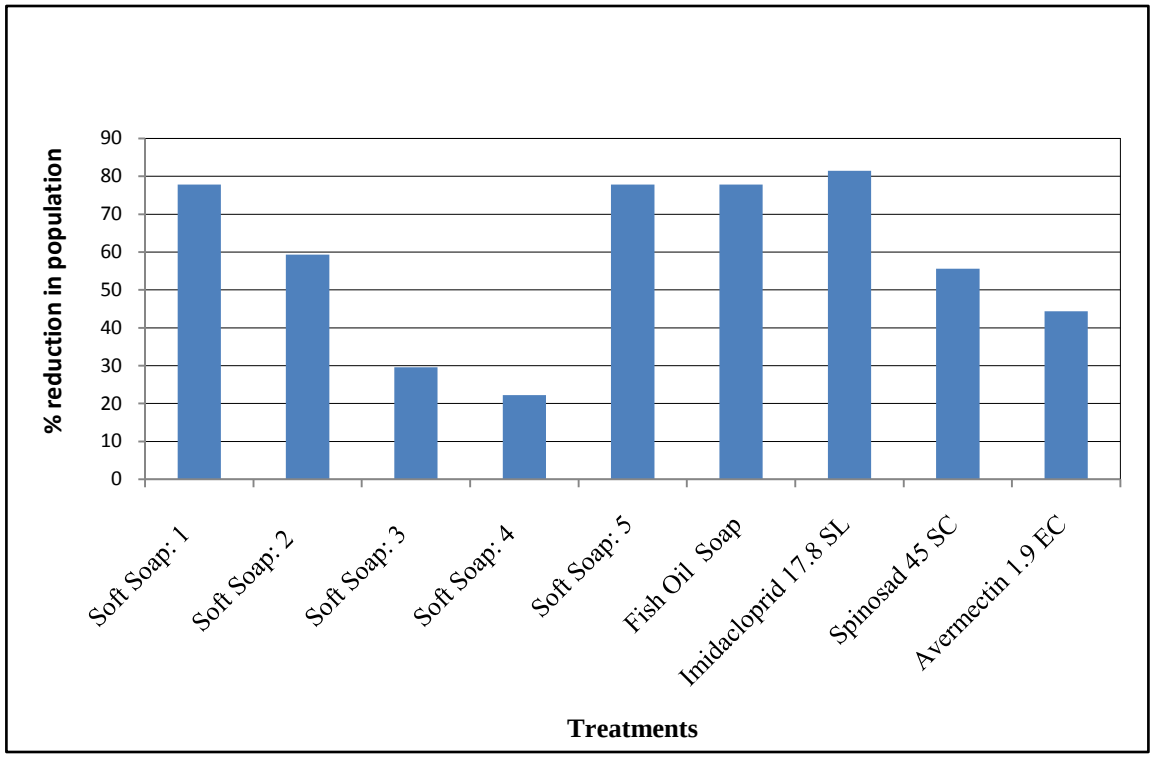


Fig. 4. Comparative efficacy of soft soaps inreducing *A. gossypii* and *M. persicae* populations on chillies in screenhouse when compared to that in control.

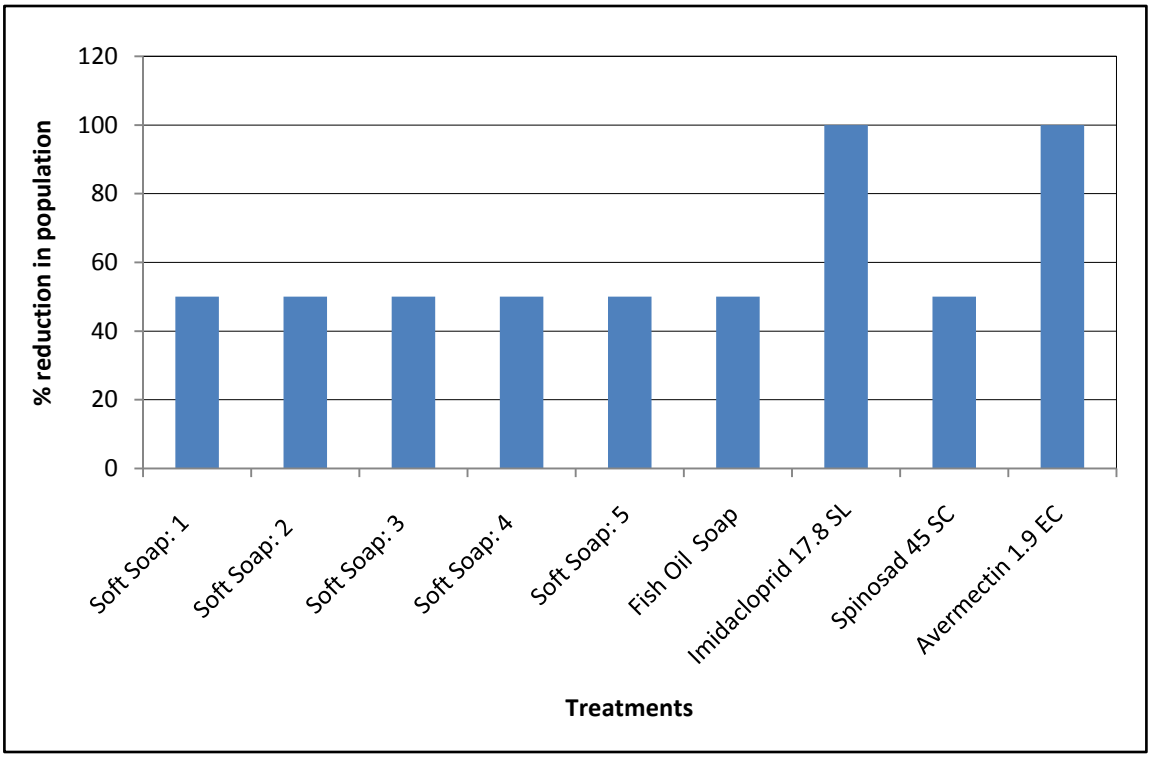


Fig. 5. Comparative toxicity of soft soaps in reducing coccinellids on chilli in field when compared to that in control.

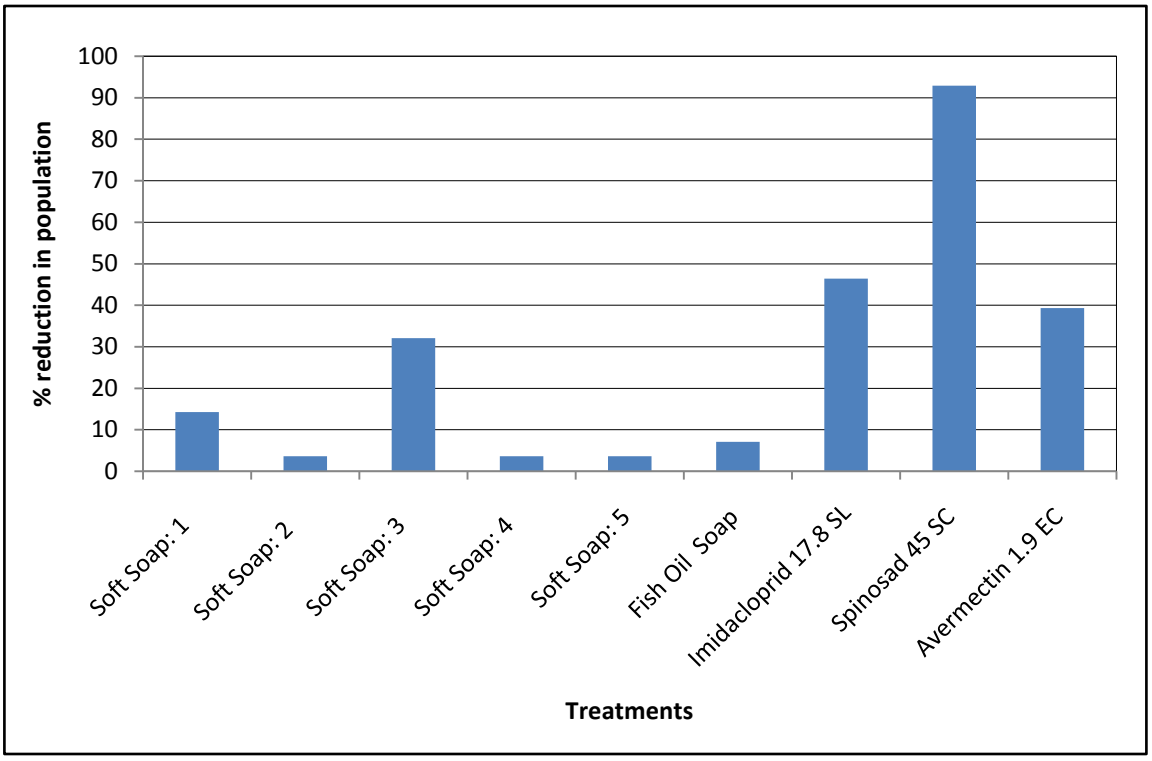


Fig. 6 Comparative efficacy of soft soaps in reducing *S. dorsalis* populations on chillies in screenhouse when compared to that in control.

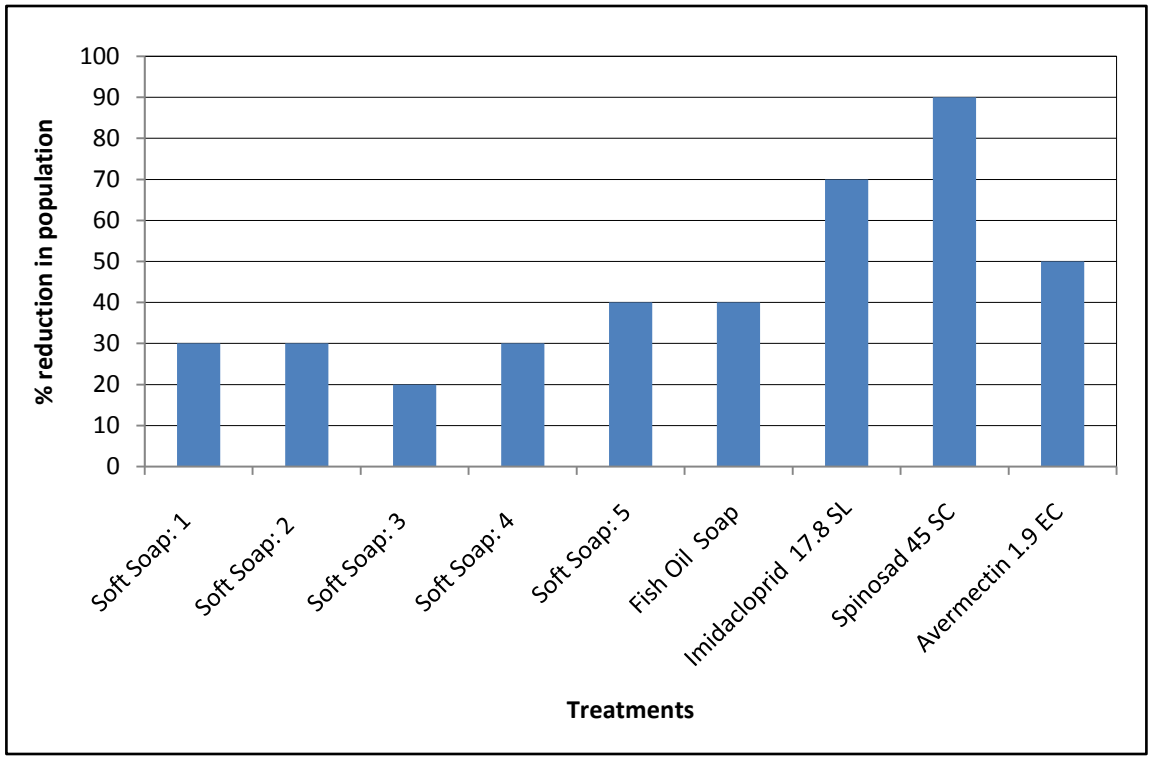


Fig. 7. Comparative efficacy of soft soaps in reducing *S. dorsalis* populations on chillies in field when compared to that in control.

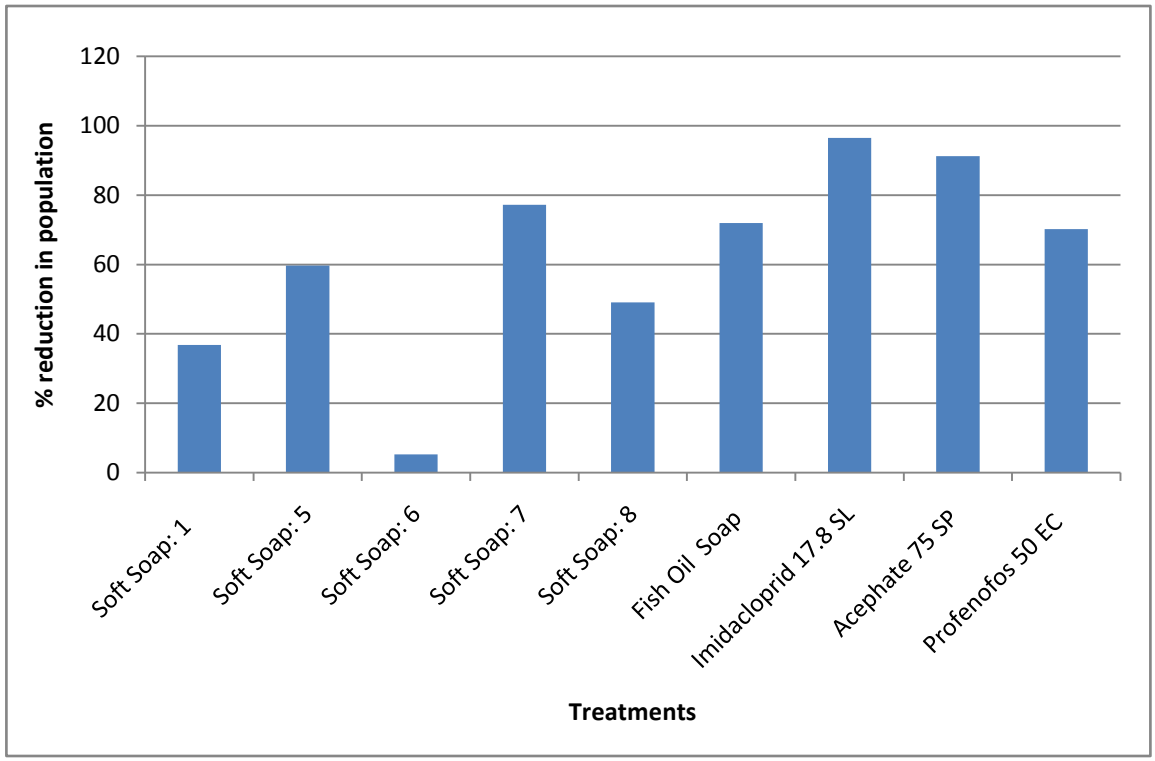


Fig. 8. Comparative efficacy of soft soaps in reducing *P. solenopsis* populations on cotton in screenhouse when compared to that in control.

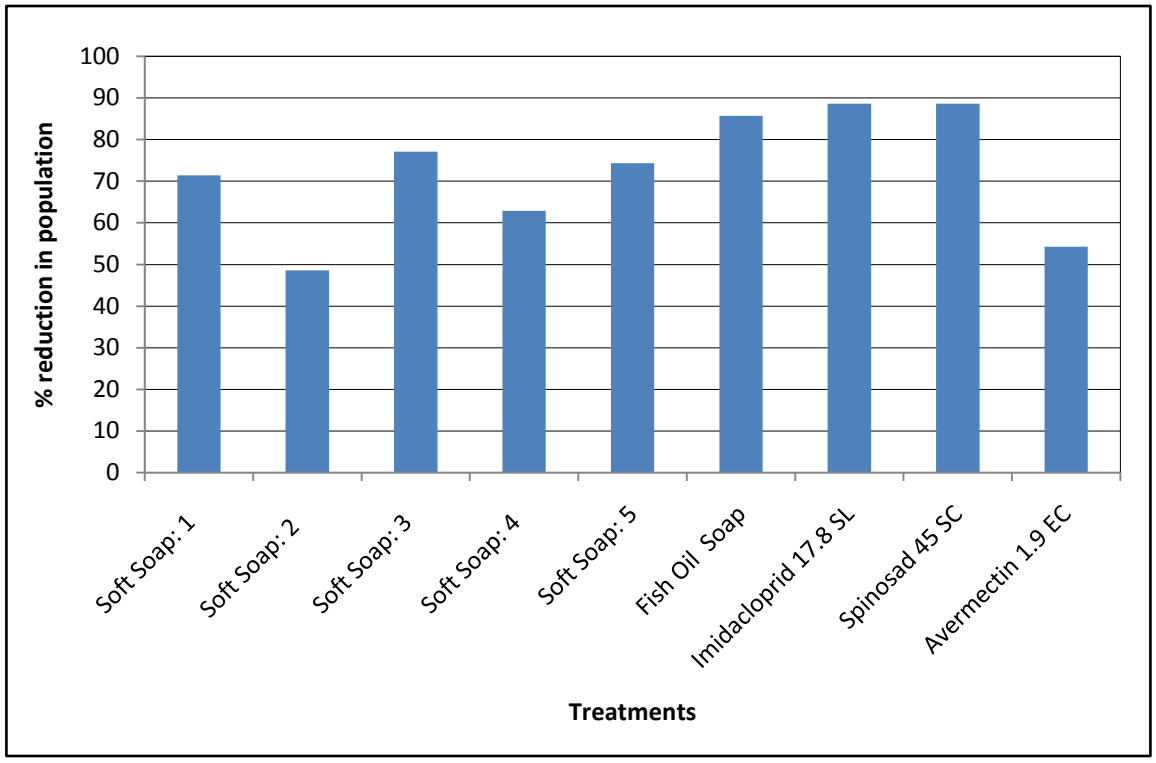


Fig. 9. Comparative efficacy of soft soaps in reducing *P. solenopsis* populations on brinjal in screenhouse when compared to that in control.

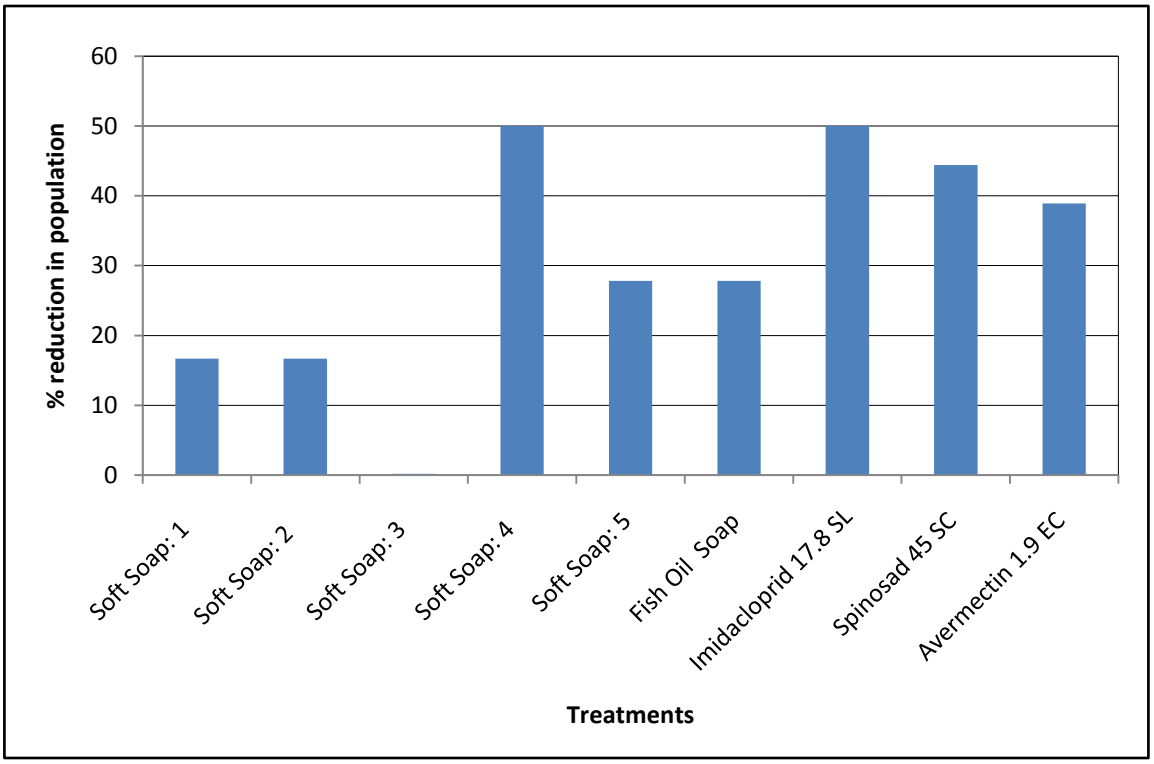


Fig. 10. Comparative efficacy of soft soaps in reducing *P. solenopsis* on brinjal in field when compared to that in control.

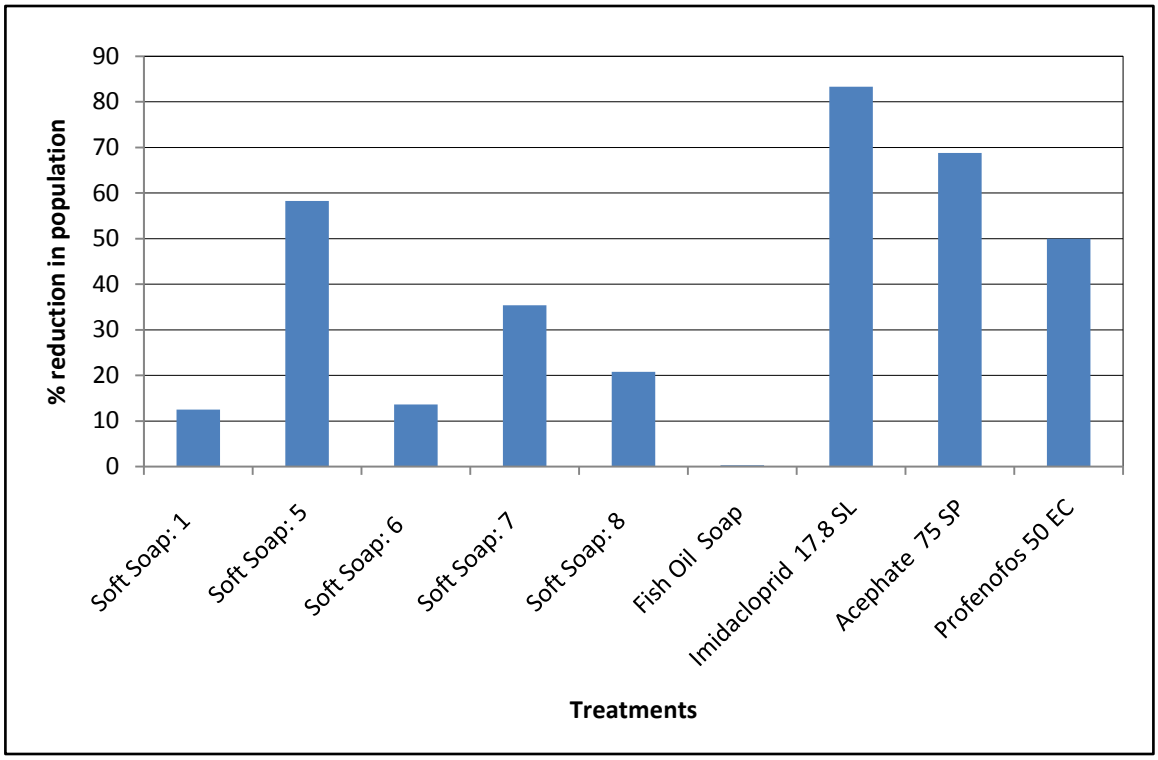


Fig. 11. Comparative efficacy of soft soaps in reducing *P. solenopsis* populations on bhendi in field when compared to that in control.

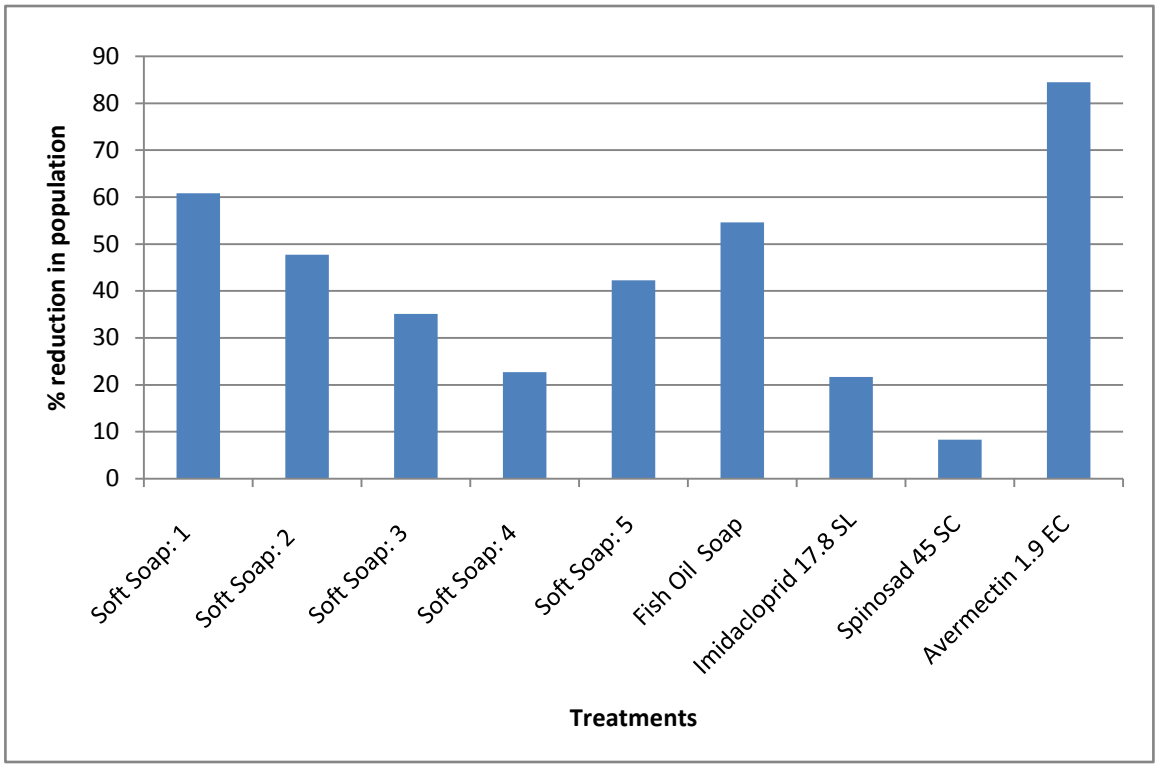


Fig. 12. Comparative efficacy of soft soaps in reducing *T. cinnabarinus* populations on brinjal in screenhouse when compared to that in control.

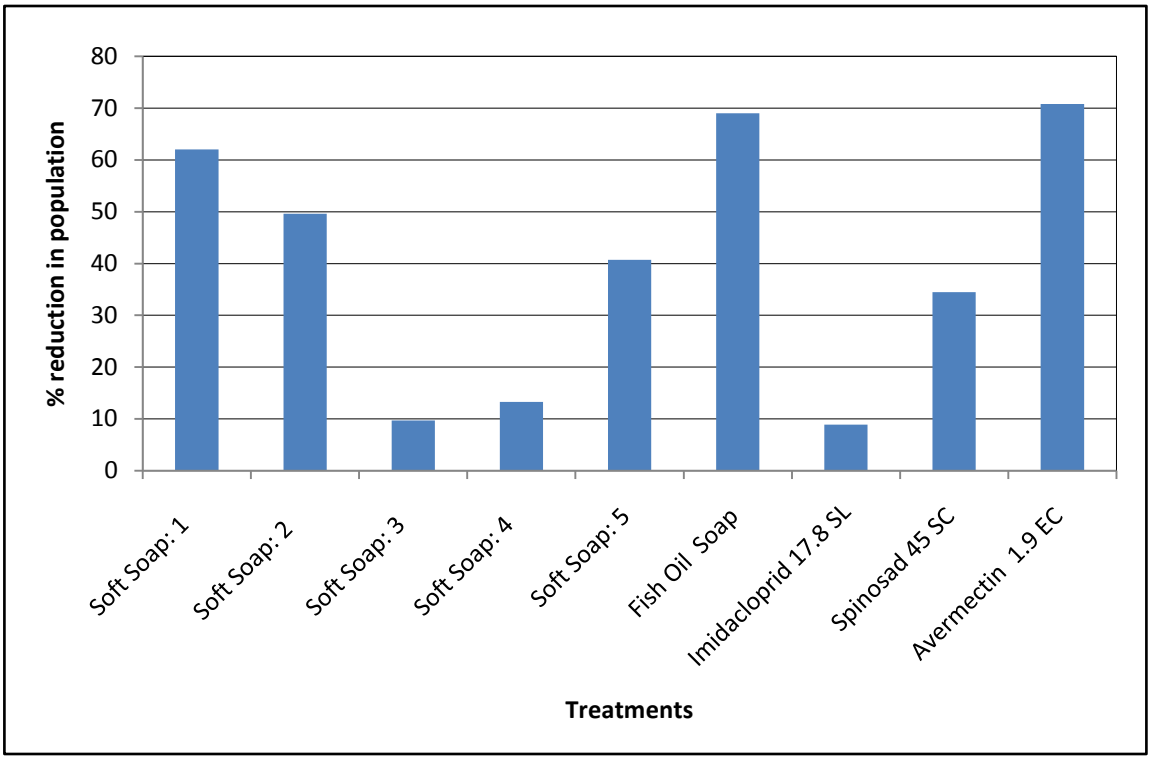


Fig. 13. Comparative efficacy of soft soaps in reducing *T. cinnabarinus* populations on bhendi in screenhouse when compared to that in control.

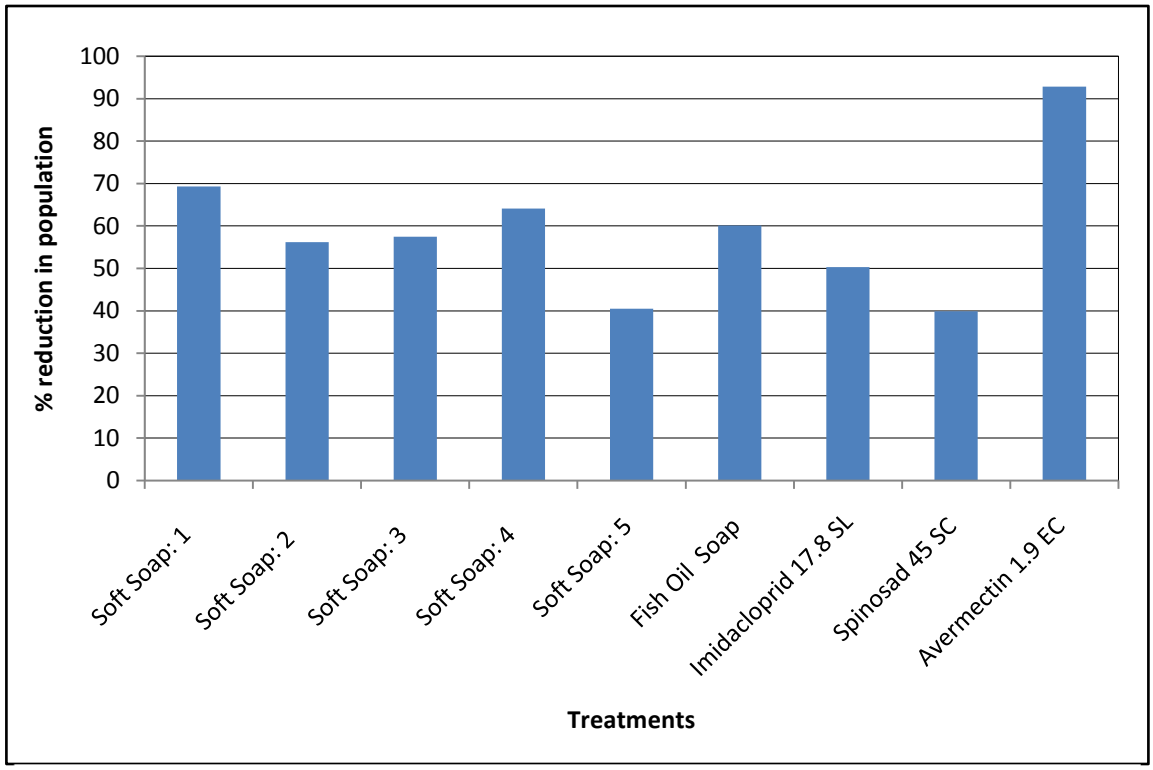


Fig. 14. Comparative efficacy of soft soaps in reducing *P. latus* populations on chillies in screenhouse when compared to that in control.

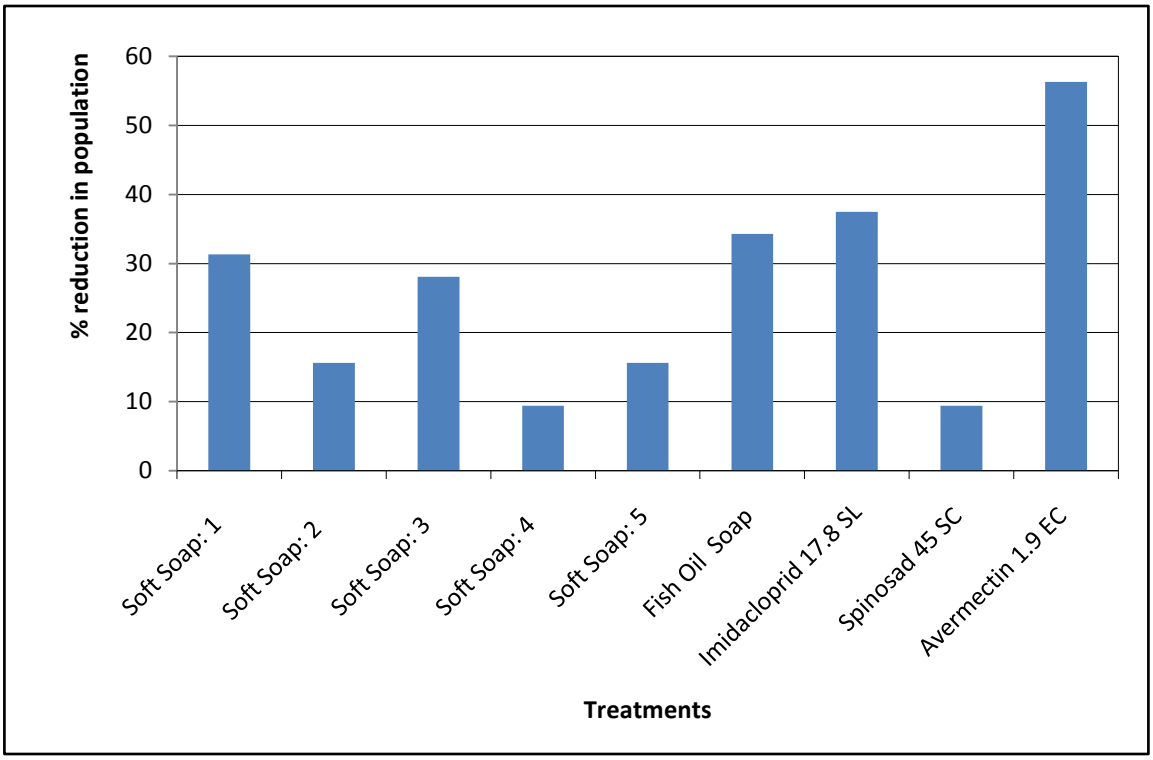


Fig. 15. Comparative efficacy of soft soaps in reducing *P. latus* populations on chilli in field when compared to that in control.

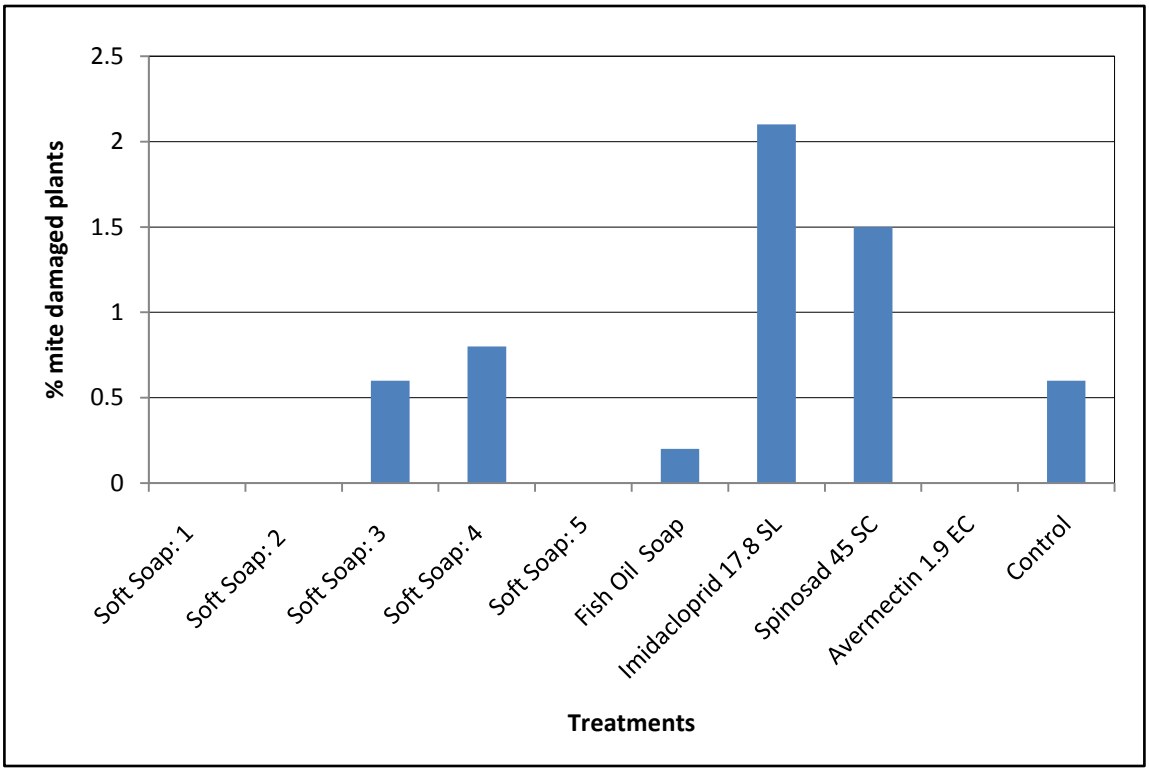


Fig. 16. Comparative efficacy of soft soaps in reducing *P. latus* damaged chilli plants.

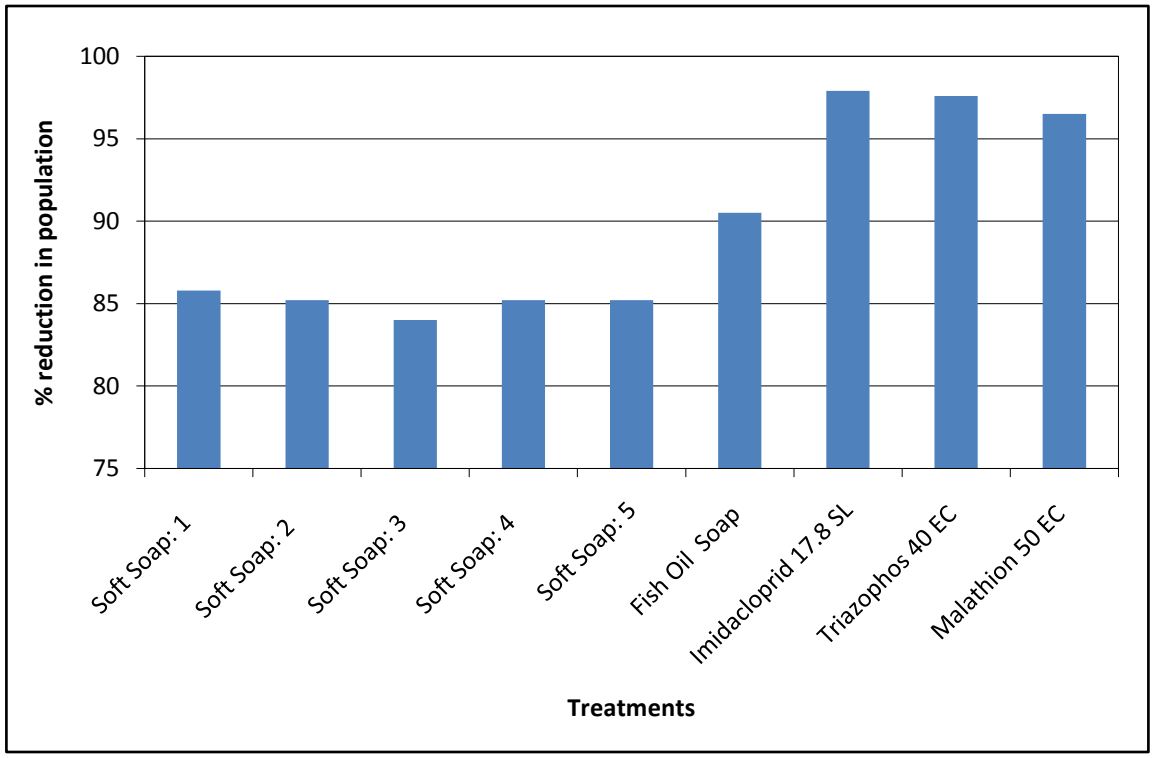


Fig. 17. Comparative efficacy of soft soaps in reducing *H. cubana* adult populations when compared to that in control.

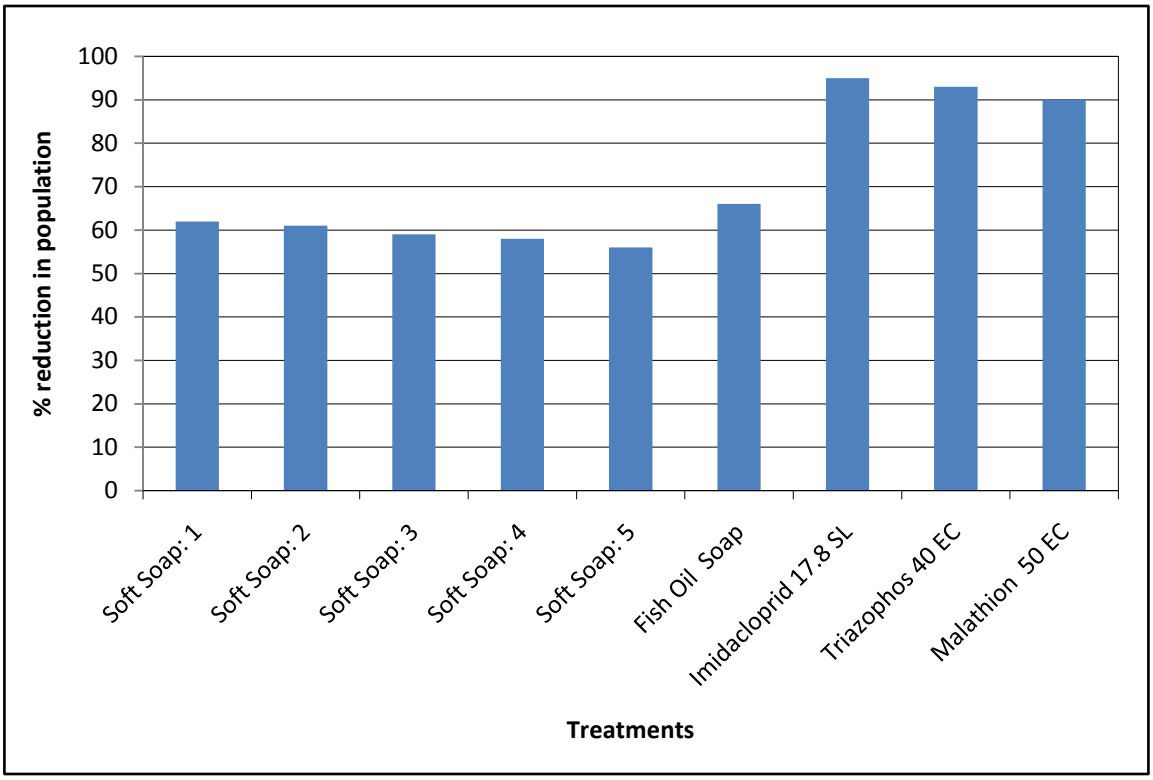


Fig. 18. Comparative efficacy of soft soaps in reducing *H. cubana* nymphal populations when compared to that in control.

ABSTRACT

Rajkumar, K. 2009. Evaluation of TNAU-Made Soft Soaps against Sucking Pests of Crops (Dr. P.M.M. David, Professor)

Potassium salts of fatty acids, called soft soaps, possess selective insecticidal properties. Eight soft soaps developed by the Department of Plant Protection, Agricultural College and Research Institute, Killikulam were evaluated at laboratory, screenhouse and field conditions during 2008 – 2009 against selected insects/mites that include: mealybug, *Phenacoccus solenopsis* Tinsley on brinjal and cotton; whiteflies, *Bemisia tabaci* (Gennadius) on bhendi and brinjal and *Trialeurodes ricini* Misra on castor; aphids, *Aphis gossypii* Glover and *Myzus persicae* (Sulzer) on bhendi, cotton and chillies; psyllids, *Heteropsylla cubana* Crawford on subabul; hoppers, *Nilaparvata lugens* (Stal.), *Nephotettix nigropictus* (Stat.), *N. virescens* (Distant) on rice nursery; *Amrasca devastans* Ishida on bhendi and brinjal; *Idioscopus clypealis* (Lethierry), *I. niveosparsus* (Lethierry), *Amritodus atkinsoni* (Lethierry) on mango; thrips, *Scirotothrips dorsalis* Hood on chillies; mites, *Tetranychus cinnabarinus* (Boisd.) on bhendi and brinjal and *Polyphagotarsonemus latus* Banks on chillies. Soft soaps were sprayed at weekly interval at 2.0 % concentration in comparison with fish oil soap at 2.5 %, imidacloprid 17.8 SL at 50g ai/ha, spinosad 45 SC at 90g ai/ha, triazophos 40 EC at 400g ai/ha, malathion 50 EC at 500g ai/ha, avermectin 1.9 EC at 5g ai/ha, profenofos 50 EC at 500g ai/ha, carbaryl 50 WDP at 1.5 kg ai/ha and acephate 75 SP at 750 g ai/ha in different experiments. The results revealed that soft soaps were highly toxic to whiteflies, aphids, psyllids and mites, moderately toxic to mealybugs, mangohoppers,and rice hoppers and less toxic to *A. devastans* and *S. dorsalis*. The impact of soft soaps on selected predators and their toxicity to plants are also discussed.