EVALUATION OF NEWER INSECTICIDES AGAINST SAFFLOWER APHID, *Uroleucon compositae* Theobald

THESIS

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By

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DECLARATION OF STUDENT

I hereby declare that the experimental work and result of the thesis entitled "**EVALUATION OF NEWER INSECTICIDES AGAINST SAFFLOWER APHID, *Uroleucon compositae* Theobald.**" or part there of has not been submitted for any other degree or diploma of any university, nor the data have been derived from any thesis or publication of any university or scientific organization. The source of material used and all assistance received during the course of investigation have been duly acknowledged.

Place: Akola

Date:31/05/2013.

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CERTIFICATE

This is to certify that, the thesis entitled "**EVALUATION OF NEWER INSECTICIDES AGAINST SAFFLOWER APHID, *Uroleucon compositae* Theobald.**"Submitted in partial fulfilment of the requirement for the degree of "**Master of Science in Agriculture (Agricultural Entomology)**" of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **Jagtap Rahul Krushnarao** under my guidance and supervision.

The subject of thesis has been approved by the student's Advisory Committee.

Place: Akola
Date: 31 /05/2013

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THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE INCLUDING EXTERNAL EXAMINER (AFTER VIVA–VOCE)

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(D) Abbreviations

%	-	per cent
CD	-	Critical difference
cm	-	Centimetre
CV	-	Coefficient of variation
DAFS	-	Days after first spraying
DASS	-	Days after second spraying
DAS	-	Days after spraying
et al.	-	et alia (And others)
etc.	-	Etcetera
ETL	-	Economic threshold level
Fig.	-	Figure
g	-	gram
ha	-	Hectare
i.e.	-	id est. (that is)
ICBR	-	Incremental cost benefit ratio
kg	-	kilogram
LBB	-	Lady Bird beetle
m	-	Meter
ml	-	millilitre
No.	-	Number
NS	-	Non significant
q	-	Quintal
RBD	-	Randomized block design
Rs.	-	Rupees
SE(m)±	-	Standard error of mean
Sig.	-	Significant
SL	-	Soluble liquid

SP	-	Soluble powder
SC	-	Soluble concentrate
ppm	-	parts per million
viz.	-	Videlicet (Namely)
WG	-	Wettable granules
WP	-	Wettable powder
EC	-	Emulsifiable concentrate
WSC	-	Water soluble concentrate

(F) **THESIS ABSTRACT**

a)	Title of the thesis	: **EVALUATION OF NEWER INSECTICIDES AGAINST SAFFLOWER APHID, *Uroleucon compositae* Theobald"**
b)	Name of student	: **Jagtap Rahul Krushnarao**
c)	Name and address of Major advisor	: **Dr. P. K. Rathod** Assistant Professor Department of Agricultural Entomology, PGI, Dr. PDKV, Akola.
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ABSTRACT

The present investigation entitled "Evaluation of newer insecticides against safflower aphid, *Uroleucon compositae* Theobald." conducted during *Rabi* of 2012-2013 at Dr. PDKV, Akola in Randomized Block Design with nine treatments.

The treatment consisting of Thiamethoxam 25 WG 0.006%, Acetamiprid 20 SP 0.004, Imidacloprid 17.8 SL 0.007, Difenthiuron 50 WP 0.6%, Lambada cyhalothrin 2.5 SC 0.005, Fipronil 5 SC 0.01%, Acephate 75 SP 0.12%, Dimethoate 30 EC0.03% and control (water spray) were evaluated.

The observations in field trial were as recorded precount of safflower aphid per 5 cm apical twig per plant taken before imposing the treatment and post count was taken from randomly selected and tagged five plants on 1 day before, 3,7 and 10 days after spraying. Second spray was given at 15 days interval. The efficacy was assessed by recording the total number of safflower aphid per 5 cm apical twig per plant (randomly selected 5 plant). Observations of safflower aphid per 5 cm apical twig per plant recorded on 10 randomly selected plants from the plot which was separately sown for recording seasonal incidence of safflower aphid.

The population of natural enemies viz., LBB, Chrysopa and Syrphid fly per plant was also recorded from same plot yield data was recorded and after statistically analysis results are presented.

For the management of safflower aphid, the treatment with Thiamethoxam 25 WG 0.006 % was found to be most effective in reducing population of safflower aphid followed by Acetamiprid 20 SP 0.004%, Imidacloprid 17.8 SL 0.007% and Acephate 75 SP 0.12% and Thaimethoxam 25 WG 0.006% and acetamiprid 20 SP 0.004% were found relatively safer against predators of safflower aphid.

The highest seed yield of safflower was obtained from the treatment of Thiamethoxam 25 WG 0.006% (1477 kg/ha) and followed by Acetamiprid 20 SP (1324 kg/ha).

On the basis of ICBR, Thiamethoxam 0.006% (1:7.87) appeared to be the most economical viable treatment followed by Acetamiprid 20 SP 0.004% (1:7.47), Dimethoate 30 EC 0.035 (6.03) and Imidacloprid 17.8 SL 0.007% (5.67).

On the basis of net monetory returns, Thiamethoxam appeared to be the most economic and effective treatment followed by Acetamiprid 20 SP 0.004% and Imidacloprid 17.8 SL 0.007%.

CHAPTER I

INTRODUCTION

1.1 Background information

Safflower (*Carthamus tinctorius* L.), an oilseed crop is a member of the family compositae. Safflower has been grown in India since time immemorial. It is mentioned as *kusumba* in ancient scriptures. Presently, in India it is most commonly known as *kardai* in Marathi and *kusum* in Hindi.

Safflower is a multipurpose crop rich in vitamin A, iron, phosphorus and calcium. It has been grown from centuries in India for the orange-red dye (carthamin) extracted from its brilliantly colored flowers and for its quality oil rich in polyunsaturated fatty acids (linoleic acid, 78%). Safflower flowers are known to have many medicinal properties for curing several chronic diseases, and they are widely used in Chinese herbal preparations (Li and Mundel, 1996). The tender leaves, shoots, and thinning of safflower are used as pot herb and as salad. Chinese Academy of Science has developed safflower tea from the dried petals of improved safflower varieties. This tea is rich in nutrition, attractive colour with certain medicinal value (Dajue, 1993).Bundles of young plants are commonly sold as a green vegetable in markets in India and some neighboring countries (Nimbkar, 2002). Safflower can be grazed or stored as hay or silage. Safflower forage is palatable, and its feed value and yields are similar to or better than those for oats or alfalfa. Thus, each part of safflower has a value attached to it. Safflower has high tolerance to low moisture conditions.

Important safflower growing countries are India, Kazakhastan, Argentina, USA and Mexico having area 3.0 lakh ha, 1.18 lakh ha, 0. 97 lakh ha, 0.67 lakh ha, and 0.57lakh ha under cultivation respectively. India has legitimate pride of being largest producer of safflower in the world. More than 60 countries of the world grow safflower but over half is produced in India mainly for vegetable oil market (Patil, 2011).

The area covered under safflower crop in world was 6, 91,000 ha with production of about 6, 15,000 tonnes. In India, safflower is grown on 2, 70,000 ha area and production of 1, 55,000 tonnes with the productivity of 574 kg per ha. Maharashtra occupies 1, 68,000 ha area with 83,900 tonnes of production and 499 kg per ha productivity. In Vidharbha, safflower is grown on 10,800 ha with 5,300 tonnes production and 491 kg productivity In India, Maharashtra and Karnataka are the major safflower growing states accounting for 73 per cent and 22 per cent area under safflower respectively. (Anonymous, 2012)

1.2 Importance of study

The safflower plant has been found to be damaged by over 80 species of insects, mites and nematodes throughout the world. In India as many as 25 pests were found of economic importance. Of these, the safflower aphid, *Uroleucon (Dactynotus) carthami* (Hille Ris Lambers) is the most destructive pest. (Singh et al, 1999)

Safflower is attacked by 36 species of pests in India Out of these the safflower aphid, *Uroleucon compositae*, (Theobald) and recently leaf eating caterpillar, *Perigea capensis* (Walker) and capsule borer, *Heliocoverpa armigera* (Hubner) are considerd to be major pests of the crop in northern parts of Karnataka. (Bharaj et al. 2003).

One of the major reasons for the low productivity is the losses due to insect pests. The safflower aphid, *Uroleucon compositae* is the most destructive and regular pest and is the major constraint in safflower production among biotic stresses. In case of severe infestation the yield losses ranged from 24.20 to 67.72 per cent. (Shetgar et al., 1993)

Suryawanshi and Pawar (1980) reported 67.72 per cent losses due to safflower aphid *Uroleucon compositae,* in safflower.

At present there is a great deal of discussion on resistance of insects to commonly used insecticides which is of grave concern to entomologists. One of the solutions to the resistance problem is the rotation of newer insecticides with the conventional ones. Hence in the present studies attempts were made to evaluate newer insecticidal molecules for management of safflower aphid.

1.3 Objectives of study

1. To know the efficacy of newer insecticides against safflower aphids.
2. To study the effect of newer insecticides against natural enemies.
3. To study the seasonal incidence of safflower aphid in relation to weather parameters.
4. To work out the economics of different insecticides.

1.4 Scope and limitations

There is large scope for developing effective pest management approach because the indiscriminate use of insecticide disturb natural balance of pest and other enemies leading to resurgence of pest and pollution in crop ecosystem.

Suryawanshi and Pawar (1980) reported a 35 to 72% loss in yield during heavy infestation periods.

Seed and oil content losses due to this pest to the extent of 20-80 % have been recorded from different parts of the country (Singh et al. 2000). These losses can be avoided by adopting proper and effective plant protection measures.

Therefore the effective control method with newer insecticidal molecules for the management of safflower aphids results in greater production of safflower. As insect-pest has developed resistance to convectional insecticides; use of newer insecticidal molecule's play an important role in resistance management.

Limitation

Insect infestation fluctuates over seasons and locations depending on biotic and abiotic factors which affect the crop and its associated invertebrate fauna. The control of aphids is difficult due to its fast development rate and high reproduction potential under congenial climate

1.5 Hypothesis

In spite of its great importance as edible oilseed, the cultivation of safflower is confined to marginal and sub marginal lands under very poor agronomical practices as well as ignorance towards the plant protection measures resulted in low average yield.

The indiscriminate use of the pesticides has resulted into numerous problems. There is resistance among the target and non-target pests against insecticides, disrupting natural balance of the pest and its enemies due to which the minor pest become major ones and adding population to ecosystems and causing hazard to human health.

Thus it is the need of the hour to evolve the new insecticides superior to existing one which are ecofriendly and safer to non-target insects. The present investigation may be helpful to evaluate newer and effective insecticidal molecules and to correlate aphid population with weather parameters so as to manipulate correct timing of pesticide application. The present study may be helpful to increase the yield and to manage the problem of resistance among the targeted insects.

CHAPTER II

REVIEW OF LITERATURE

The present studies on "Evaluation of newer insecticides against safflower aphid *Uroleucon compositae* Theobald was undertaken to evaluate newer insecticides for effective management of safflower aphid *Uroleucon compositae* Theobald during rabi 2012-13 at Oilseed Research Unit, Dr. Panjabrao Deshmukh krishi vidyepeeth, Akola (MS).

The safflower is extensively grown in Vidarbha and Marathwada region of the Maharashtra. The important and regular pest infesting the crop in the state is safflower aphid (*Uroleucon compositae* Theobald) which occur regularly in the safflower growing areas and damage the crop during vegetative and flowering stages of the crop cause heavy losses due to its infestation. The efficacy of different insecticides has been tested by several workers against safflower aphid (*Uroleucon compositae* Theobald). The comprehensive review is prepared by referring to the most important available literature and presented below under different sub headings.

2.1 Occurrence, damage and losses due to safflower aphid

Goud (1980) reported that among the 22 *Carthamus tinctorius* varieties screened for their reaction to *U. compositae*, the mean number of aphids per plant ranged from 1527.67 to 9138.50.The presence of low amounts of total amino acids, high amounts of reducing sugars, total sugars and total phenols appeared to increase resistance.

Basavanagoud et al. (1981) reported the yield losses in safflower (variety A-300) caused by *Uroleucon compositae* (Theo.) The grain losses in untreated plots were 67.72% greater than in plots sprayed with 0.05% phosphamidon, 55.93% greater than in plots from which aphids were removed with a brush, and 66.72% greater than in plots where the plants were protected by caging.

Ghorpade and Shinde (1983) reported that the aphid, *U. compositae* (Theobald) is the key pest of safflower and the yield losses due to aphids alone ranged from 20 to 24 per cent. Another pest of economic importance is *Heliothis armigera* (Hubner). The crops should be sown early i.e. up to the first week of October to escape attack from aphids in Maharashtra.

Suryawanshi and Pawar (1983) determined the losses in grain yield of safflower due to aphids. The number of aphids per leaf in untreated plots averaged 19.3 in the 1st season and 12.12 in the 2nd, as compared with 0.0 and 0.7 in treated plots. The corresponding grain yields were 244 and 325 kg/ha, as compared with 617 and 715.

Mhase et al. (1986) carried out a field experimenton the effect of sowing time of safflower on the incidence of *U. carthami.*The crop sown in the middle of September had the lowest aphid population (189.6 aphids/10 cm apical twig per plant) and the highest seed yield (996.5 kg/ha).

Pawar et al. (1986) reported that the highest concentration of cartap 0.07% was significantly superior than other treatments in controlling safflower aphid (*Dactynotus sonchi* L.) and also recorded highest yield of 1927 kg/ha.

Ghule et al (1987) studied the effect of sowing date on the incidence of the aphid *U.carthami* on safflower. The lowest aphid population was observed when the crop was sown 15 days before or on the normal sowing date i.e. the 1st week of October.

Naik et al. (1987) reported that the seed treatatment with carbofuran 50 SP, benfarocarb 50 SP, carbofuran 35 STD and 25 STD, bromophos methyl 25 SP and UC-100 S at 60 g/kg seed effective show suppress in aphid population up to six weeks after germination.

Palaskar et al. (1987) reported that the insecticides like fluvalinate 0.004%, phosphamidon 0.05%, methamidophos 0.05% and mecarbam 0.03% were equally effective as phosphamidon 0.02% and quinalphos 0.05% in both, controlling aphid population and in increasing yield.

Borkar and Borkar (1988) reported that the incidence of aphid occurs as early as mid-November and continues till the end of March with various intensities of infestation depending on the physiology of safflower crop and the prevailing weather conditions, causing as much as 50-60% losses in crop production. Mustard aphid (*Lipaphis erysimi*) which causes various levels of damages in mustard production was recently found to attack safflower crop in Indore region of Madhya Pradesh, India.

Shetgar et al. (1993) reported that safflower crop is attacked by 36 species of insects and non insect pest in India. One of the major reasons for the low productivity is the insect pests, among them safflower aphid is most destructive and regular pest under winter season. In case of severe infestation of aphid the yield losses ranged from 24.20 to 67.72 per cent in safflower.

Akashe et al (1995) reported that the population of aphid build up in Solapur region of Maharashtra started at end of October and reached a peak by January first week when maximum and minimum temperature and morning and evening relative humidity were 31.1°C, 12.9° C and 67 and 39 per cent respectively.

Kumar et al. (1997) reported that average temperature of 18.06°C (maximum 22.81°C and minimum 13.31°C) under the influence of high relative humidity with the range from 80.71 % to 86.50% provided conductive conditions for aphid incidence on Indian bean.

Bade and Kadam (2001) studied the biology of *Uroleucon compositae* (Theobald) during December-January under field conditions at the prevailing climatic conditions. They revealed that the aphid multiplied parthenogenetically. The pre-reproductive period was 2.25 days. There were four nymphal stages. The average duration of first, second, third and fourth nymphal stages were 2.24, 2.00, 2.00 and 2.90 days respectively. Average total life-cycle was found to be completed in 19.44 ' to 20.33 days. On an average, a female produced 34 nymphs during 7.20 to 13.5 days.

Mallapur et al (2005) correlated aphid population with weather parmeters and reported that there was significantly positive correlation with relative humidity, minimum temperature and cloudy weather, whereas the aphid population was negatively correlated with maximum temperature, heavy rainfall and as crop age advances.

Bhavani and Punnaiah (2006) proved the effectiveness of flufenxuron 10EC @ 0.01% reducing the population of cabbage aphid *Lipaphis erysimi* (Kalt.) by 78.97% over control and was on par with all other treatments *viz.,* neem oil mixed with endosulfan, profenofos, acephate, neem oil. These treatments were significantly superior in increasing yield of safflower.

Singh and Singh (2007) reported that the safflower crop was damaged by a number of insect pests of which aphid *U. compositae* Theobald (Aphidae: Homoptera) is the key pest causing 40-50% loss in yield of safflower and under unprotected condition there was complete crop loss.

Patil et al. (2008) reported the influence of crop phenology on population dynamics of aphid (*U. compositae*) and its predator's *C. septempunctata, M. sexmaculatus and C. carnea*. Severe infestation of aphid was reached during pre-flowering stage when the crop was of 70 days old. Crop phenology of two months i.e., 3rd standard week (SW) was crucial for survival and multiplication of safflower aphid. The temperature ranging from 13.2°C to 28.4°C coupled with 84.4 per cent RH proved conducive for aphid multiplication coinciding with crop reproductive stage.

Akashe et al. (2009) studied the effect of sowing dates on incidence of aphids with four different sowing dates and two safflower varieties *viz.*, Bhima and SSF-702. Planting of safflower in first fortnight of September possessed minimum aphid incidence and produced significantly higher seed yield of 662.03 and 405.09 kg/ha from Bhima and SSF-702, respectively under unprotected condition. It was followed by second fortnight of September (465.28 and 207.18 kg/ha).

Gud et al. (2009) conducted survey of total 80 farmer's fields from 25 villages of Solapur, Osmanabad, Ahmednagar and Pune districts of western Maharashtra during flowering to seed development stage of the crop for the occurrence of diseases, insect pests and their natural enemies. The intensity of predators (lady bird beetle) and unknown parasites was low. Safflower aphid, *U. compositae* T. was found to be major pest (20 to 125 aphid/plant) followed by *Heliocoverpa armigera* (0 to 3 larvae/plant).

Mane et al. (2012) conducted experiment to evaluate the Incidence of safflower aphid (*U. compositae* Theobald) on timely sown and late sown safflower crop and reported that incidence of aphids on timely sown safflower crop incidence of was initiated in 51st MW (7 aphids/5cm twig) and continuously increased up to 3rd MW (19.90 aphids/5cm twig) and then reduced to 16 aphids/5 cm twigs. Negative correlation was obtained between aphid incidence and temperature.

2.2 Management of safflower aphid with insecticides

Rathore et al. (1982) reported that Methyl demeton 0.025% spray (250 ml a.i./ha) was the most effective insecticide against the safflower aphid for four weeks, followed by monocrotophos 0.04% and dimethoate 0.03% sprays. Methyl demeton also gave the highest seed yield, appeared selective to the coccinellid predators, and was the most economical aphicide.

Ghorpade and Shinde (1983) reported that the application of methyl parathion (50EC) 0.05% or Methyl parathion 2% dusts 20kg/ha during bud formation and 50% flowering stage of crop found effective to control safflower aphids and *H. armigera*.

Dhoble et al. (1985) reported that two applications at 15 days interval apart of dust formulations of 4% malathion, 1.5% quinalphos or 5% carbaryl or endosulfan (all at 20 kg/ha) significantly reduced aphid populations, with no significant difference between them, but they had no significant effect on the yield. It is concluded that plant growth was suboptimal owing to late sowing, low rainfall and moisture stress, and that, in these conditions (which occur every 4-5 years in Maharashtra) insecticides are less beneficial if applied in dust rather than spray formulations.

Gargav and Verma (1985) tested the efficacy of methyl demeton @ 0.025%, monocrotophos @ 0.040%, phosphalone @ 0.035%, phosphomidon @ 0.150% and carbaryl @ 0.150% a.i./ha against safflower aphid, *U. compositae* T. After 24 hr. of treatment methyl demeton, monocrotophos and phosphimidon were found more effective than carbaryl and phosolone, but after 72 hr. all treatments were comparable.

Pawar et al. (1987) reported that etrofolon 50 WP 0.15% and butacarboxim 50 EC 0.01% were significantly effective against safflower aphid and significantly increased yield of safflower due these treatments.

Devakumar et al. (1988) evaluated hexane-extracted oil, deterpenated pure oil and lipid-associated limonoids, all derived from fresh neem seeds, limonoidal residue from expeller grade neem oil and groundnut oil against the safflower pest *Dactynotus carthami* (*Uroleucon carthami*). They reported that only those components containing limonoids were aphicidal. The problem of insolubility of azadirachtin and its congeners in xylene was overcome by the use of passive groundnut oil as a liquid carrier. Azadirachtin was found to be highly toxic to *U. carthami.*

Narangalkar and Shivpuje (1990) reported the effectiveness of triazophos, acephate, methidathion, pirimiphos-methyl, quinalphos, butocarboxim and phosphamidon against safflower aphid *U. sonchi,* a pest of safflower. Pirimiphos-methyl proved the most effective followed by others and butocarboxim was least toxic against aphid.

Pote and Pawar (1991) tested the efficacy of different insecticides against safflower aphid *U. compositae* (Theobald). Out of the seven insecticides monocrotophos 36 EC 0.05% and dimethoate 30 EC 0.03% were more effective against safflower aphids and increasing the yield.

Singh and Gaud (1991) revealed that acephate 75 WP @ 500 ml/ha was most effective against safflower aphid *U. compositae* (Theobald). But monocrotophos 36 EC at 1000ml/ha proved to be residually more toxic than all other insecticides and highest yield (1556 kg/ha) was obtained from Acephate @ 500 ml/ha.

Ghorpade et al. (1994) reported that application of 0.05 % methyl parathion @ 500 ml/ha or 20kg dust formulation of 2 % methyl -o-demeton at 60 days after sowing was better than 15 other insecticide formulations tested for control of aphid on Bhima variety of safflower.

Shrivastava et al. (1998) evaluated several insecticides for the control of *U. compositae* and *Acanthiophilus helianthi. U. compositae* was effectively controlled with monocrotophos (0.036%) and oxydemeton-methly (0.04%), while *A. helianthi* was effectively controlled with monocrotophos (0.036%) and dimethoate (0.045%).

Patel and Patel (1999) evaluated the efficacy of some dust formulations against safflower aphid. Two base applications of methyl parathion 2% at a threshold 15 or more aphids per 100 cm length of safflower twig proved effective against safflower aphid.

Neharkar et al. (2003) evaluated the efficacy of insecticides against safflower aphid. Dimethoate 0.03% and phosphimidon 0.02% were found significantly superior in reducing aphid population and increasing yield. The plant characters *viz.,* Plant height, number of leaves, diameter of capitula's and grains per capitula's were found superior in treated plots than untreated control.

Wadnerkar et al. (2004) reported that thiamethoxam 25 WG @ 50, 70 and 100 g a.i/ha were found to be significantly superior over imidacloprid 17.8 SL and dimethoate 30 EC in reducing cotton aphid population.

Shirisha (2005) tested the bioefficacy of selected insecticides against safflower aphid *U. compositae* Theobald. Among different insecticides, dimethoate 0.05% was more effective than other treatments against safflower aphid.

Preetha et al. (2007) reported that imidacloprid 17.8 SL @ 25 g a.i. /ha aphis gossypii infesting upto 25 days.

Akashe et al. (2007) conducted field experiment to evaluate the efficacy of newer insecticides from different groups against safflower aphid (*U. compositae*). Among the eight chemical treatments thiamethoxam 0.005% and acetamiprid 0.004% proved best by recording maximum per cent decline in aphid population and providing the highest seed yield of 1087 and 952 kg/ha respectively. The economics of treatment showed that the treatment 0.005%, thiamethoxam recorded highest B: C ratio of 1.89 followed by 0.004% acetamiprid (1.62), 0.03% dimethoate (1.52) and 0.0045% imidacloprid (1.46).

Hanumantharaya et al. (2007) tested newer molecules of insecticides against safflower aphid. Thiamethoxam, acetampirid followed by imidacloprid were found more effective and economic as against dimethoate. These insecticides recorded more than 97per cent mortality.

Kanna et al. (2007) reported that acetamiprid tested at all dose rates was superior to the conventional insecticides in controlling cotton aphids and jassids.

Kumar et al. (2007) reported that on the 7th day after spraying imidacloprid 17.8 SL @ 0.0178% found most effective against mustard aphid *Lipaphis erysimi* (Kalt.) followed by oxydemeton methyl 25 EC 0.025%, monocrotophos 36 EC 0.036%, dimethoate 30 EC 0.03 %, chloropyriphos 20 EC 0.05%, imidacloprid 17.8 SL 0.0178% , cypermethrin 10 EC 0.01%, and neemarin 0.03%.

Dhawan et al. (2008) reported that thiamethoxam 0.001 LC50 (ug/mL-1) and deltamethrin 0.001 LC50 (ug/mL-1) were relatively more toxic to *A. Gossypii* compared to other insecticides.

Anitha and Nandihalli (2009) reported that seed treatment of imidacloprid 70 WS 5 g/kg and thiamethoxam 70 WS 5g/kg found effective against okra aphids. The treatment imidacloprid 200 SL recorded highest fruit yield (47.71 q/ha) followed by imidacloprid 70 WS (44.43 q/ha) and thiamethoxam 70 WS (44.10 q/ha) All treatments found significantly effective and superior over untreated check (23.19 q/ha).

Mane and Kulkarni (2009) reported lowest population of aphids in the plot treated with methyl demeton 0.05%, followed by endosulfan 0.05%. These two treatments were significantly superior over rest of the treatments.

Patil et al. (2009) tested the efficacy of fipronil 5% SC @ 800 g/ha, fipronil 40% + imidacloprid 200 SL @ 200 ml/ha, acetamiprid 20SP @ 100 g/ha and triazophos 40 EC @ 1500 ml/ha (standard checks) against sucking pests of cotton, All the insecticides were found to be effective against leafhoppers, aphids and thrips.

Dhaka et al. (2009) evaluated newer insecticides against mustard aphid, *Lipaphis erysimi* (Kalt.) and their effect on *Coccinella septumpunctata*. They reported that acetamiprid 20 SP (125 g/ha) found effective followed by acephate, thiamethoxam, imidacloprid, profenofos, dimethoate and oxydemeton methyl for the management of aphids. Thiamethoxam was found to be safer insecticide to the coccinellids.

Jat et al. (2009) reported that dimethoate 30 EC 0.03% was found to be most effective against aphid followed by imidacloprid 17.8 SL 0.005% and acephate 70 SP (0.05%) and reduced maximum aphid population up to 92.40, 91.79 and 89.83 % respectively.

Sharma et al. (2009) conducted field experiment to study effectiveness of some newer insecticides against safflower aphids. They reported that the ethofenprox (0.01% and 0.02%), and cartap hydrochloride were found to be effective in reducing aphid population followed by dimethoate and malathion.

Gore et al. (2010) reported that the thiamethoxam 25 WG was most effective compound in reducing damage caused by *U. compositae* on safflower. The highest seed yield (15.55 quintal / ha) was also recorded with thiamethoxam, followed by imidacloprid 17.8 SL (0.0045%), acetamiprid 20 SP (0.004%), fipronil 5 SC (0.01%), acephate 75 SP (0.03%), difenthiuron 50 WP (0.06%), and dimethoate 30 SC (0.03%).

Shivanna et al. (2011) reported that fenpropathrin 30 EC 120 ml a.i. /ha recorded 56.10 % mortality of cotton aphid (*Aphis gossypii*) at one day after treatment followed by acetamiprid 20 SP (36.49 %) dimethoate 30 EC (39.43%) and imidacloprid 17.8 SL (38.58%). However at three days after treatment dimethoate 30 EC and imidacloprid 17.8 SL recorded maximum mortality of 59.59 and 54.10 per cent, respectively.

Basavraj et al. (2012) reported that thiamethoxam 25 % WG @ 0.12g/l and clothianidin 50% WDG @ 0.2g/l was found to be effective against safflower aphids, *U. compositae* and recorded highest seed yield of 1.25.1 and 945.3 kg/ha respectively.

2.3 Predators of aphid

Bindra and Vaishampayan (1976) observed predators population on aphid, *U. sonchi* L., major pest of safflower crop. The coccinellids Coccinella *septampunctata, Menochilus sexmaculatus* and Scymnus sp. were found to be predating on safflower aphids.

Badgujar et al. (2000) revealed that the highest reductiojn in safflower aphid population was found in the plots treated with dimethoate 0.03%. Larval release of *Chrysoperla carnea* @ 2 or 3 larvae at the population level of 10 or 20 aphids per shoot reduced the population between 40 and 50%. On the basis of yield, promising treatments were dimethoate 0.03% (15.8 q/ha), 3 larvae of *Chrysoperla carnea* released at 10 aphids (13.43 q/ha) and 20 aphids (13.20 q/ha) population level.

Hemagirish et al. (2001) reported that the larval release of *chrysoperla carnea* (Stephens) @ 2 or 3 larvae/plant reduced the population levels of aphid up to 40 to 50 %.

Kamath and Hugar (2001) reported that the release of *C. Carnea* @ 1.75 lakh/ha reduced the aphid population to the maximum extent of (23%) and also recorded increase in yield of 3.52 q/ha over control.

Patil et al (2008) reported that predatory *Coccinella septampunctata* Linn and *Menochilus sexamaculatus* Fab. and the green lacewing *Chrysoperla carnea* Stephens were found after appereance of aphid infestation till its disappearance on the crop. The maximum coccinellids (0.69/ plant) and chrysopid larvae (0.62/plant) were recorded at aphid peak incidence i.e. on 3rd standard week or 11th week of crop growth.

Chakraborty and Korat (2010) studied the feeding efficiency of green lacewing, *Chrysoperla carnea* (Stephens) on different species of aphids. They indicated that the predatory efficiency of *C. carnea* was increased with the development of grub. As the grub grew from first instar to third instars, the consumption rate was increased in all the species of aphid used as prey.

Singh et al. (2012) reported that maximum predation was recorded by *C. septempunctata* (56.02 aphids per day) followed by *Syrphus confrater* (49.54 aphids per day) and *Ischiodon scutellaris* (37.42 aphids per day) of mustard aphid.

Javed et al. (2013) reported that the four insect genera including jassid (*Amrasca bigutella bigutella*), aphid (*Uroleucon carthami*), lygus bug (*Lygus Hesperus* K.) and pod borer (*Heliocoverpa armigera*) and two beneficial insect genera including green lacewing (*Chrysoperla carnea*) and lady bird beetle (*Coccinella septampuntata* Linn.) were found on safflower.

2.4 Effect of different insecticides on Predator of safflower aphid.

Shrivastava et al. (1978) reported that safflower aphid was least preferred by *C. septempunctata* amongst the nine different species of aphids.

Pathak and Rathore (1981) reported that the adult population of the coccinellid predators, *Coccinella septempunctata* Linn. *Menochilus sexmaculata* (Fabr.), *Brumussu turalis* Fabr. and *Scymnus nubilus* (Muls.) was declined due to management of safflower aphid *U. compositae* (Theobald) with conventional pesticides.

Chaudhary et al. (1983) reported that quinalphos, dimethoate, formothion, demeton-S-methyl (Metasystox) and phosphamidon at 0.03%, monocrotophos and phosalone at 0.04% and endosulfan at 0.075% gave good control of aphid. These treatments also reduced the number of the predator although demeton-S-methyl, quinalphos and dimethoate permitted the population of predator to recover after 10 days.

Mishra and Saptathy (1984) reported that methyl-o-demeton was safest of all insecticides for coccinellids and at the same time more toxic to the aphid, followed by diazinon and endosulfan.

Nikusch and Gernorth (1986) reported that chloropyriphos and acephate were toxic to the predacious coccinellids.

Picard (1987) evaluated sumicidin (fenvalerate) against aphid infesting wheat and found that the use of pyrethroid insecticides was not necessarily harmful to beneficial insects including coccinellids, syrphids, carabids, chrysopids and staphylinids that prey on aphids.

Kadam and bade (1993) found that maximum number of coccinellids (7.65/5plants) was survived in the untreated control. While maximum number of coccinellids (4.00 beetles/5 plants) was found in the treatment with phosphamidon 0.02 + neemark 0.15%.

Thrimurthi (1995) reported that the populations of coccinellids, syrphids and *Chrysopa* sp. were largely unaffected by carbofuran granular application, but were reduced by monocrotophos spraying.

Dhingra Swaran (1999) evaluated efficacy of insecticides on the adults of *Coccinella septempunctata* Linn. predating on different aphid species, the reprted that least toxic insecticides were lindane, endosulfan, aphidan and menazon, which gave less than 50 per cent mortality even at 1 per cent concentration. A comparison of relative resistance values of adults of *C. septempunctata* vis-a-vis important aphid pests, *viz, Lipaphis erysimi, Dactynotus carthami, Aphis craccivora* and *Myzus persicae* indicated that out of the various insecticides tested, methyl demeton, lindane, endosulfan and aphid an exhibited a very high safety margin for the predatory adults, being at the same time most effective and commonly used against these various aphid species.

Jansen (2000) reported that fenvalerate and fluvalinate were less toxic to syrphid larvae whereas, pirimicarb, cyfluthrin, deltamethrin and phosalone were quite toxic to the larva. The population of syrphid fly larva was comparatively low in insecticidal spray with methyl demeton (625 ml/ha) than control plot.

Katole and Patil (2000) revealed that seed treatment was safer than foliar sprays in cotton. Imidacloprid @ 10 g/kg seed treatment allowed activities of maximum lady bird beetle adults and thiamethoxam @ 4g/kg seed treatment allowed maximum oviposition of *Chrysoperla* which was found at par with untreated control.

Mannan et al. (2002) reported the effectiveness of malathion 57 EC and diazinon 60 EC with different doses (1 ml, 2 ml, and 3 ml/L) against aphid. Malathion 57 EC was more effective than diazinon for control of mustard aphid and it was less toxic for the other beneficial insects. The lower doses of insecticides have less adverse effect on predator and other beneficial insects than the higher dose.

Zanwar and Jadhav (2003) conducted a field trial to know the effect of insecticides on field population of coccinellids in safflower. They reported that maximum number of coccinellid beetle were found in untreated control (13.36 LBB/plot) followed by endosulphan (4.06 LBB/plot). Significantly minimum number of ccoccinellids (0.89 LBB/plot) was observed in the plot treated with acephate 0.03%

Youn et al. (2003) reported that some of the Lady Bird beetles was susceptible to chemical insecticides likes chloropyriphos and pinnicarb at the recommended rates. Generally, the 1st and 2nd instars of lady bird beetle were very sensitive to thiamethoxam and abamectin.

Hanumantharaya et al. (2008) reported that significantly higher number of *C. carnea* eggs (7.6 eggs/ plant) and *coccinellids* (1.4 grubs and adults/plant) and lowest pest activity were observed on safflower crop @ 13%.when sown with coriander as mixed crop 13 %. as compared to safflower as a sole crop. But, in other treatments where mixed cropping of coriander with safflower @ 10 and 7 per cent were next best in recording higher predatory population and lower pest density compared to rest of the treatments including safflower as a sole crop.

Patel and Das (2010) reported that the spider population was highest in untreated control with 0.73/ plant which was on par with imidacloprid @ 0.4 ml/L and fipronil @ 2 ml/L recording 0.53 and 0.33 spider/ plant respectively. The coccinellid beetles population was highest in untreated control with 0.33/plant which was on par with fipronil @ 2 ml/L and imidacloprid @ 0.4 ml/L recording 0.20 and 0.13 cocinellids beetles/plant respectively.

Sohail et al. (2011) studied the efficacy of different chemical pesticides on mustard aphid (*L. erysimi*) and their adverse effects on lady bird beetle in turnip field. Fastkil (methomyl) 200 ml was found most lethal for the Lady Bird beetle population followed by Confidor (120 ml), Actara (5 gm), Confidor (80 ml), Confidor (100 ml) and Actara (10gm) respectively.

Khedkar et al. (2012) recorded significantly lower coccinellids population in all insecticidal treatments than untreated control. Thiacloprid recorded the highest (0.24 LBB/ plant) coccinellids population which was at par with dimethoate (0.19 LBB/ plant). Imidacloprid 0.008% recorded the lowest (0.11 LBB/ plant) population of coccinellids per plant and proved to be more toxic chemicals.

2.5 Effect of insecticides on yield of safflower

Ghule et al. (1987) conducted field experiment to evaluate the dust and EC formulations of chemical insecticides against safflower aphids, among the insecticides, quinalphos (1.5% dust and 0.05% spray), malathion (5% dust), BHC (10% dust), phosphomidon (0.05% spray) and dimethoate (0.05% spray) were tested for the control of aphid, *U. carthami* on safflower, the greatest reduction in the aphid population (97.07%) and the highest yield were obtained in plots treated with 2 sprays of phospomidon with a 15 days interval.

Chandrakar and Gupta (1989) tested nine insecticides against aphids, *Uroleucon compositae* on safflower, applied at 55 and 80 days after sowing. The best results were obtained with demeton-methly1000 ml/ha, followed by phosphamidon at 300 ml /ha, monocrotophos at 750 ml/ha and dimethoate at 625 ml/ha. The corresponding yields were 14.43, 11.77, 11.50, 10.04, q/ha respectively as compared with 5.17 q/ha for no treatment, and the benefit/cost ratios of 9.9, 7.4, 5.4 and 5.7, respectively.

Dange et al. (1996) evaluated the efficacy of 10 insecticides viz.,against aphid, 0.03% dimethoate, 0.02% phosphomidon, 0.045 monocrotophos, 0.5% Neemark, 1.0% indiara, 0.003% Chinmix, 0.003% fluvalinate, 0.003% lambada-cyhalothrin, 0.05% quinalphos and 0.1% carbaryl against safflower aphid The lowest number of *U. Sonchi* was observed in plots treated with monoctotophos (1.26 aphids/2.5 cm shoot). The highest grain yield was recorded in carbaryl- treated plots (12.4 g/plant).

Patel and Patel (1999) reported effectiveness of dust formulations insecticides against aphid, *U. compositae* Theobald. infesting safflower. They reported that base application of methyl parathion 2% dust at a threshold of 15 or more aphids per 100 cm length of safflower twig gave effective control of aphids and resulted in the highest cost: benefit ratio (1:5.48).

Pote et al. (2005) conducted field experiments to evaluate the efficiency of different spray or dust formulations in controlling aphid *U. sonchi* on safflower. The results revealed that significantly lowest aphid population and maximum seed yield were recorded with two sprayings of 0.012% fluvalinate at 45 and 60 days after sowing followed by two dustings of 10% carbaryl D at 45 and 60 DAS and one dusting of 2% parathion-methyl D at 45 DAS. However, one dusting of 2% parathion-methyl D at 20 kg/ha at 45 DAS gave the highest incremental cost-benefit ratio (ICBR) (1:15.14) resulting into the highest net profit of Rs. 4653/ha followed by two dustings of 2% parathion-methyl D at 20 kg/ha at 45 and 60 DAS resulting into an ICBR of 1:7.54.

Singh (2005) conducted field studies to find out the efficacy and economics of neem based insecticides for the management of aphid (*U. carthami* H.R.L.) and its predator (*Menochilus sexmaculata* Fab.) in safflower (*Carthamus tinctorius* L.). Significantly lowest aphid populations i.e. 25-85, 20-76 and 33-46 aphids/plant were recorded at 3rd, 7th and 15th day after spray, respectively with the treatment neem seed kernel extract (NSKE) 5% which were on par with neem seed kernel (NSK) powder 3% and by neem cake 5%.

Bhat et al. (2007) reported that dimethoate (0.03%) was found most effective against aphid *Ureoleucon compositae* of gaillardia crop, followed by methyl-o-demeton 0.025% and monocrotophos 0.04%.

Akashe et al. (2009) conducted field experiments for the management of aphid (*U. compositae*) on safflower. The spray fluid @ 500 L ha-1 was used to each of the treatments. Every year, two sprays of all treatments except seed treatment and absolute control were given at an interval of 15 days commencing from 15-20 days after aphid occurrence. The results revealed that treatment 0.03% dimethoate was the most effective in suppressing infestation of aphid and producing good yield (1002 kg/ha).

Mandal and Mandal (2010) reported that difenthiuron 50 WP@ 50 g a.i. /ha was found to be most effective against mustard aphids *Lipaphis erysami* Kalt. With higher yield of mustard (10.70 q/ha) followed by thiamethoxam 25 WG@ 25 g a.i. /ha (10.53 q/ha) and acetamiprid 20 SP @ 40g a.i. /ha (10.12 q/ha).

Khedkar et al. (2012) reported that spraying of imidacloprid 17.8 SL 0.08% was found to be most effective and economical insecticides against mustard aphid *L. erysami* which recorded 55.60% incresese in yield followed by acetamiprid 20 SP 0.01%, acephate 75 SP 0.075% and thiamethoxam 25 WG 0.0125%.

CHAPTER III

MATERIAL AND METHODS

The field trial was conducted to evaluate the efficacy of newer insecticides for management of safflower aphid (*Uroleucon compositae* Theobald) at Oilseed Research unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Rabi* season of 2012-13. Nine treatments along with untreated control were evaluated in the experiment. The material used and methods adopted during the course of investigation are given below.

3.1 Materials

For conducting this experiment material like safflower seed (Bhima), fertilizer, chemical insecticides, nylon string, tape, pegs, weighing balance, labour, bullocks, sprayers, measuring cylinder, bucket etc were used.

The detailed information about chemical insecticides used in these experiments are given in Table 1.

Table 1 : Details of insecticides

Sr. No.	Common name	Chemical name	Trade name	Supply source
1	Thiamethoxam 25 WG	3-(2-chloro- thiazol-S-ylemethyl)-5- methyl 1-3,5 oxadiaziam 4 ylidense-N- nitro amine	Actara	M/S Rallies India Ltd. Mumbai.
2	Acetamiprid 20 SP	(E)-N1-[(6-chloro-3pyridyl)methyl]-N2-cyno-N1-methly acetamipridine	Prestige	Maruti Pesticides Pvt. Ltd. Gujarat.
3	Imidacloprid 17.8 SL	1-(6-chloro-3-pyridylmethyl)-N-nitroimidazolidin-2-ylideneamine	Confidor	Bayer Ltd. India.
4	Difenthiuron 50 WP	N-[2,6-bis(1-methylethyl)-4-phenoxyphenyl]-N'-(1,1-dimethylethyl)thiourea	Polo	Syngenta India Ltd.
5	Lambda cyhalothrin 2.5 EC	*S*)-a-cyano-3-phenoxybenzyl (*Z*)-(1*R*,3*R*)-3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate	Warrior	Tagros Chemicals India Ltd. Chennai.
6	Fipronil 5 SC	5-amino-1-(2,6-dichloro-a,a,a-trifluoro-*p*-tolyl)-4-[(trifluoromethyl)sulfinyl]pyrazole-3-carbonitrile	Gardan	Gujarat Krushi Rasayan Pvt. Ltd.
7	Acephate 75 WP	O,S-Dimethyl acetylphosphoramidothioate	Dragon	Gujarat Pesticides.Pvt Ltd.
8	Dimethoate 30 EC	*O,O*-dimethyl-methylcarbamoylmethyl phosphorodithioate	Runner	RPH Crop Science Ltd. Rajkot Gujarat, India

3.2 Methods

3.2.1 Details of the field used for experimentation

The experiment was conducted on field of Oilseed Research Unit Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Rabi* 2012-13. The soil was medium to deep black. The layout of plan for the experiment is illustrated in Fig no.1

3.2.2 Details of experiment

1. Design	: Randomized Block Design (RBD)
2. Season	: *Rabi* 2012-13
3. No. of treatments	: 09
4. Replications	: 03
5. Total no. of plots	: 27
6. Crop and variety	: safflower *Carthamus tinctorius* and Bhima
7. Fertilizer dose	: 25:25:0 Kg NPK /ha
8. Plot size	
a) Gross plot size	: 4.5 x 2.4 m^2
b) Net plot size	: 3.6 x 2.20 m^2
9. Spacing	
a) Row to Row	: 45 cm
b) Plant to plant	: 10 cm
10. Date of sowing	: 20th Oct 2012
11. Date of emergence	: 30th Oct 2012

Large plot of safflower (10×10 m) variety- Bhima was sown for recording seasonal abundance of aphid (no. of aphid per 5 cm apical twig per plant on randomly selected 10 plants).

3.2.3 Details of treatments

Name of treatment, concentration of spray solution required are given in following table.

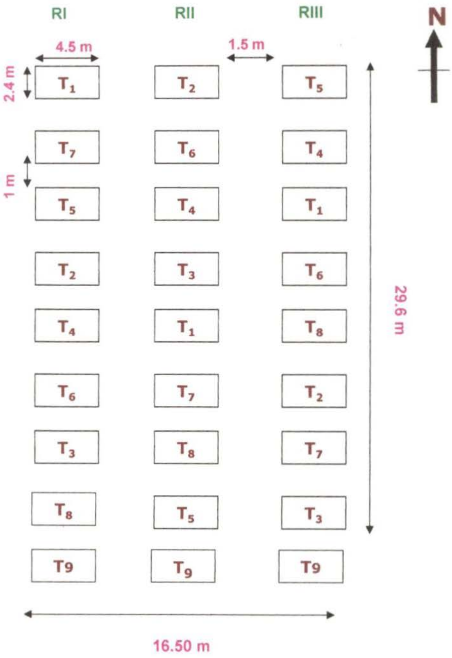

Fig. 1: Plan of layout

Table 2: Details of treatments

Sr. No.	Name of treatment	Dose/Concentration (%)
1	Thiamethoxam 25 WG	0.006%
2	Acetamiprid 20 SP	0.04%
3	Imidacloprid 17.8 SL	0.007%
4	Diafenthiuron 50 WP	0.06%
5	Lambda cyhalothrin 2.5 EC	0.005%
6	Fipronil 5 SC	0.01%
7	Acephate 75 SP	0.12%
8	Dimethoate 30 EC	0.03%
9	Untreated control	-

3.2.4 Cultural operations

3.2.4.1 Preparatory tillage

Field was brought to optimum tilth condition by repeated harrowing. Then field was cleaned by picking stubbles of previous crop. Before sowing, the layout was made on the field in accordance with experimental design with the help of measuring tape, rope and wooden pegs.

3.2.4.2 Sowing

The sowing was done in marked plots on 10-10-2012. By dibbling as the seeds of safflower is oval shape and bold, to have uniform distribution of seeds in sowing.

3.2.4.3 Thinning

Thinning was done when the crop was 15-20 days old keeping plant to plant distance of 10 cm approximately.

3.2.4.4 Application of fertilizers

The fertilizers were applied @ 25:25:0 Kg NPK/ha. Half dose of nitrogen and full dose of phosphorus was applied at the time of sowing and remaining half dose of nitrogen was applied one month after sowing.

3.2.4.5 Intercultural operations

Hoeing and weeding operations were carried out to keep the field clean by removing weeds to conserve soil moisture.

3.2.5 Preparation of spray solution

The spray solution of desired concentration was freshly prepared on the field before application. The required quantity of water for spraying each plot was estimated by spraying plane water on untreated control plot. The required quantity of chemicals for each respective treatment was worked out and spray solution was prepared by mixing them in water thoroughly. Quantity of spray solution was updated as per the growth stages of the crop.

Spray solution of desired concentration was prepared by following formula

$$V = \frac{C \times A}{\%\ a.i.}$$

Where,

V = Volume of commercial insecticide in ml/gm

C = Concentration of required solution in percentage

A = quantity of spray solution required in lit.

% a. i. = per cent active ingredient in commercial product

3.3.1 Application of the spray solutions

The knapsack sprayer was used for spraying operations. After every treatment spray, sprayer was washed thoroughly with clean water. Every care was taken to minimize drift and contamination of insecticides to the adjacent plot at the time of spraying. The spraying details are as under.

Sr. No.	Spray no.	Days after Emergence	Date of spraying
1	First	40	10-12-2012
2	Second	55	25-12-2012

3.3.2 Method of recording observations

The observations were recorded on five randomly selected plants from each plot, after 7 days of germination.

Treatments were imposed at 40 DAE; second spray was given at 15 days interval. Precount of aphid per 5 cm twig per plant was taken before imposing the treatment and post count was taken at 3, 7 and 10 days after each spraying.

1. The observations on population of aphids/5 cm apical twig per plant and predators / 5 plant were recorded at 1 day before and 3rd, 7th and 10th day after 1st spraying.
2. The observations on population of aphids/5 cm apical twig per plant and predators /5 plant were recorded at 1 day before and 3rd, 7th and 10th day after 2nd spraying.
3. Weekly seasonal incidence of aphid (per 5 cm apical twig per plant) was recorded on randomly selected 10 plants. from separately sown 10×10 m plot.
4. The observations on population of predator viz., Lady Bird beetle, Syrphid, Chrysopa per plant were also recorded throughout the crop season from the separate sown 10×10 m plot.

3.3.3 Post harvest observations

The yield of safflower from each net plot was recorded and transformed into yield kg/ha by multiplying with Hectare factor.

3.3.4 Economics of the treatments

The yield data from each treatment plot were used to calculate economics of the spraying. The cost of insecticides and the cost of spray application i.e. labour charges prevailing during the course of investigations were taken into considerations to work out the cost of each treatment per ha. Similarly income obtained from the sale of grains as per the prevailing market rates was also calculated for each treatment to work out the incremental cost benefit ratio (ICBR).

3.3.5 Statistical analysis

The field data collected during the course of experimentation were subjected to statistical analysis as per the statistical design used, in order to test level of significance among the various treatments as per Gomez and Gomez (1984)

3.3.6 Place and Seasons of Experiments

The field experiment was undertaken in *Rabi* season of 2012-13 on the field of Oilseeds Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS)

3.3.7 Meteorological data

The data regarding maximum and minimum temperature, relative humidity (morning and evening) and rainfall etc. during the crop season 2012-13 were also recorded (Appendix 1).

CHAPTER IV

RESULTS AND DISCUSSION

Research work leading to post graduate study entitled "Evaluation of newer insecticides against safflower aphid, *Uroleucon compositae* Theobald" was conducted at the field of Oilseeds Research Unit Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Rabi* 2012-13 with the major object to evaluate the efficacy of different insecticides for the management of safflower aphid.

4.1 Effect of different insecticides on population of safflower aphid after 1st spraying

It is revealed from the Table 3 and Fig. 2 that the data pertaining to the average population of safflower aphid at 3, 7, and 10 days after first spraying was found significant.

4.1.1 3rd DAFS

All treatments were found to be significantly superior over untreated control. Significantly lowest population of safflower aphid was observed in thiamethoxam 25 WG @ 0.006% (1.53 aphids/5 cm apical twig/ plant) which was statistically at par with acetamiprid 20 SP @ 0.04% (1.60 aphids/5 cm apical twig/ plant), imidacloprid 17.8 SL 0.007% %(2.67 aphids/5 cm apical twig/ plant) and acephate 75 SP @ 0.12% %(3.40 aphids/5 cm apical twig/ plant)

The next effective treatment was dimethoate 30 EC @ 0.03% (4.40 aphids/5 cm apical twig/plant), difenthiuron 50 WP @ 0.06%,%(5.33 aphids/5 cm apical twig/ plant), fipronil 5 SC @ 0.01% % (6.20 aphids/5 cm apical twig/ plant) and lambada cyhalothrin 2.5 EC @0.005 % (6.60 aphids/5 cm apical twig/ plant) which were statistically at par with each other and significantly superior over untreated control. Significantly maximum population of safflower aphid was observed in untreated control (35.40 aphids/5 cm apical twig/plant).

Table 3. Effects of different insecticides on population of safflower aphid after first spraying

Sr.No	Treatments	No. of aphids /5cm apical twig/plant					
		Conc. (%)	Precount	3DAS	7DAS	10DAS	Mean
1	Thiamethoxam 25 WG	0.006	35.93 (6.03)*	1.53 (1.38)	2.07 (1.56)	6.67 (2.65)	3.42 (1.95)
2	Acetamiprid 20 SP	0.004	33.00 (5.78)	1.60 (1.44)	2.40 (1.68)	7.80 (2.85)	3.93 (2.09)
3	Imidacloprid 17.8 SL	0.007	31.07 (5.59)	2.67 (1.77)	3.07 (1.87)	9.93 (3.22)	5.22 (2.38)
4	Difenthiuron 50 WP	0.06	36.80 (6.10)	5.33 (2.40)	6.47 (2.62)	16.27 (4.09)	9.36 (3.14)
5	Lambda cyhalothrin 2.5 EC	0.005	30.27 (5.52)	6.60 (2.65)	7.60 (2.83)	17.33 (4.22)	10.51 (3.31)
6	Fipronil 5 SC	0.01	29.33 (5.45)	6.20 (2.59)	7.27 (2.77)	17.07 (4.18)	10.18 (3.26)
7	Acephate 75 SP	0.12	27.47 (5.26)	3.40 (1.94)	4.00 (2.10)	11.13 (3.41)	6.18 (2.57)
8	Dimethoate 30 EC	0.03	32.87 (5.77)	4.40 (2.21)	5.00 (2.33)	15.13 (3.95)	8.18 (2.94)
9	Untreated control	-	32.27 (5.79)	35.40 (5.97)	38.33 (6.20)	45.27 (6.74)	39.67 (6.31)
F Test			NS	sig	sig	sig	sig
SE (m)±			0.33	0.22.	0.26	0.23	0.22
CD at 5%			-	0.65	0.77	0.69	0.65
CV %			-	15.08	16.73	10.22	12.12

4.1.2 7th DAFS

All treatments were found to be significantly superior over untreated control. Significantly lowest population of safflower aphid was observed due to thiamethoxam 25 WG @ 0.006% (2.07 aphids/5 cm apical twig/ plant) which was statistically at par with acetamiprid 20 SP @

0.004%(2.40 aphids/5 cm apical twig/ plant), imidacloprid 17.8 SL @ 0.007% (3.07 aphids/5 cm apical twig/ plant) and acephate 75 SP @ 0.12% %(4.00 aphids/5 cm apical twig/ plant)

The next effective treatment was dimethoate 30 EC @ 0.03%%(5.00 aphids/5 cm apical twig/ plant), difenthiuron 50 WP @ 0.06%%(6.47 aphids/5 cm apical twig/ plant), fipronil 5 SC @ 0.01%%(7.27 aphids/5 cm apical twig/ plant), lambada cyhalothrin 2.5 EC @ 0.005 %%(7.60 aphids/5 cm apical twig/ plant) which were statistically at par with each other and significantly superior over untreated control. Significantly maximum population of safflower aphid was recorded in untreated control (38.33 aphids/5 cm apical twig/plant).

4.1.3 10th DAFS

All treatments were found to be significantly superior over untreated control. Significantly lowest population of safflower aphid was observed in thiamethoxam 25 WG @ 0.006 %(6.67 aphids/5 cm apical twig/ plant) which was statistically at par with acetamiprid 20 SP @ 0.004 %(7.80 aphids/5 cm apical twig/ plant) and imidacloprid 17.8 SL @ 0.007% (9.93 aphids/5 cm apical twig/ plant)

The next effective treatment was acephate @ 0.12 %(11.13 aphids/5 cm apical twig/plant), dimethoate 30 EC @ 0.03 %(15.13 aphids/5 cm apical twig/plant), difenthiuron 50 WP @ 0.06 %(16.27 aphids/5 cm apical twig/plant), fipronil 5 SC @ 0.01 % (17.07aphids/5 cm apical twig/plant). and lambada cyhalothrin 2.5 EC @ 0.005 % (17.33 aphids/5 cm apical twig/plant) which were singnificantly superior over untreated control (45.27 aphids/5cm apical twig/plant).

Over all efficacy by considering mean aphid population at 3, 7 and 10 days after first spraying, mediated that significantly lowest population of safflower aphid was observed due to treatment thiamethoxam 25 WG @ 0.006% (3.42 aphids/5 cm apical twig/ plant) which was statistically at par with acetamiprid 20 SP @ 0.004%(3.93 aphids/5 cm apical twig/ plant), imidacloprid 17.8 SL @ 0.007% (5.22 aphids/5 cm apical twig/ plant) and acephate 75 SP @ 0.12%(6.18 aphids/5 cm apical twig/ plant). The next effective treatment was dimethoate 30 EC @ 0.03% (8.18 aphids/5 cm apical twig/plant), difenthiuron 50 WP @ 0.06% (9.23

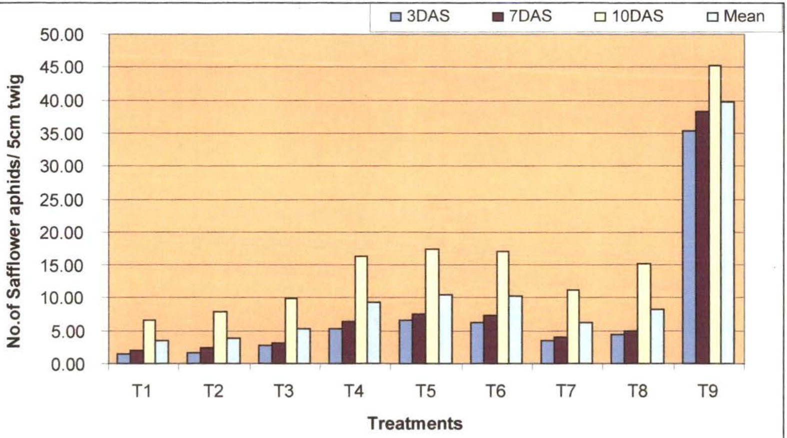

Fig.2 : . Effect of different insecticides on population safflower aphid after first spraying

aphids /5 cm apical twig/plant), fipronil 5 SC @ 0.01% (10.18 aphids /5 cm apical twig/plant) and lambada cyhalothrin 2.5 EC @0.005 % (10.51aphids/5 cm apical twig/plant) which were statistically at par with each other and significantly superior over untreated control. Significantly maximum population of safflower aphid was recorded in untreated control (39.67/5 cm apical twig/plant).

4.2 Effect of different insecticides on population of safflower aphid after 2nd spraying

It is revealed from the Table. 4 and Fig. 3 that the data pertaining to the average population of safflower aphid were significant at 3, 7, 10 days after second spraying. All treatments were significantly superior over unatreated control.

4.2.1 3rd DASS

Significantly lowest population of safflower aphid was observed in thiamethoxam 25 WG @ 0.006%(0.93 aphids /5 cm apical twig/ plant) which was at par with acetamiprid 20 SP @ 0.04%(1.47 aphids /5 cm apical twig/ plant) and imidacloprid 17.8 SL @ 0.007% (1.80 aphids /5 cm apical twig/ plant)

The next effective treatment was acephate 75 SP 0.01% (3.00 aphids/ 5 cm apical twig/plant), dimethoate 30 EC @ 0.03 %(3.80 aphids/5 cm apical twig/plant), difenthiuron 50 WP @ 0.06 % (5.20 aphid/5 cm apical twig/plant)., fipronil 5 SC @ 0.01% (5.87 aphids/5 cm apical twig/plant) and lambada cyhalothrin 2.5 EC @0.005 % (6.07aphids/5 cm apical twig/plant) which were statistically at par with each other. However significantly maximum population of safflower aphid was recorded in untreated control (62.07aphids/5 cm apical twig/plant).

4.2.2 7th DASS

Significantly lowest population of safflower aphid was observed in thiamethoxam 25 WG @ 0.006% (2.13 aphids/5 cm apical twig/ plant) which was at par with acetamiprid 20 SP @ 0.004%(2.27aphids/5cm apical twig/ plant), imidacloprid 17.8 SL @ 0.007% (3.93 aphids/5 cm apical twig/ plant) and acephate 75 SP @ 0.12% (4.47 aphids/5 cm apical twig/plant).

Table 4. Effects of different insecticides on population of safflower aphid after second spraying

Sr. No	Treatments	No.of aphids / 5cm apical twig/ plant					
		Conc. (%)	Precount	3DAS	7DAS	10DAS	Mean
1	Thiamethoxam 25 WG	0.006	20.80 (4.56)*	0.93 (1.19)	2.13 (1.61)	7.33 (2.79)	3.47 (1.99)
2	Acetamiprid 20 SP	0.004	24.33 (4.97)	1.47 (1.39)	2.27 (1.66)	8.40 (2.97)	4.04 (2.13)
3	Imidacloprid 17.8 SL	0.007	26.40 (5.17)	1.80 (1.50)	3.93 (2.09)	10.13 (3.24)	5.29 (2.40)
4	Difenthiuron 50 WP	0.06	29.13 (5.42)	5.20 (2.38)	8.07 (2.92)	15.27 (3.94)	9.51 (3.15)
5	Lambda cyhalothrin 2.5 EC	0.005	29.40 (5.43)	6.07 (2.54)	9.33 (3.13)	19.53 (4.47)	11.64 (3.48)
6	Fipronil 5 SC	0.01	29.13 (5.43)	5.87 (2.52)	8.93 (3.06)	17.07 (4.18)	10.62 (3.33)
7	Acephate 75 SP	0.12	28.37 (5.38)	3.00 (1.83)	4.47 (2.19)	12.53 (3.59)	6.67 (2.67)
8	Dimethoate 30 EC	0.03	28.93 (5.40)	3.80 (2.06)	6.60 (2.65)	14.00 (3.78)	8.13 (2.93)
9	Untreated control	-	51.87 (7.22)	62.07 (7.88)	66.93 (8.18)	74.73 (8.67)	67.91 (8.27)
F Test			NS	sig	sig	sig	sig
SE (m)±			-	0.18	0.19	0.26	0.17
CD at 5%				0.53	0.71	0.79	0.51
CV %				15.71	13.39	10.98	8.70

Figures in the parentheses are Square root (x+ 0.5) transformed value

The next effective treatment was dimethoate 30 EC @ 0.03 %(6.60 aphids/5 cm apical twig/plant), difenthiuron 50 WP @ 0.06% (8.07 aphids/5 cm apical twig/plant), fipronil 5 SC @ 0.01 %(8.93 aphids/5 cm apical twig/plant) and Lambada cyhalothrin 2.5 EC @ 0.005 %(9.33 aphids/5 cm apical twig/plant) which were at par with each other. Significantly maximum population of safflower aphid was recorded in untreated control (66.93 aphids/5 cm apical twig/plant).

4.2.3 10th DASS

Significantly lowest population of safflower aphid was observed in thiamethoxam 25 WG @ 0.006%(7.33 aphids/5 cm apical twig/ plant), acetamiprid 20 SP @ 0.004%(8.40 aphids/5 cm apical twig/ plant) and imidacloprid 17.8 SL @ 0.007% (10.13 aphids/5 cm apical twig/ plant) which were statistically at par with each other.

The next effective treatment was acephate @ 0.12 %(12.53 aphids/5 cm apical twig/plant), dimethoate 30 EC @ 0.03 %,(14.00 aphids/5 cm apical twig/plant).difenthiuron 50 WP @ 0.06 % (15.27 aphids/5 cm apical twig/plant), fipronil 5 SC @ 0.01% (17.07 aphids/5 cm apical twig/plant) and lambada cyhalothrin 2.5 EC @ 0.005 %(19.53 aphids/5 cm apical twig/plant) which were statistically at par with each other. However significantly maximum population of safflower aphid was recorded in untreated control (74.73 aphids/5 cm apical twig/plant).

Over all efficaçy by considering mean aphid population at 3, 7 and 10 days after second spraying indicated that significantly lowest population of safflower aphid was observed due to treatment thiamethoxam 25 WG @ 0.006% (3.47 aphid/5 cm apical twig/ plant) which was statistically at par with acetamiprid 20 SP @ 0.004%(4.04 aphids/5 cm apical twig/ plant) and imidacloprid 17.8 SL @ 0.007% (5.29 aphids/5 cm apical twig/ plant). The next effective treatment was acephate 75 SP @ 0.12% (6.67 aphids/5 cm apical twig/plant) which was at par with imidacloprid and significantly superior over remaining treatments. Other effective treatments were dimethoate 30 EC @ 0.03% (8.13 aphids/5 cm apical twig/plant), difenthiuron 50 WP @ 0.06% (9.51 aphids/5 cm apical twig/plant), fipronil 5 SC @ 0.01% (10.62 aphids/5 cm apical twig/plant) and lambada cyhalothrin 2.5 EC @ 0.005 % (11.64 aphids/5 cm apical

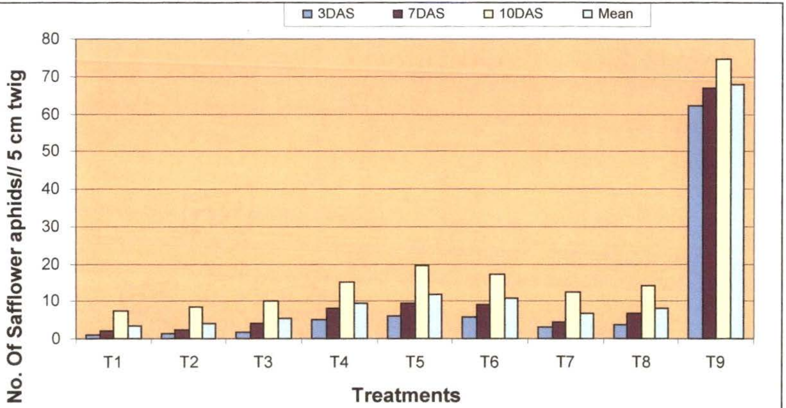

Fig.3 : Effect of different insecticides on population of safflower aphid after second spraying

twig/plant) which were found statistically at par with each other. However significantly maximum population of safflower aphid recorded in untreated control (67.91 aphids/5 cm apical twig/plant).

4.3. Cumulative effect of different insecticides on safflower aphid after 1st and 2nd spraying

It is evident from the Table 5 and Fig.4 that the data pertaining to the average population of safflower aphid were significant at 3, 7 and 10 days after first and second spraying which are presented below.

4.3.1 3rd DAFS & DASS

All treatments were found to be significantly superior over untreated control. Significantly lowest population of safflower aphid was observed in thiamethoxam 25 WG @ 0.006% (1.23 aphids/5 cm apical twig/ plant) which was found statistically at par with acetamiprid 20 SP @ 0.04%(1.53 aphids /5 cm apical twig/ plant) and imidacloprid 17.8 SL @ 0.007%(2.23 aphids /5 cm apical twig/ plant)

The next effective treatment was acephate 75 SP @ 0.12 % followed by dimethoate 30 EC @ 0.03%, difenthiuron 50 WP @ 0.06%, which were statistically at par with each other.

recording 3.20, 4.10, 5.27, 6.03 and 6.33 aphids per 5 cm apical twig per plant, respectively. Significantly maximum population of safflower aphid was recorded in untreated control (48.73 aphids/5 cm apical twig/plant).

4.3.2 7th DAFS & DASS

All treatments found significantly superior over untreated control. Significantly lowest population of safflower aphid was observed in thaimethoxam 25 WG @ 0.006% (2.10 aphids/5 cm apical twig/ plant) which was found statistically at par with acetamiprid 20 SP @ 0.004%(2.33 aphids /5 cm apical twig/ plant), imidacloprid 17.8 SL @ 0.007% (3.50 aphids/5 cm apical twig/ plant) and acephate 75 SP @ 0.12% (4.23 aphids/5 cm apical twig/ plant).

Table 5. Cumulative effect of different insecticides on population of safflower aphid after first and second spraying

Sr. No	Treatments	Mean number of aphids/5 cm apical twig /plant					
		Conc. (%)	Precount	3DAS	7DAS	10DAS	Mean
1	Thiamethoxam 25 WG	0.006	28.37 (5.37)*	1.23 (1.29)	2.10 (1.59)	7.00 (2.72)	3.44 (1.97)
2	Acetamiprid 20 SP	0.004	28.67 (5.39)	1.53 (1.42)	2.33 (1.67)	8.10 (2.93)	3.99 (2.11)
3	Imidacloprid 17.8 SL	0.007	28.73 (5.38)	2.23 (1.64)	3.50 (1.99)	10.03 (3.24)	5.26 (2.40)
4	Difenthiuron 50 WP	0.06	32.97 (5.77)	5.27 (2.39)	7.27 (2.77)	15.77 (4.03)	9.43 (3.14)
5	Lambda cyhalothrin 2.5 EC	0.005	29.83 (5.48)	6.33 (2.59)	8.47 (2.99)	18.43 (4.35)	11.08 (3.40)
6	Fipronil 5 SC	0.01	29.23 (5.44)	6.03 (2.55)	8.10 (2.92)	17.07 (4.18)	10.40 (3.29)
7	Acephate 75 SP	0.12	28.07 (5.32)	3.20 (1.89)	4.23 (2.15)	11.83 (3.51)	6.42 (2.62)
8	Dimethoate 30 EC	0.03	30.90 (5.59)	4.10 (2.14)	5.80 (2.50)	14.57 (3.88)	8.16 (2.94)
9	Untreated control	-	46.37 (6.83)	48.73 (7.01)	52.63 (7.28)	60.00 (7.77)	53.79 (7.37)
F Test			NS	sig	sig	sig	sig
SE (m)±			0.31	0.18	0.19	0.17	0.14
CD at 5%			0.94	0.53	0.56	0.50	0.41
CV %			9.67	11.95	11.24	7.09	7.24

Figures in the parentheses are Square root (x+ 0.5) transformed value

The next effective treatments were dimethoate 30 EC@ 0.03 %, difenthiuron 50 WP @ 0.06%, fipronil 5 SC @ 0.01% and lambada cyhalothrin 2.5 EC @ 0.005%which were found statistically at par with each other recording 5.80, 7.27, 8.10 and 8.47 aphids per 5 cm apical twig per plant, respectively. Significantly maximum population of safflower aphid was recorded in untreated control (52.63 aphids/5 cm apical twig/plant)

4.3.3 10th DAFS & DASS

Significantly lowest population of safflower aphid was observed in thiamethoxam 25 WG @ 0.006% (7.00 aphids/5 cm apical twig/ plant) which was statistically at par with acetamiprid 20 SP @ 0.004 %(8.10 aphids/5 cm apical twig/ plant). The next effective treatment was imidacloprid 17.8 SL @ 0.007% (10.03 aphids /5 cm apical twig/plant), acephate @ 0.12 %(11.83 aphids/5 cm apical twig/plant).

Other effective treatments were dimethoate 30 EC @ 0.03% (14.57 aphids/5 cm apical twig/plant), difenthiuron 50 WP @ 0.06 %(15.77 aphids/5 cm apical twig/ plant), fipronil 5 SC @ 0.01 % (17.06 aphids/5 cm apical twig/ plant) and lambada cyhalothrin 2.5 EC @ 0.005 % 18.43 aphids/5 cm apical twig/ plant) which were statistically at par with each other. However significantly maximum population of safflower aphid was recorded in untreated control (60.00 aphids/5 cm apical twig/plant).

Considering over all efficacy on the basis of mean aphid population at 3, 7 and 10 days after first and second spraying, significantly lowest population of safflower aphid was observed due to treatment thaimethoxam 25 WG @ 0.006% (3.44 aphids/5 cm apical twig/ plant) which was statistically at par with acetamiprid 20 SP @ 0.004 %(3.99 aphids/5 cm apical twig/ plant). The next effective treatment was imidacloprid 17.8 SL @ 0.007% (5.29 aphids/5 cm apical twig/ plant) followed by acephate 75 SP @ 0.12% (6.42 aphids/5 cm apical twig/plant), dimethoate 30 EC @ 0.03% (8.16 aphids/5cm apical twig/plant), difenthiuron 50 WP @ 0.06% (9.43 aphids/5 cm apical twig/plant) fipronil 5 SC @ 0.01% (10.40 aphids/5 cm apical twig/plant) and lambada cyhalothrin 2.5 EC @ 0.005 % (11.08 aphids/5 cm apical twig/plant). Significantly maximum population of safflower aphid was recorded in untreated control (53.79 aphids/5 cm apical twig/plant).

The findings of present investigations are in close conformity with the following research workers.

Wadnerkar et al. (2004) reported that thiamethoxam 25 WG @ 50, 70 and 100 g a.i/ha were found to be significantly superior over imidacloprid 17.8 SL and dimethoate 30 EC in reducing cotton aphid population.

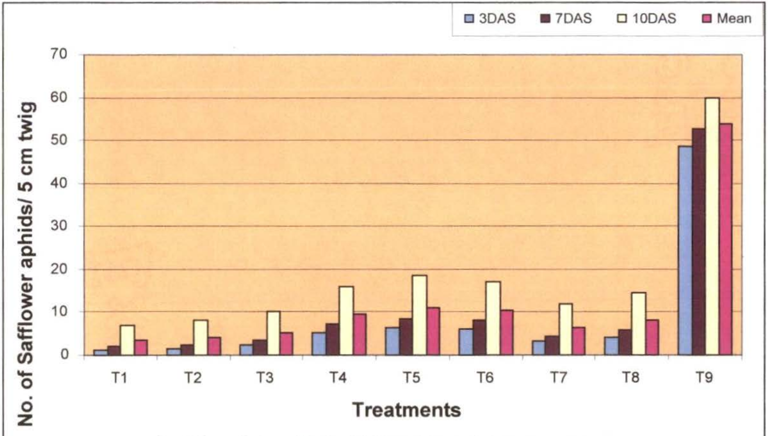

Fig.4 Cumulative effect of different insecticides on average population of safflower aphid after first and second spraying

Akashe et al. (2008) reported that thiamethoxam 0.005% and Acetamiprid 0.004% proved to be best by recording maximum per cent decline in aphid population.

Akashe et al. (2010) also reported effectiveness of thiamethoxam against safflower aphid. Amongst the treatments, thiamethoxam 0.005 %, acetamiprid @ 0.004% and imidacloprid @ 0.0045% registered the less aphid population than the earlier recommended dimethoate @ 0.03%.

Hanumantharaya et al. (2007) tested newer molecules of insecticides against safflower aphid. Thiamethoxam, acetampirid followed by imidacloprid were found to be more effective and economic as against dimethoate. These insecticides recorded more than 97per cent mortality.

Results of present investigation are strongly corroborate with the findings of Neharkar et al. (2003) and Shirisha (2005) who also reported the effectiveness of dimethoate 0.03% against safflower aphid, which was found to be significantly superior in reducing aphid population and increasing yield.

Singh and Gaud (1991) reported that acephate 75 WP @ 500 ml/ha was effective against safflower aphid, *U. compositae* (Theobald).

4.4 Effect of different insecticides on population of Lady Bird beetle after 1st spraying

It is revealed from the Table 6 and Fig.5 that the data pertaining to the average population of lady bird beetle were significant at 3, 7, and 10 after first spraying.

4.1.1 3rd DAFS

Significantly highest population of lady bird beetle was observed in untreated control (1.93 LBB/5 plant). Among the insecticides treatments, maximum population of lady bird beetle was recorded in thiamethoxam 25 WG @ 0.006%(0.87 LBB/5 plant) which significantly superior over acephate and was at par with acetamiprid 20 SP @ 0.04%(0.80 LBB/5 plant), fipronil 5 SC @ 0.01%(0.73 LBB/5 plant), imidacloprid 17.8 SL @ 0.007% (0.67 LBB/5 plant), dimethoate 30 EC @ 0.03%(0.53 LBB/5 plant), difenthiuron 50 WP @ 0.06%(0.47/5 plant) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.40LBB/5 plant). Significantly minimum population of lady bird beetle was observed due to the acephate 75 SP.

Table 6. Effects of different insecticides on population of lady bird beetle after first spraying

Sr.No	Treatments	No. of lady bird beetles /5plant					
		Conc (%)	Precount	3 DAS	7DAS	10 DAS	Mean
1	Thiamethoxam 25 WG	0.006	1.93 (1.55)*	0.87 (1.16)	0.80 (1.12)	0.93 (1.18)	0.87 (1.16)
2	Acetamiprid 20 SP	0.004	2.27 (1.66)	0.80 (1.14)	0.73 (1.10)	0.87 (1.16)	0.80 (1.13)
3	Imidacloprid 17.8 SL	0.007	1.73 (1.47)	0.67 (1.07)	0.60 (1.04)	0.60 (1.04)	0.62 (1.05)
4	Difenthiuron 50 WP	0.06	1.60 (1.44)	0.47 (0.98)	0.40 (0.94)	0.40 (0.94)	0.42 (0.96)
5	Lambda cyhalothrin 2.5 EC	0.005	1.13 (1.27)	0.40 (0.93)	0.33 (0.90)	0.47 (0.98)	0.40 (0.94)
6	Fipronil 5 SC	0.01	1.40 (1.37)	0.73 (1.10)	0.67 (1.06)	0.80 (1.13)	0.73 (1.10)
7	Acephate 75 SP	0.12	1.40 (1.37)	0.20 (0.83)	0.13 (0.79)	0.27 (0.86)	0.20 (0.83)
8	Dimethoate 30 EC	0.03	1.60 (1.45)	0.53 (1.01)	0.47 (0.97)	0.60 (1.04)	0.53 (1.00)
9	Untreated control	-	1.87 (1.53)	1.93 (1.55)	2.00 (1.57)	2.13 (1.61)	2.02 (1.58)
	F Test		NS	Sig	Sig	Sig	Sig
	SE (m)±		0.11	0.11	0.12	0.12	0.11
	CD at 5%		0.33	0.32	0.35	0.35	0.34
	CV %		13.14	17.11	19.38	18.05	17.93

Figures in the parentheses are Square root (x+ 0.5) transformed value

4.4.2 7th DAFS

Significantly maximum population of lady bird beetle was observed in untreated control (2.00 LBB/5 plant) there were non-significant difference among the insecticidal treatments. However relatively maximum population of lady bird beetle was observed in thiamethoxam 25 WG @

0.006%(0.80 LBB/5 plant) followed by acetamiprid 20 SP @ 0.04%(0.73 LBB/5 plant), fipronil 5 SC @ 0.01%(0.67 LBB/5 plant), imidacloprid 17.8 SL @ 0.007% (0.60 LBB/5 plant), dimethoate 30 EC @ 0.03%(0.47 LBB/5 plant), difenthiuron 50 WP @ 0.06%(0.40LBB/5 plant) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.33 LBB/5 plant). Lowest population of lady bird beetle was recorded in acephate 75 SP @ 0.12 %(0.13 LBB/ plant)

4.4.3 10th DAFS

Significantly maximum population of lady bird beetle was observed in untreated control (2.13 LBB/5 plant). There were non-significant differences among the insecticidal treatments. However relatively maximum population of lady bird beetle was observed in thiamethoxam 25 WG @ 0.006%(0.93 LBB/5 plant), acetamiprid 20 SP @ 0.04%(0.87 LBB/5 plant), fipronil 5 SC @ 0.01%(0.80 LBB/5 plant), imidacloprid 17.8 SL @ 0.007% (0.60 LBB/5 plant), dimethoate 30 EC @ 0.03%(0.60 LBB/5 plant), lambada cyhalothrin 2.5 EC @ 0.005 %(0.47 LBB/5 plant) and difenthiuron 50 WP @ 0.06%(0.40LBB/5 plant). Lowest population of lady bird beetle was recorded in acephate 75 SP @ 0.12% % (0.27 LBB/ plant)

Over all efficacy by considering mean lady bird beetle population at 3, 7 and 10 days after first spraying indicated that significantly maximum population was observed in untreated control (2.02 LBB/ 5 plant).There were non significant differences among the insecticidal treatment. However relatively safer treatment recording maximum population of lady bird beetle was thiamethoxam 25 WG @ 0.006% (0.87 LBB/5 plant), acetamiprid 20 SP @ 0.04%(0.80 LBB /5 plant) followed by fipronil 5 SC @ 0.01%(0.73 LBB /5 plant), imidacloprid 17.8 SL @ 0.007% (0.62 LBB /5 plant), dimethoate 30 EC @ 0.03%(0.53 LBB /5 plant), lambada cyhalothrin 2.5 EC @ 0.005 %(0.40 LBB /5 plant) and difenthiuron 50 WP @ 0.06%(0.42 LBB /5 plant). Lowest population of lady bird beetle was recorded in acephate 75 SP @ 0.12 %(0.20 LBB /5 plant)

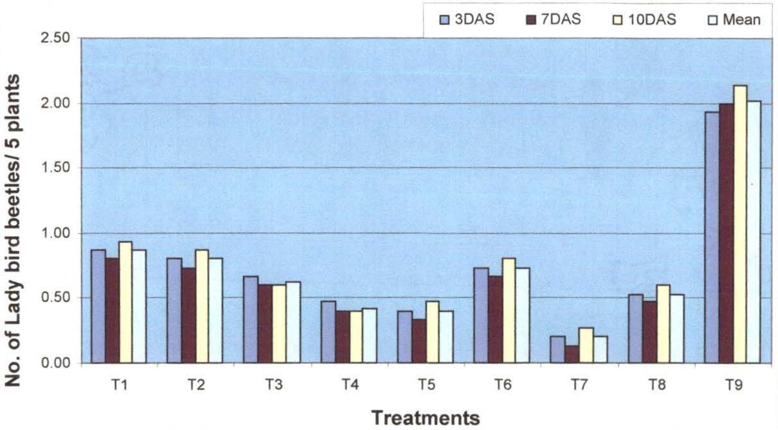

Fig. 5: Effect of different insecticides on population of lady bird beetle after first spraying

4.5 Effect of different insecticides on population of Lady Bird beetle after 2nd spraying

It is revealed from the Table 7 and Fig.6 that the data pertaining to the average population of Lady Bird beetle were significant at 3, 7, and 10 after second spraying

4.5.1 3rd DASS

Significantly maximum population of lady bird beetle was observed in untreated control (2.07 LBB/ 5 plants). There were non-significant differences among the insecticidal treatments. However relatively maximum population of lady bird beetle was observed in thiamethoxam 25 WG @ 0.006%(0.80 LBB /5 plant), acetamiprid 20 SP @ 0.04%(0.73 LBB/5 plant), fipronil 5 SC @ 0.01%(0.60 LBB /5plant), imidacloprid 17.8 SL @ 0.007% (0.47 LBB /5 plant), difenthiuron 50 WP @ 0.06%(0.33 LBB /5 plant), dimethoate 30 EC @ 0.03%(0.27 LBB /5 plant) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.27 LBB /5 plant). Lowest population of lady bird beetle was recorded in acephate 75 SP @ 0.12% (0.20 LBB /5 plants).

4.5.2 7th DASS

Significantly maximum population of lady bird beetle was observed in untreated control (2.20 LBB /5 plants). There were non-significant differences among the insecticidal treatments. However relatively maximum population of lady bird beetle was observed in thiamethoxam 25 WG @ 0.006%(0.93 LBB/5 plants), acetamiprid 20 SP @ 0.04%(0.87 LBB/5 plants), fipronil 5 SC @ 0.01% (0.73 LBB/5 plants), imidacloprid 17.8 SL @ 0.007% (0.47 LBB/5 plants), dimethoate 30 EC @ 0.03%(0.40 LBB/5 plant), lambada cyhalothrin 2.5 EC @ 0.005 % (0.40 LBB/5 plants) and difenthiuron 50 WP @ 0.06%(0.33 LBB /5 plants). Lowest population of lady bird beetle was recorded in acephate 75 SP @ 0.12 %(0.27 LBB /5 plants).

Table 7. Effect of different insecticides on population of lady bird beetle after second spraying

Sr. No	Treatments	No. of lady bird beetles/5plant					
		Conc. (%)	Precount	3 DAS	7DAS	10 DAS	Mean
1	Thiamethoxam 25 WG	0.006	1.80 (1.51)*	0.80 (1.13)	0.93 (1.19)	1.40 (1.37)	1.04 (1.23)
2	Acetamiprid 20 SP	0.004	2.13 (1.62)	0.73 (1.10)	0.87 (1.16)	1.33 (1.34)	0.98 (1.21)
3	Imadacloprid 17.8 SL	0.007	1.60 (1.42)	0.47 (0.98)	0.47 (0.98)	0.80 (1.13)	0.58 (1.03)
4	Difenthiuron 50 WP	0.06	1.47 (1.39)	0.33 (0.89)	0.33 (0.89)	0.47 (0.96)	0.38 (0.92)
5	Lambda cyhalothrin 2.5 EC	0.005	1.00 (1.22)	0.27 (0.86)	0.40 (0.93)	0.60 (1.04)	0.42 (0.95)
6	Fipronil 5 SC	0.01	1.27 (1.31)	0.60 (1.04)	0.73 (1.09)	0.93 (1.18)	0.76 (1.11)
7	Acephate 75 SP	0.12	1.27 (1.31)	0.20 (0.82)	0.27 (0.86)	0.47 (0.98)	0.31 (0.89)
8	Dimethoate 30 EC	0.03	1.47 (1.40)	0.27 (0.87)	0.40 (0.94)	0.60 (1.04)	0.42 (0.96)
9	Untreated control	-	2.00 (1.57)	2.07 (1.58)	2.20 (1.62)	2.27 (1.64)	2.18 (1.61)
	F Test		NS	Sig	Sig	Sig	Sig
	SE(m) ±		0.13	0.11	0.12	0.14	0.12
	CD at 5%		0.38	0.32	0.35	0.41	0.36
	CV %		15.69	18.04	18.84	19.96	18.75

Figures in the parentheses are Square root (x+ 0.5) transformed value

5.3 10th DASS

Significantly maximum population of lady bird beetle was observed in untreated control (2.27 LBB /5 plants). There were non-significant differences among the insecticidal treatments. thiamethoxam 25 WG @ 0.006 %(1.40 LBB/5 plants), acetamiprid 20 SP @ 0.04% (1.33 LBB/5 plants), fipronil 5 SC @ 0.01% (0.93 LBB /5 plants), imidacloprid

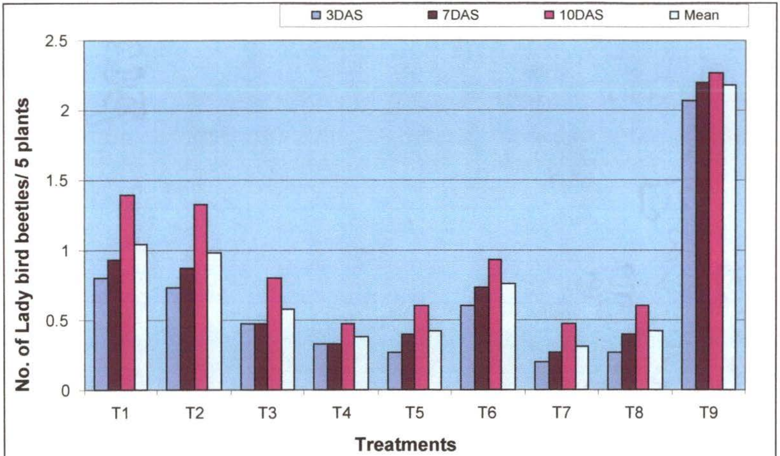

Fig. 6 : Effect of different insecticides on population of lady bird beetle after Second spraying

17.8 SL @ 0.007% (0.80 LBB/5 plants), dimethoate 30 EC @ 0.03% (0.60/5 plants), lambada cyhalothrin 2.5 EC @ 0.005 %(0.60/5 plants), acephate 75 SP @ 0.12% % (0.47/5 plants). Lowest population of lady bird beetle was recorded in difenthiuron 50 WP @ 0.06% (0.47 LBB/5 plants).

Over all efficacy by considering mean number of lady bird beetle per plant at 3, 7 and 10 days after second spraying, indicated that significantly maximum population was observed in untreated control (2.18 LBB/ 5 plant). There were non significant differences among the insecticidal treatment. However, relatively maximum population of lady bird beetle was observed in treatment thiamethoxam 25 WG @ 0.006%(1.04 LBB/5 plants), acetamiprid 20 SP @ 0.04%(0.98 LBB/5 plants), fipronil 5 SC @ 0.01%(0.76 LBB/5 plants), imidacloprid 17.8 SL @ 0.007% (0.58 LBB/5 plant), dimethoate 30 EC @ 0.03%(0.42 LBB/5 plants), difenthiuron 50 WP @ 0.06%(0.38 LBB/5 plants) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.42 LBB/5 plants). Lowest population of lady bird beetle was recorded in acephate 75 SP @ 0.12% (0.31 LBB/5 plants).

4.6 Cumulative effect of different insecticides on population of Lady Bird beetle after 1st and 2nd spraying

It is revealed from the Table 8 and Fig. 7 that the data pertaining to the average population of Lady Bird beetle were found to be significant after first and second spraying.

4.6.1 3rd DAFS & DASS

Significantly maximum population of lady bird beetle was observed in untreated control (2.00 LBB/5 plants). Among the insecticidal treatments. However significantly maximum population of lady bird beetle was observed in thiamethoxam 25 WG @ 0.006% (0.83 LBB/5 plants) over acephate75 SP @ 0.12% (0.20 LBB/5 plants). However, it was at par with rest of the insecticidal treatments.

Plate 1. Lady bird beetle feeding on safflower aphid

Table 8 Cumulative effect of different insecticides on population of Lady Bird beetle after 1st and 2nd spraying

Sr. No	Treatments	Lady bird beetles 5/plant					
		Conc (%)	Precount	3 DAS	7DAS	10 DAS	Mean
1	Thiamethoxam 25 WG	0.006	1.87 (1.53)*	0.83 (1.15)	0.87 (1.16)	1.17 (1.28)	0.96 (1.20)
2	Acetamiprid 20 SP	0.004	2.20 (1.64)	0.77 (1.12)	0.80 (1.14)	1.10 (1.26)	0.89 (1.18)
3	Imidacloprid 17.8 SL	0.007	1.67 (1.45)	0.57 (1.03)	0.53 (1.01)	0.70 (1.09)	0.60 (1.04)
4	Difenthiuron 50 WP	0.06	1.53 (1.42)	0.40 (0.94)	0.37 (0.92)	0.43 (0.96)	0.40 (0.94)
5	Lambda cyhalothrin 2.5 EC	0.005	1.07 (1.25)	0.33 (0.91)	0.37 (0.93)	0.53 (1.02)	0.41 (0.95)
6	Fipronil 5 SC	0.01	1.33 (1.34)	0.67 (1.08)	0.70 (1.09)	0.87 (1.17)	0.74 (1.11)
7	Acephate 75 SP	0.12	1.33 (1.34)	0.20 (0.83)	0.20 (0.83)	0.37 (0.92)	0.26 (0.86)
8	Dimethoate 30 EC	0.03	1.53 (1.42)	0.40 (0.95)	0.43 (0.96)	0.60 (1.05)	0.48 (0.99)
9	Untreated control	-	1.93 (1.55)	2.00 (1.57)	2.10 (1.60)	2.20 (1.62)	2.10 (1.60)
	F Test		NS	Sig	Sig	Sig	Sig
	SE (m)$\pm$		0.12	0.08	0.09	0.09	0.09
	CD at 5%		0.36	0.25	0.26	0.28	0.26
	CV %		14.31	13.52	14.16	14.08	13.77

Figures in the parentheses are Square root (x+ 0.5) transformed value

4.6.2 7th DAFS & DASS

Significantly maximum population of lady bird beetle was observed in untreated control (2.10 LBB/ 5 plants). Among the insecticidal treatments. However significantly maximum population of lady bird beetle was observed in thiamethoxam 25 WG @ 0.006% (0.87 LBB/5 plants), over acephate75 SP @ 0.12% (0.20 LBB/5 plants). However, it was at par with rest of the insecticidal treatments.

4.6.3 10th DAFS & DASS

Significantly maximum population of lady bird beetle was observed in untreated control (2.20 LBB/5 plants). Among the insecticidal treatments. However significantly maximum population of lady bird beetle was observed in thiamethoxam 25 WG @ 0.006% (1.17 LBB/5 plants), over acephate 75 SP @ 0.12% (0.73 LBB/5 plants) and difenthiuron 50 WP@ 0.06% (0.42 LBB/ 5 plants). However, it was at par rest of the insecticidal treatments.

Over all efficacy by considering mean lady bird beetle population at 3, 7 and 10 days after first and second spraying indicated that significantly maximum population was observed in untreated control (2.10 LBB/5 plants). Among the insecticidal treatments.Significantly maximum population of lady bird beetle was observed in treatment thiamethoxam 25 WG @ 0.006% (0.96 LBB/5 plants), over acephate 75 SP @ 0.12% (0.26 LBB/5 plants). However it was at par with rest of the insecticidal treatments.

Results of present investigation are in close conformity with those of Sohail et al. (2011) was concluded that thiamethoxam was few be effective for the control of aphid with less toxic effect against lady bird beetle.

Accoding to Dhaka et al. (2009) thiamethoxam was found as safer insecticide to the coccinellids. Hanumantharaya et al. (2008) reported that thiamethoxam 25 WG @ 0.005% was found to be effective against safflower aphid and relatively safer to lady bird beetle and chrysopids.

Zanwar and Jadhav (2003) also reported lowest number of lady bird beetle in the plot treated with acephate and maximum number of lady bird beetle in untreated control plot.

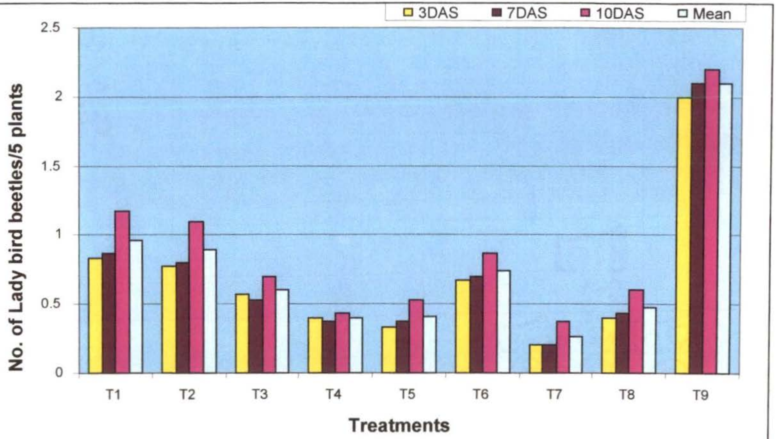

Fig.7 : Cumulative effect of different insecticides on population of lady bird beetle after first and Second spraying

4.7 Effect of different insecticides on population of Chrysopa aftyer 1st spraying

It is revealed from the Table 9 and Fig. 8 that the data pertaining to the average population of Chrysopa were significant at 3, 7, and 10 after first spraying.

4.7.1 3rd DAFS

Significantly maximum population of Chrysopids was observed in untreated control (1.27 chrysopa/5 plants). Among the insecticidal treatments significantly maximum population of Chrysopa was observed in thiamethoxam 25 WG @ 0.006% (0.87 chrysopa/5 plants),over lambada cyhalothrin 2.5 EC @ 0.005 %(0.33 chrysopa/5 plants) and acephate 75 SP @ 0.12 % (0.20 chrysopa/5 plants). However it was at par with rest of the insecticidal treatments.

4.7.2 7th DAFS

Significantly maximum population of Chrysopids was observed in untreated control (1.33 chrysopa/5 plant). Among the insecticidal treatment. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006%(0.80 chrysopa/5 plants) followed by acetamiprid 20 SP @ 0.04%(0.73 chrysopa/5 plants), imidacloprid 17.8 SL @ 0.007% (0.40 chrysopa/5 plants), fipronil 5 SC @ 0.01%(0.47 chrysopa/5 plants), dimethoate 30 EC @ 0.03% (0.47 chrysopa/5 plants), difenthiuron 50 WP @ 0.06%(0.40 chrysopa/5 plants) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.27 chrysopa/5 plants). Lowest population of Chrysopa was recorded in acephate 75 SP @ 0.12 %(0.13 chrysopa/ 5 plants).

4.7.3 10th DAFS

Significantly maximum population of Chrysopids was observed in untreated control (1.60 chrysopa /5 plants). Among the insecticidal treatments. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006 %(0.93 chrysopa/5 plants), over lambada cyhalothrin 2.5 EC @ 0.005 %(0.33 chrysopa/5 plant) and acephate 75 SP @ 0.12 %(0.27 chrysopa/5 plants). However, it was at par with rest of the insecticidal treatments

Table 9. Effect of different insecticides on population of Chrysopa after first spraying

Sr. No	Treatments	No. of chrysopa/5 plant					
		Conc. (%)	Precount	3DAS	7DAS	10DAS	Mean
1	Thiamethoxam 25 WG	0.006	1.13 (1.26)*	0.87 (1.16)	0.80 (1.13)	0.93 (1.18)	0.87 (1.16)
2	Acetamiprid 20 SP	0.004	1.07 (1.25)	0.80 (1.14)	0.73 (1.10)	0.80 (1.14)	0.78 (1.13)
3	Imadacloprid 17.8 SL	0.007	1.00 (1.22)	0.80 (1.13)	0.73 (1.10)	0.87 (1.16)	0.80 (1.13)
4	Difenthiuron 50 WP	0.06	0.93 (1.19)	0.47 (0.98)	0.40 (0.94)	0.47 (0.98)	0.44 (0.97)
5	Lambda cyhalothrin 2.5 EC	0.005	1.00 (1.22)	0.33 (0.90)	0.27 (0.87)	0.33 (0.90)	0.31 (0.89)
6	Fipronil 5 SC	0.01	1.13 (1.27)	0.53 (1.01)	0.47 (0.98)	0.47 (0.98)	0.49 (0.99)
7	Acephate 75 SP	0.12	1.07 1.25	0.20 (0.83)	0.13 (0.79)	0.27 (0.87)	0.20 (0.83)
8	Dimethoate 30 EC	0.03	1.27 (1.32)	0.53 (1.00)	0.47 (0.98)	0.60 (1.05)	0.53 (1.01)
9	Untreated control	-	1.20 (1.30)	1.27 (1.32)	1.33 (1.35)	1.60 (1.44)	1.40 (1.37)
F Test			NS	Sig	Sig	Sig	Sig
SE (m)±			0.09	0.09	0.07	0.08	0.08
CD at 5%			0.27	0.26	0.22	0.23	0.23
CV %			12.63	14.09	12.51	12.58	12.68

Figures in the parentheses are Square root (x+ 0.5) transformed value

Over all efficacy by considering mean Chrysopids population at 3, 7 and 10 days after first spraying, revealed that significantly maximum population was observed in untreated control (1.40 chrysopa/5 plants). Among the insecticidal treatment. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006 %(0.87 chrysopa /5 plants) over lambada cyhalothrin 2.5 EC @ 0.005 %(

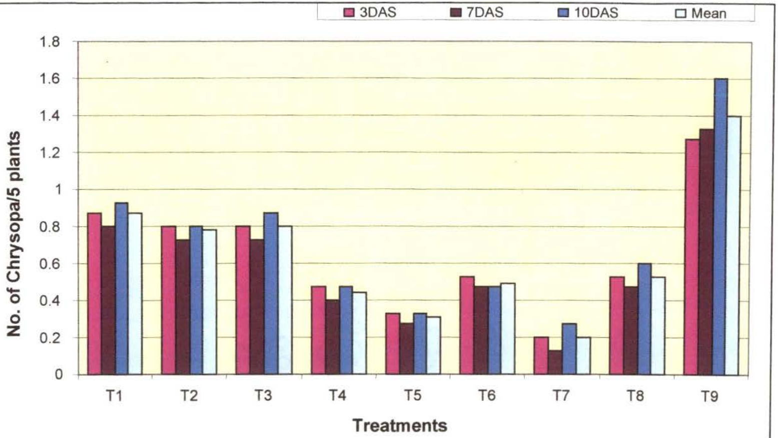

Fig.8 : Effect of different insecticides on population of Chrysopa after first spraying

0.31/5 plants) and acephate 75 SP @ 0.12 %(0.20 chrysopa/5 plants). However, it was at par with rest of the insecticidal treatments

4.8 Effect of different insecticides on population of Chrysopa after 2nd spraying

It is revealed from the Table 10 and Fig.9 that the data pertaining to the average population of Chrysopa were at 3, 7, and 10 after second spraying

4.8.1 3rd DASS

Significantly maximum population of Chrysopids was observed in untreated control (1.80 chrysopa/5 plants). Among the insecticidal treatments. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006%(0.93 chrysopa/5 plants), followed by imidacloprid 17.8 SL @ 0.007% (0.80 chrysopa/5 plants), acetamiprid 20 SP @ 0.04%(0.67 chrysopa/5 plants), fipronil 5 SC @ 0.01%(0.67 chrysopa/5 plants), dimethoate 30 EC @ 0.03%(0.60 chrysopa /5 plants), difenthiuron 50 WP @ 0.06%(0.60 chrysopa/5 plants) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.53 chrysopa/5 plants). Lowest population of Chrysopa was recorded in acephate 75 SP @ 0.12 %(0.33 chrysopa /5 plants).

4.8.2 7th DASS

Significantly maximum population of Chrysopids was observed in untreated control (1.87 chrysopa/5 plants). Among the insecticidal treatments. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006% (0.87 chrysopa/5 plants) over acephate 75 SP @ 0.12 % (0.20 chrysopa /5 plants). However, it was at par with rest of the insecticidal treatments.

4.8.3 10th DASS

Significantly maximum population of Chrysopids was observed in untreated control (1.93 chrysopa/5 plant). Among the insecticidal treatments. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006 %(1.07 chrysopa/5 plants) over acephate 75 SP @ 0.12 %(0.27 chrysopa/5 plants). However, it was at par with rest of the insecticidal treatments.

Table 10. Effects of different insecticides on population of Chrysopa after second spraying

Sr. No	Treatments	No. of Chrysopa/5 plants					
		Conc. (%)	Precount	3DAS	7DAS	10DAS	Mean
1	Thiamethoxam 25 WG	0.006	1.20 (1.29)*	0.93 (1.17)	0.87 (1.15)	1.07 (1.24)	0.96 (1.19)
2	Acetamiprid 20 SP	0.004	1.00 (1.22)	0.67 (1.07)	0.60 (1.05)	0.73 (1.10)	0.67 (1.07)
3	Imidacloprid 17.8 SL	0.007	1.07 (1.24)	0.80 (1.14)	0.73 (1.10)	0.87 (1.16)	0.80 (1.14)
4	Difenthiuron 50 WP	0.06	0.93 (1.19)	0.60 (1.04)	0.53 (1.01)	0.67 (1.06)	0.60 (1.04)
5	Lambda cyhalothrin 2.5 EC	0.005	0.80 (1.14)	0.53 (1.01)	0.47 (0.98)	0.60 (1.04)	0.53 (1.01)
6	Fipronil 5 SC	0.01	1.00 (1.22)	0.67 (1.07)	0.53 (1.01)	0.67 (1.06)	0.62 (1.05)
7	Acephate 75 SP	0.12	0.93 (1.19)	0.33 (0.91)	0.20 (0.83)	0.27 (0.86)	0.27 (0.87)
8	Dimethoate 30 EC	0.03	1.00 (1.21)	0.60 (1.05)	0.60 (1.05)	0.73 (1.10)	0.64 (1.06)
9	Untreated control	-	1.73 (1.49)	1.80 (1.51)	1.87 (1.53)	1.93 (1.56)	1.87 (1.54)
F Test			NS	Sig	Sig	Sig	Sig
SE (m)±			0.08	0.09	0.09	0.09	0.09
CD at 5%			0.24	0.27	0.26	0.28	0.26
CV %			11.21	13.93	14.11	14.28	13.68

Figures in the parentheses are Square root (x+ 0.5) transformed value

Over all efficacy by considering mean Chrysopids population at 3, 7 and 10 days after second spraying, significantly maximum population was observed in untreated control (1.87 chrysopa/5 plant). Among the insecticidal treatment significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006%

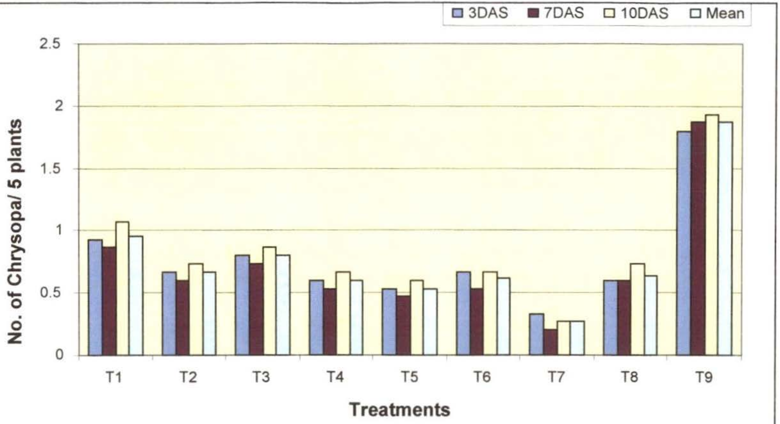

Fig.9 : Effect of different insecticides on population of Chrysopa after second spraying

(0.96 chrysopa/5 plants) over acephate 75 SP @ 0.12 %(0.27 chrysopa/5 plant). However, it was at par with rest of the insecticidal treatments

4.9 Cumulative effect of different insecticides on Chrysopa after 1st and 2nd spraying

It is revealed from the Table 11 and Fig.10 that the data pertaining to the average population of Chrysopa were significant after first and second spraying

4.9.1 3rd DAFS & DASS

Significantly maximum population of Chrysopids was observed in untreated control (1.53 chrysopa/5 plants). Among the insecticidal treatments. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006% (0.90 chrysopa/5 plants) over acephate 75 SP @ 0.12 %(0.27 chrysopa/5 plants). However, it was at par with rest of the insecticidal treatments

4.9.2 7th DAFS & DASS

Significantly maximum population of Chrysopids was observed in untreated control (1.60 chrysopa/5 plant). Among the insecticidal treatment. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006% (0.83 chrysopa/5 plant), over acephate 75 SP @ 0.12 %(0.17 chrysopa/5 plant). However, it was at par with rest of the insecticidal treatments.

4.9.3 10th DAFS & DASS

Significantly maximum population of Chrysopids was observed in untreated control (1.77 chrysopa/5 plant). Among the insecticidal treatment. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006% (1.00 chrysopa/5 plants), over acephate 75 SP @ 0.12 % (0.27 chrysopa/5 plants). However, it was at par with imidacloprid 17.8 SL @ 0.007% (0.87 chrysopa /5 plants), acetamiprid 20 SP @ 0.04% (0.77 chrysopa/5 plants), dimethoate 30 EC @ 0.03%(0.67 chrysopa/5 plants), difenthiuron 50 WP @ 0.06%(0.57 chrysopa/5 plants), fipronil 5 SC @ 0.01%(0.57 chrysopa/5 plants) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.47 chrysopa/5 plants)

Table 11. Cumulative Effect of different insecticides on population of Chrysopa after first and second spraying

Sr. No	Treatments	No. of chrysopa/5 plant					
		Conc. (%)	Precount	3DAS	7DAS	10DAS	Mean
1	Thiamethoxam 25 WG	0.006	1.17 (1.28)*	0.90 (1.16)	0.83 (1.14)	1.00 (1.21) ()	0.91 (1.17)
2	Acetamiprid 20 SP	0.004	1.03 (1.23)	0.73 (1.11)	0.67 (1.08)	0.77 (1.12)	0.72 (1.10)
3	Imidacloprid 17.8 SL	0.007	1.03 (1.24)	0.80 (1.14)	0.73 (1.10)	0.87 (1.16)	0.80 (1.13)
4	Difenthiuron 50 WP	0.06	0.93 (1.19)	0.53 (1.01)	0.47 (0.98)	0.57 (1.02)	0.52 (1.00)
5	Lambda cyhalothrin 2.5 EC	0.005	0.90 (1.18)	0.43 (0.96)	0.37 (0.92)	0.47 (0.97)	0.42 (0.95)
6	Fipronil 5 SC	0.01	1.07 (1.25)	0.60 (1.04)	0.50 (0.99)	0.57 (1.02)	0.56 (1.02)
7	Acephate 75 SP	0.12	1.00 (1.22)	0.27 (0.87)	0.17 (0.81)	0.27 (0.87)	0.23 (0.85)
8	Dimethoate 30 EC	0.03	1.13 (1.27)	0.57 (1.03)	0.53 (1.01)	0.67 (1.07)	0.59 (1.04)
9	Untreated control	-	1.47 (1.40)	1.53 (1.42)	1.60 (1.45)	1.77 (1.50)	1.63 (1.46)
F Test			NS	Sig	Sig	sig	Sig
SE (m)±			0.07	0.08	0.07	0.08	0.08
CD at 5%			-	0.25	0.23	0.25	0.24
CV %			9.69	13.50	12.90	13.21	13.05

Figures in the parentheses are Square root (x+ 0.5) transformed value

Over all efficacy by considering mean Chrysopids population at 3, 7 and 10 days after first and second spraying, indicated that significantly maximum population was observed in untreated control (1.63 chrysopa/5 plants). Among the insecticidal treatment. Significantly maximum population of Chrysopa was observed in treatment

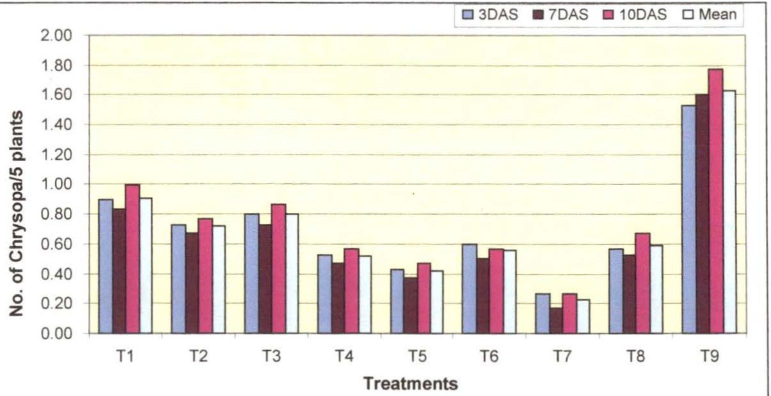

Fig.10: Cumulative Effects of different insecticides on population of chrysopa after first and second spraying.

thaimethoxam 25 WG @ 0.006 %(0.91 chrysopa/5 plants) over acephate 75 SP @ 0.12% %(0.23 chrysopa/ plants). However, it was at par with imidacloprid 17.8 SL @ 0.007% (0.80 chrysopa/5 plants), acetamiprid 20 SP @ 0.04%(0.72 chrysopa/5 plants), dimethoate 30 EC @ 0.03%(0.59 chrysopa/5 plant), fipronil 5 SC @ 0.01%(0.56 chrysopa /5 plants), difenthiuron 50 WP @ 0.06%(0.52 chrysopa/5 plants) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.42 chrysopa /5 plants).

The findings of present investigation are similar to those of Hanumantharaya et al. (2008) who reported that thiamethoxam 25 WG @ 0.005% was found to be effective against safflower aphid and relatively safer to lady bird beetle and crysopids. Katole and Patil (2000) also reported that thiamethoxam @ 4g/kg seed treatment allowed maximum oviposition of *Chrysoperla* which was found at par with untreated control.

Toda and kashiao (1997) reported that imidacloprid was less toxic to *chrysoperla* larvae among 34 insecticides tested.

4.10 Effect of different insecticides on larval population of Syrphid fly after 1st spraying

It is revealed from the Table 12 and Fig.11 that the data pertaining to the average population of Syrphid fly were significant at 3, 7, and 10 after first spraying.

4.10.1 3rd DAFS

Significantly maximum population of Syrphid was observed in untreated control (1.20 syrphid /5 plants). Among the insecticidal treatment. Significantlyb maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.60 syrphid /5 plants) over acephate 75 SP @ 0.12 %(0.07 syrphid / plants). However, it was at par with acetamiprid 20 SP @ 0.04%(0.53 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.47 syrphid /5 plant), dimethoate 30 EC @ 0.03%(0.47 syrphid /5 plants), fipronil 5 SC @ 0.01%(0.33 syrphid /5 plants), difenthiuron 50 WP @ 0.06%(0.33 syrphid /5 plant) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.27 syrphid /5 plants).

Table 12. Effects of different insecticides on larval population of Syrphid fly after first spraying

Sr. No	Treatments	No. of syrphid / 5 plant					
		Conc. (%)	Precount	3DAS	7DAS	10DAS	Mean
1	Thiamethoxam 25 WG	0.006	0.93 (1.17)*	0.60 (1.04)	0.53 (1.01)	0.80 (1.14)	0.64 (1.06)
2	Acetamiprid 20 SP	0.004	1.00 (1.22)	0.53 (1.01)	0.47 (0.98)	0.67 (1.07)	0.56 (1.02)
3	Imidacloprid 17.8 SL	0.007	0.87 (1.16)	0.47 (0.98)	0.40 (0.94)	0.47 (0.98)	0.44 (0.97)
4	Diafenthiuron 50 WP	0.06	0.93 (1.19)	0.33 (0.89)	0.27 (0.86)	0.53 (1.01)	0.38 (0.93)
5	Lambda cyhalothrin 2.5 EC	0.005	1.07 (1.25)	0.27 (0.86)	0.20 (0.83)	0.33 (0.91)	0.27 (0.87)
6	Fipronil 5 SC	0.01	1.00 (1.21)	0.33 (0.91)	0.27 (0.87)	0.33 (0.91)	0.31 (0.90)
7	Acephate 75 SP	0.12	1.13 (1.27)	0.07 (0.75)	0.07 (0.75)	0.20 (0.83)	0.11 (0.78)
8	Dimethoate 30 EC	0.03	1.07 (1.25)	0.47 (0.98)	0.40 (0.94)	0.47 (0.98)	0.44 (0.97)
9	Untreated control	-	0.87 (1.16)	1.20 (1.30)	1.33 (1.35)	1.60 (1.44)	1.38 (1.36)
F Test			NS	sig	sig	sig	sig
SE (m)±			0.10	0.09	0.08	0.07	0.08
CD at 5%			-	0.28	0.25	0.22	0.24
CV %			14.94	16.72	15.26	12.43	13.94

Figures in the parentheses are Square root (x+ 0.5) transformed value

4.10.2 7th DAFS

Significantly maximum population of Syrphid was observed in untreated control (1.33 syrphids /5 plants). Among the insecticidal treatments. Significantly maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.53 syrphid /5 plants), over acephate 75 SP @ 0.12 %(0.07 syrphid /5 plants), However, it was at par with acetamiprid 20 SP @ 0.04%(0.47 syrphid /5 plants), imidacloprid 17.8

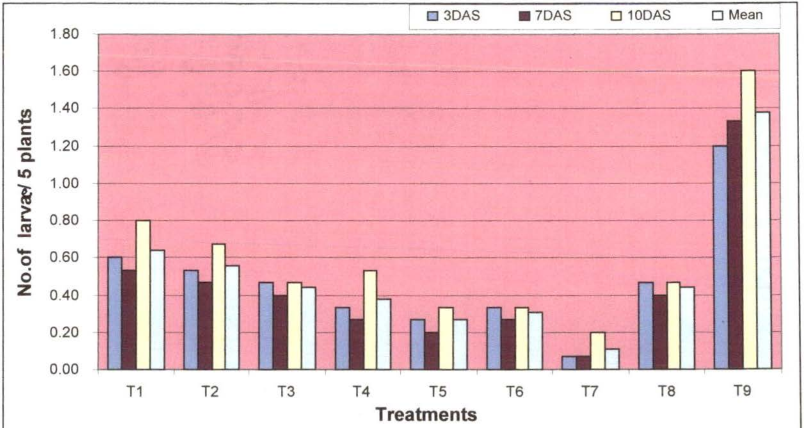

Fig.11: Effects of different insecticides on larval population of syrphid fly after first spraying

SL @ 0.007% (0.40 syrphid /5 plants), dimethoate 30 EC @ 0.03%(0.40 syrphid /5 plants), fipronil 5 SC @ 0.01%(0.27 syrphid /5 plants), difenthiuron 50 WP @ 0.06%(0.27 syrphid /5 plants) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.20 syrphid /5 plants).

4.10.3 10th DAFS

Significantly maximum population of Syrphid was observed in untreated control (1.60 syrphid /5 plants). Among the insecticidal treatment. However relatively maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.80 syrphid /5 plant), over acephate 75 SP @ 0.12 %(0.20 syrphid / plants), However, it was at par with acetamiprid 20 SP @ 0.04%(0.67 syrphid /5 plants), difenthiuron 50 WP @ 0.06%(0.53 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.47 syrphid /5 plant), dimethoate 30 EC @ 0.03%(0.47 syrphid /5 plant), lambada cyhalothrin 2.5 EC @ 0.005 %(0.33 syrphid /5 plant) and fipronil 5 SC @ 0.01%(0.33 syrphid /5 plant).

Over all efficacy by considering mean syrphid population at 3, 7 and 10 days after first spraying indicated that significantly maximum population was observed in untreated control (1.38 syrphids/5 plant). Among the insecticidal treatments significantly maximum population syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.64 syrphids /5 plants), over acephate 75 SP @ 0.12% (0.11 syrphid / 5 plants). Followed by acetamiprid 20 SP @ 0.04%(0.56 syrphid /5 plant), imidacloprid 17.8 SL @ 0.007% (0.44 syrphid /5 plant), dimethoate 30 EC @ 0.03%(0.44 syrphid /5 plant),difenthiuron 50 WP @ 0.06%(0.38 syrphid /5 plant), fipronil 5 SC @ 0.01%(0.31 syrphid /5 plant) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.27/5 plants).

4.11 Effect of different insecticides on larval population of Syrphid fly after 2nd spraying

It is revealed from the Table13 and Fig.12 that the data pertaining to the average population of Syrphid fly were significant at 3, 7, and 10 days after second spraying.

4.11.1 3rd DASS

Significantly maximum population of Syrphid was observed in untreated control (1.87 syrphid/5 plant). Among the insecticidal treatments. Significantly maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.80 syrphids/5 plants) over acephate 75 SP @ 0.12% (0.20 syrphids /5 plants). However, it was at par with acetamiprid 20 SP @ 0.04%(0.73 syrphid/5 plants), imidacloprid 17.8 SL @ 0.007% (0.60 syrphids /5 plant), difenthiuron 50 WP @ 0.06%(0.53 syrphid /5 plants), fipronil 5 SC @ 0.01%(0.47 syrphid /5plants), dimethoate 30 EC @ 0.03%(0.47 syrphid/5 plants) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.33 syrphid /5 plants).

4.11.2 7th DASS

Significantly maximum population of Syrphid was observed in untreated control (1.93 syrphid/5 plant). Among the insecticidal treatments. Significantly maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006 %(0.73 syrphid /5 plants), acephate 75 SP @ 0.12% (0.13 syrphid /5 plants). However, it was at par with rest of the insecticidal treatments. acetamiprid 20 SP @ 0.04%(0.67 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.53 syrphid /5 plants), difenthiuron 50 WP @ 0.06%(0.40 syrphid/5 plants), dimethoate 30EC @0.03%(0.40 syrphid/5 plants), fipronil 5 SC @ 0.01%(0.33 syrphid /5 plants) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.20 syrphid /5 plant).

4.11.3 10th DASS

Significantly maximum population of Syrphid was observed in untreated control (2.00 syrphids/5 plant). Among the insecticidal treatments. Significantly maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.93 syrphid /5 plants), over lambada cyhalothrin 2.5 EC @ 0.005 % (0.33 syrphid /5 plants) and acephate 75 SP@ 0.12% (0.27 Syrphid/ 5 plants). However, it was at par with acetamiprid 20 SP @ 0.04%(0.80 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.67 syrphid /5 plants), fipronil 5 SC @ 0.01%(0.53 syrphid /5 plants), dimethoate 30 EC @ 0.03%(0.53 syrphid /5 plants) and difenthiuron 50 WP @ 0.06%(0.53 syrphid /5 plants).

Table 13. Effect of different insecticides on larval population of syrphid fly after second spraying

Sr. No	Treatments	No. of syrphid /5plant					
		Conc. (%)	Precount	3DAS	7DAS	10DAS	Mean
1	Thiamethoxam 25 WG	0.006	1.07 (1.25)*	0.80 (1.14)	0.73 (1.11)	0.93 (1.19)	0.82 (1.15)
2	Acetamiprid 20 SP	0.004	1.07 (1.25)	0.73 (1.10)	0.67 (1.07)	0.80 (1.13)	0.73 (1.10)
3	Imidacloprid 17.8 SL	0.007	1.00 (1.22)	0.60 (1.05)	0.53 (1.01)	0.67 (1.08)	0.60 (1.05)
4	Difenthiuron 50 WP	0.06	0.93 (1.19)	0.53 (1.00)	0.40 (0.94)	0.53 (0.99)	0.49 (0.98)
5	Lambda cyhalothrin 2.5 EC	0.005	0.67 (1.07)	0.33 (0.91)	0.20 (0.83)	0.33 (0.89)	0.29 (0.88)
6	Fipronil 5 SC	0.01	0.87 (1.16)	0.47 (0.98)	0.33 (0.90)	0.53 (1.02)	0.44 (0.97)
7	Acephate 75 SP	0.12	0.80 (1.14)	0.20 (0.83)	0.13 (0.79)	0.27 (0.87)	0.20 (0.84)
8	Dimethoate 30 EC	0.03	0.87 (1.16)	0.47 (0.98)	0.40 (0.94)	0.53 (1.01)	0.47 (0.98)
9	Untreated control	-	1.73 (1.49)	1.87 (1.53)	1.93 (1.56)	2.00 (1.58)	1.93 (1.56)
F Test			NS	Sig	Sig	Sig	Sig
SE (m)±			0.08	0.08	0.07	0.08	0.08
CD at 5%			0.23	0.24	0.22	0.25	0.23
CV %			10.69	13.37	12.22	13.36	12.40

Figures in the parentheses are Square root (x+ 0.5) transformed value

Over all efficacy by considering mean Syrphid population at 3, 7 and 10 days after second spraying revealed that significantly maximum population was observed in untreated control (1.93 syrphid /5 plant). Among the insecticidal treatments. Significantly maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.82

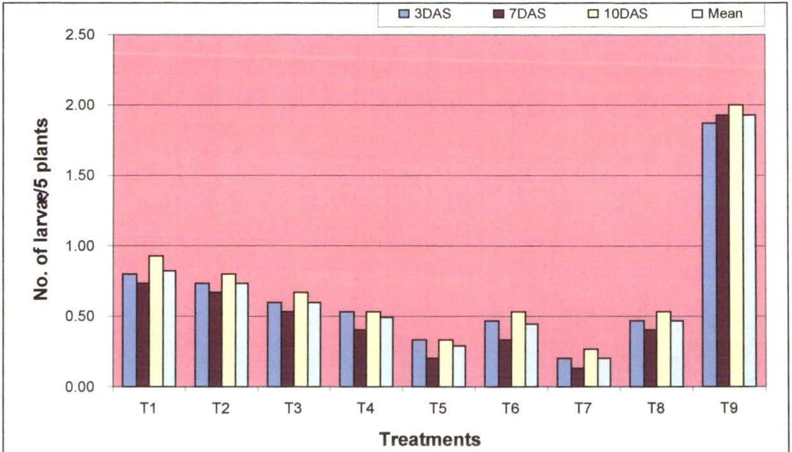

Fig.12 : Effect of different insecticides on larval population of syrphid fly after second spraying

syrphid /5 plants) over lambada cyhalothrin 2.5 EC @ 0.005 % (0.29 syrphid /5 plants) and acephate 75 SP@ 0.12% (0.20 Syrphid/ 5 plants). However it was at par with acetamiprid 20 SP @ 0.04%(0.73 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.60 syrphid /5 plants), difenthiuron 50 WP @ 0.06% (0.49 syrphid /5 plants), dimethoate 30 EC @ 0.03%(0.47 syrphid /5 plants) and fipronil 5 SC @ 0.01%(0.44 syrphid /5 plants).

4.12 Cumulative effects of different insecticides on larval population of Syrphid fly after 1st and 2nd spraying

It is revealed from the Table14 and Fig.13 that the data pertaining to the average population of Syrphid fly were significant after first and second spraying.

4.12.1 3rd DAFS & DASS

Significantly maximum population of Syrphid was observed in untreated control (1.53 syrphid/5 plant). Among the insecticidal treatments. Significantly maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.70 syrphid/5 plants) over acephate 75 SP @ 0.12 @ (0.13 syrphid/ 5 plants). However, it was at par with acetamiprid 20 SP @ 0.04%(0.63 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.53 syrphid /5 plant), dimethoate 30 EC @ 0.03%(0.47 syrphid /5 plant), difenthiuron 50 WP @ 0.06%(0.43 syrphid /5 plants) and fipronil 5 SC @ 0.01%(0.40 syrphid /5 plant), lambada cyhalothrin 2.5 EC @ 0.005 %(0.30 syrphid /5 plants).

4.12.2 7th DAFS & DASS

Significantly maximum population of Syrphid was observed in untreated control (1.63 syrphid/5 plant). Among the insecticidal treatments. Significantly maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.63 syrphid /5 plants), over lambada cyhalothrin 2.5 EC @ 0.005 % (0.20 syrphid /5 plants) and acephate 75 SP @ 0.12 % (0.10 syrphid/ 5 plant). However, it was at par with acetamiprid 20 SP @ 0.04% (0.57 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.47 syrphid /5 plants), dimethoate 30 EC @ 0.03% (0.40 syrphid /5 plants), difenthiuron 50 WP @ 0.06%(0.33 syrphid /5 plants) and fipronil 5 SC @ 0.01%(0.30 syrphid /5 plants).

Table 14.Cumulative Effects of different insecticides on larval of population of syrphid fly after first and second spraying

Sr. No	Treatments	Mean number of syrphid /5 plant					
		Conc. (%)	Precount	3DAS	7DAS	10DAS	Mean
1	Thiamethoxam 25 WG	0.006	1.00 (1.21)*	0.70 (1.09)	0.63 (1.06)	0.87 (1.17)	0.73 (1.11)
2	Acetamiprid 20 SP	0.004	1.03 (1.24)	0.63 (1.06)	0.57 (1.03)	0.73 (1.10)	0.64 (1.06)
3	Imidacloprid 17.8 SL	0.007	0.93 (1.93)	0.53 (1.01)	0.47 (0.98)	0.57 (1.03)	0.52 (1.01)
4	Diafenthiuron 50 WP	0.06	0.93 (1.20)	0.43 (0.95)	0.33 (0.90)	0.53 (1.00)	0.43 (0.95)
5	Lambda cyhalothrin 2.5 EC	0.005	0.87 (1.17)	0.30 (0.89)	0.20 (0.83)	0.33 (0.91)	0.28 (0.88)
6	Fipronil 5 SC	0.01	0.93 (1.20)	0.40 (0.94)	0.30 (0.89)	0.43 (0.96)	0.38 (0.93)
7	Acephate 75 SP	0.12	0.97 (1.21)	0.13 (0.79)	0.10 (0.77)	0.23 (0.85)	0.16 (0.81)
8	Dimethoate 30 EC	0.03	0.97 (1.21)	0.47 (0.98)	0.40 (0.95)	0.50 (0.99)	0.46 (0.97)
9	Untreated control	-	1.30 (1.34)	1.53 (1.42)	1.63 (1.46)	1.80 (1.51)	1.66 (1.46)
F Test			NS	Sig	Sig	Sig	Sig
SE (m)±			0.07	0.08	0.07	0.07	0.07
CD at 5%			0.20	0.24	0.22	0.22	0.22
CV %			9.27	13.99	13.03	11.90	12.56

Figures in the parentheses are Square root (x+ 0.5) transformed value

4.12.3 10th DAFS & DASS

Significantly maximum population of syrphid was observed in untreated control (1.80 syrphids /5 plants). Among the insecticidal treatments. Significantly maximum population of syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.87 syrphid /5 plants) over lambada cyhalothrin 2.5 EC @ 0.005 % (0.33 syrphid /5 plants) and

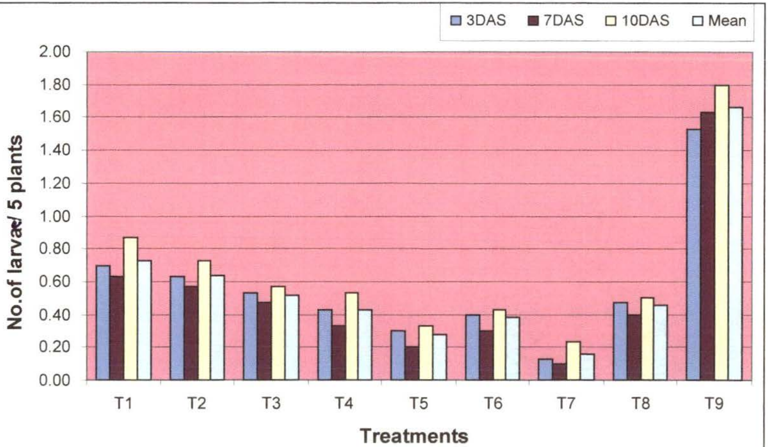

Fig.13 : Cumulative effect of different insecticides on larval population of syrphid fly after first and second spraying

acephate 75 SP @ 0.12 % (0.23 syrphid/ 5 plant) However, it was at par with acetamiprid 20 SP @ 0.04% (0.73 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.57 syrphid /5 plants), difenthiuron 50 WP @ 0.06%(0.53 syrphid /5 plants), dimethoate 30 EC @ 0.03%(0.50 syrphid /5 plants) and fipronil 5 SC @ 0.01%(0.43 syrphid /5 plants).

Over all efficacy by considering mean Syrphid population at 3, 7 and 10 days after first and second spraying indicated that significantly maximum population was observed in untreated control (1.66 syrphid /5 plant). Among the insecticidal treatments significantly maximum population of Syrphid was observed in treatment thaimethoxam 25 WG @ 0.006%(0.73 syrphid /5 plant), acetamiprid 20 SP @ 0.04%(0.64 syrphid /5 plant), imidacloprid 17.8 SL @ 0.007% (0.52 syrphid /5 plant), dimethoate 30 EC @ 0.03%(0.46 syrphid /5 plant), difenthiuron 50 WP @ 0.06%(0.43 syrphid /5 plant) and fipronil 5 SC @ 0.01%(0.38 syrphid /5 plant).

4.13 Effect of different insecticides on yield of safflower

All treatments were found significantly superior over untreated control. (Table 15). Significantly maximum yield was recorded in treatment thiamethoxam 25 WG 0.006% (1477 kg/ha) which was at par with acetamiprid 0.004% (1324 kg/ha), imidacloprid 17.8 SL 0.007% (1307 kg/ha) acephate 75 SP 0.12 % (1303 kg/ha), fipronil 5 SC 0.01% (1292 kg/ha), dimethoate 30 EC 0.03% (1286 kg/ha), lambada cyhalothrin 2.5 EC 0.005 % (1284 kg/ha) and difenthiuron 50 WP % (1282 kg/ha). Significantly minimum yield was recorded in untreated control (995 kg/ha).

4.13.1 Incremental cost benefit ratio as influenced by different treatments

The data in respect of incremental cost benefit ratio obtained due to various treatments are presented in Table 16 and illustrated in Fig 14. It is revealed that treatment with thiamethoxam 25 WG 0.006% recorded higher ICBR (1:1.87) followed by acetamiprid 20 SP 0.004% dimethoate 30 EC 0.03% (1:6.03), imidacloprid 17.8 SL 0.007% (1:5.67), lambada cyhalothrin 2.5 EC 0.005% (1:5.07), acephate 75 SP 0.12% (1:4.72), fipronil 5 SC 0.01% (1:2.50) and difenthiuron 50 WP 0.06% (1:1.56).

Table 15. Effect of different treatments on yield and ICBR of safflower

Sr.No	Treatments	Yield (kg/ha)	Net monet-ory Return (Rs/ha)	Increm-ental benefit Rs./ha	ICBR
1	Thiamethoxam 25 WG@0.006%	1477	47,669	14324	7.87
2	Acetamaprid 20SP@0.004%	1324	43,044	9699	7.47
3	Imidacloprid 17.8SL	1307	42,214	8869	5.67
4	Difenthuron 50WP@0.06%	1282	39,182	5838	1.56
5	Lambdacyhalothrin 2.5EC@0.005%	1284	41,413	8068	5.07
6	Fipronil 5SC@0.01%	1292	40,443	7098	2.50
7	Acephate 75SP@0.12%	1303	41,839	8495	4.72
8	Dimethoate 30EC@0.03%	1286	41,689	8345	6.03
9	Untreated control	995	-	-	-
'F' Test		Sig.	-	-	-
SE$\pm$ (m)		92	-	-	-
CD at 0.05%		276	-	-	-
CV%		12.41	-	-	-

Thus it can be concluded that thiamethoxam 25 WG 0.006% proved to be most economical treatment followed by acetamiprid 20 SP 0.004%.

Results of present investigation in respect of yield are in close conformity with the findings of Akashe et al. (2008) who also reported that thiamethoxam 0.005% and acetamiprid 20 SP 0.004% proved to be best by recording maximum per cent decline in aphid population and providing the highest seed yield of 1087 and 952 kg/ha respectively. The economics of treatment showed that the treatment, 0.005% thiamethoxam recorded highest B: C ratio of 1.89 followed by 0.004% acetamiprid (1.62), 0.03% dimethoate (1.52) and 0.0045% imidacloprid (1.46).

Akashe et al. (2009) reported that treatment 0.03% Dimethoate was the most effective in suppressing infestation of aphid and producing good yield (1002 kg/ha-1).

Gore et al. (2010) reported that the highest seed yield (15.55 quintal / ha) was recorded with thiamethoxam, followed by imidacloprid 17.8 SL (0.0045%), acetamiprid 20 SP (0.004%), fipronil 5 SC (0.01%), acephate 75 SP (0.03%), difenthiuron 50 WP (0.06%), and dimethoate 30 SC (0.03%).

Basavraj et al. (2012) reported that thiamethoxam 25 % WG @ 0.12g/l found be effective against safflower aphids, *Uroleucon compositae* and produce highest seed yield of 1025.1 kg/ha.

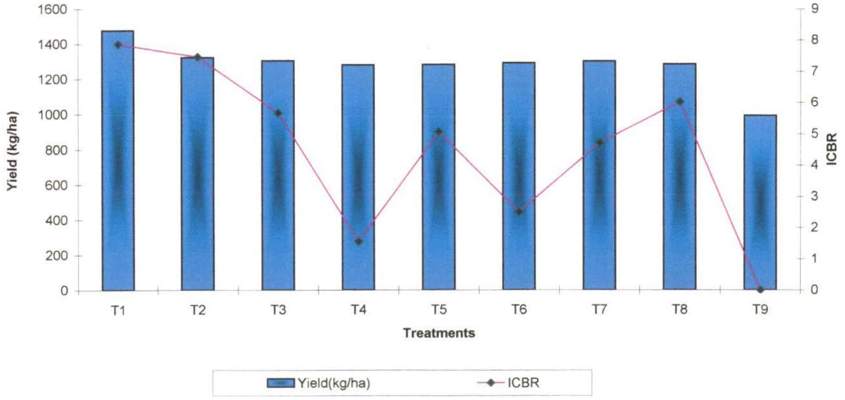

Fig.14.Effect of different treatments on yield and ICBR of safflower

Table 16. Details of economics and incremental cost benefit ratio of different treatments

Sr.No	Treatments	Quantity of insecticide require for two spraying (g)	Cost of Insecticide(Rs.)	Labour charges (Rs.) for two spraying	Spray pump charges (Rs.)	Total input cost/ha (Rs.)	Yield (kg/ha)	Yield increased over control (kg/ha)	Gross monetary Return (Rs/ha)	Net monetory Return (Rs/ha)	Incremental benefit Rs./ha	ICBR
1	Thiamethoxam 25 WG@0.006%	120+120	710	960	150	1820	1477	482	49,489	47,669	14324	7.87
2	Acetamaprid 20SP@0.004%	100+100	188	960	150	1298	1324	329	44,342	43,044	9699	7.47
3	Imidacloprid 17.8SL	126+126	454	960	150	1564	1307	312	43,778	42,214	8869	5.67
4	Difenthuron 50WP@0.06%	600+600	2640	960	150	3750	1282	287	42,932	39,182	5838	1.56
5	Lambdacyhalothrin 2.5EC@0.005%	1000+1000 ml	480	960	150	1590	1284	289	43,003	41,413	8068	5.07
6	Fipronyl 5SC@0.01%	1000+1000ml	1732	960	150	2842	1292	297	43,285	40,443	7098	2.50
7	Acephate 75SP@0.12%	800+800gm	688	960	150	1798	1303	308	43,637	41,839	8495	4.72
8	Dimethoate 30EC@0.03%	500+500ml	274	960	150	1384	1286	291	43,073	41,689	8345	6.03
9	Untreated control	--	-	-	-	-	995	-	33,345	-	-	-

- Thiamethoxam 25WG@Rs.740/250gm, Acetamiprid 20SP@Rs.940/l., Imidacloprid 17.8Sl@Rs.180/100ml, Difenthuron 50WP@Rs.2200/kg., Lambda Cyhalothrin 2.5 EC@Rs.240/lit., Fipronil 5SC@Rs.866/lit., Acephate 75WP@Rs.430/kg., Dimethoate 30EC@Rs.274/lit., Labour charges =Rs 120/labour /day, No. of labour/spray/ha=4,
- Spray pump charges@ Rs.25/pump/day and
- Market price of safflower as on 2012= Rs.3350/q

4.14 Seasonal incidence of safflower aphid on safflower

Observations on population of safflower aphid were recorded at weekly intervals starting from emergence to harvest. The summarized data is presented in the Table 17 and Fig.15

First incidence of safflower aphid was noticed in 46 MW (2 aphid/ 5 cm twig). Incidence of safflower aphid varied from 2 to 98.5 safflower aphid / 5cm twig/ plant. The highest population was recorded in 3rd MW (98.5 aphids/5 cmtwig)

Table 17: Incidence of safflower aphid in relation to weather factor during *rabi* 2012-2013

Sr. No	MW	Date of observations	Aphids/ 5 cm twig	Bioagents/plant			Weather parameters				
				LBB/pl.	Chrysopa /pl.	Syrphid fly/pl.	Temp		Relative humidity		RF (mm)
							Max.	Min.	Mor.	Eve.	
1	44	01.11.12	0	0	0	0	33.0	18.6	76	28	0.0
2	45	8.11.12	0	0	0	0	31.4	17.1	75	35	0.0
3	46	15.11.12	2	0	0	0	32.1	14.9	72	23	0.0
4	47	22.11.12	4	0	0	0	31.0	11.9	73	21	0.0
5	48	29.11.12	6	0	0	0	30.7	13.0	73	26	0.0
6	49	6.12.12	13.2	0	0	0	31.8	15.5	70	28	0.0
7	50	13.12.12	62	0.1	0	0	31.1	15.2	65	21	0.0
8	51	20.12.12	84	0.5	0.2	0.1	31.4	15.1	76	31	0.0
9	52	27.12.12	93.5	0.6	0.2	0.1	29.2	11.9	79	27	0.0
10	1	3.01.13	96.5	0.6	0.3	0.3	28.1	10.7	72	27	0.0
11	2	10.01.13	86.5	0.8	0.3	0.3	29.3	13.0	78	27	8.0
12	3	17.01.13	98.5	0.8	0.4	0.3	28.0	9.1	68	16	0.0
13	4	24.01.13	46.5	0.7	0.1	0.2	30.8	13.0	68	28	0.0
14	5	31.01.13	22.4	0.4	0.1	0	27.2	14.2	78	37	19.5
15	6	7.02.13	10.0	0.4	0.1	0	30.1	14.9	62	22	0.0
16	7	14.02.13	0.0	0.0	0.0	0	31.5	17.3	72	34	0.7
17	8	21.02.13	0.0	0.0	0.0	0.0	31.0	16.0	73	27	3.5

N.B. Pest populations are of respective meteorological week while meteorological parameters are of previous week.

4.15 Correlation between weather parameters and safflower aphid population

The data on simple correlation between weather parameters and saffloweraphid population per 5 cm twig are presented in the Table 18 & Fig.16.

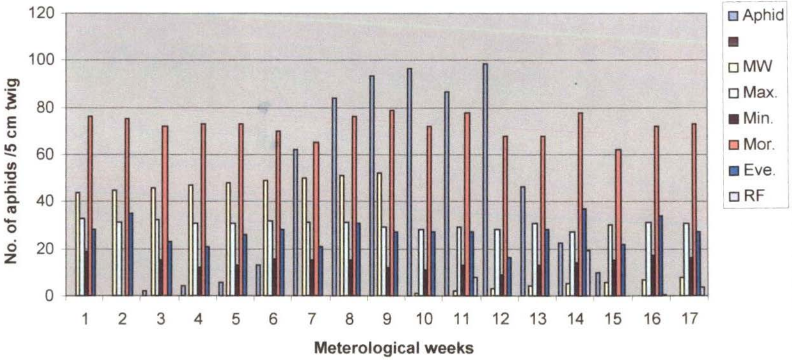

Fig.15 Incidence of safflower aphid in relation to weather factors during rabi 2012-2013

Table 18: Correlation between weather parameters and safflower aphid population

Natural enemies/pest	Rainfall (mm)	Temp. (°C) max.	Temp. (°C) min.	RHI Morning (%)	RHII Evening (%)
Aphids	-0.011	-0.586*	-0.666**	0.097	-0.253

'r' value at 1 % =0.482 '** significant at 1%
'r' value at 5% = 0.606 * significant at 5%

The results brought out significant negative correlation between number of aphid population per plant and minimum temperature (r = - 0.666**) and maximum temperature (r = - 0.586*), However correlation between aphid population and relative humidity (morning) was positively non significant. Correlation between aphid population and relative humidity (evening) and rainfall were negatively non significant.

4.16 Correlation between weather parameters and population of Natural enemies

The data on simple correlation between weather parameters and predators viz. lady bird beetle, chrysopids and syrphid population per plant are presented in the Table 19 and Fig.17, 18, 19.

Table 19: Correlation between weather parameters and population of natural enemies

Natural enemies/pest	Rainfall (mm)	Temp. (°C) max.	Temp. (°C) min.	RHI Morning (%)	RHII Evening (%)
Lady bird beetle	0.197	-0.698**	-0.668**	0.040	-0.158
Chrysopa	0.111	-0.720**	-0.720**	0.101	-0.253
Syrphid fly	-0.002	-0.573*	-0.697**	0.049	-0.252

'r' value at 1 % =0.482 '** significant at 1%
'r' value at 5% = 0.606 * significant at 5%

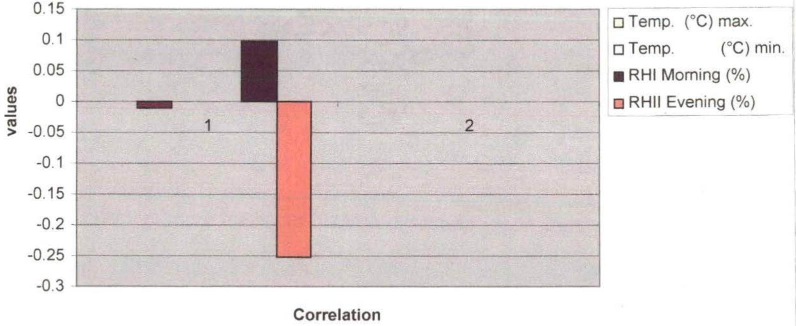

Fig.16: Correlation between weather parameters and safflower aphid population

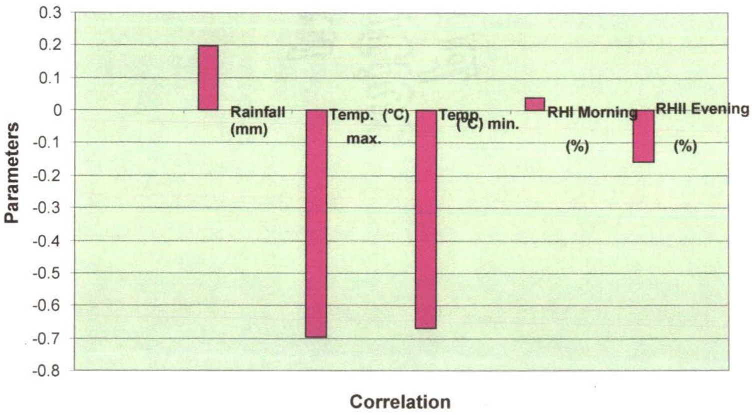

Fig.17 : Correlation between Weather paramtersand and on population lady bird beetles

The results brought out significant negative correlation between Lady Bird beetle and minimum temperature (r= -0.668**), maximum temperature (r = 0.698**). There were non-significant correlation between lady bird beetle and other weather parameters.

Significantly negative correlations were observed between chrysopids and minimum temperature (r = -720**) and maximum temperature(r = -720**).There were non significant correlations between chrysopids and rest of the weather parameters recorded.

Significantly negative correlations were observed between syrphid and minimum temperature (r = -697**) and maximum temperature (r = -573*).There were non significant correlation between population of sryphid fly and rest of the weather parameters recorded.

4.17 Correlation between population of safflower aphids and natural enemies

The simple Correlation between aphids and natural enemies viz. lady bird beetle, chrysopids and syrphid fly were worked out and presented in Table 20 and Fig.20.

Table 20 .Correlation between population of safflower aphid and natural enemies

Pest	Natural enemies		
Aphid	LBB	Chrysopa	Syrphid
	0.834**	0.873**	0.815**

'r' value at 1 % =0.482 '** significant at1%
'r' value at 5% = 0.606 * significant at 5%

Significant positive correlation between safflower aphid and lady bird beetle (r=0.834**), Chrysopa (0.873**) and Syrphid fly (0.815**) was observed during Rabi season 2012-13.

Findings of present investigation are in close conformity with those of Mane et al. (2012) who reported that incidence of safflower aphids

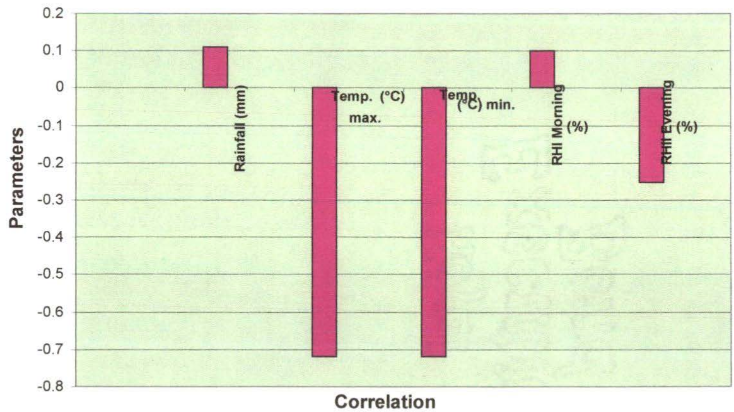

Fig. 18 : Correlation between weather parameters and population of Chrysopa

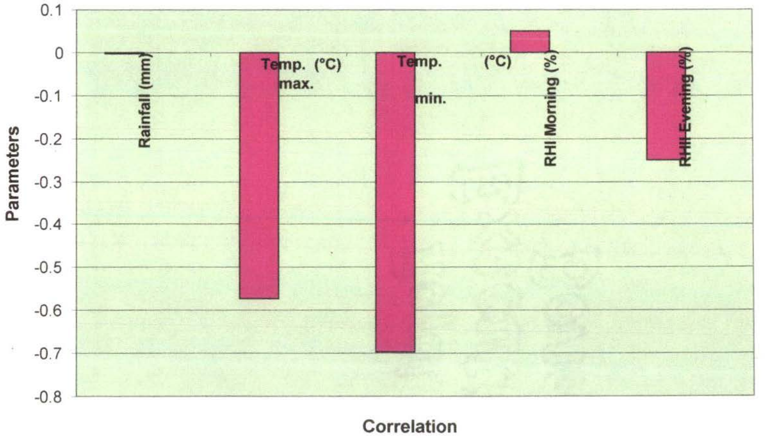

Fig.19 : Correlation between weather parameters and larval population of syrphid fly

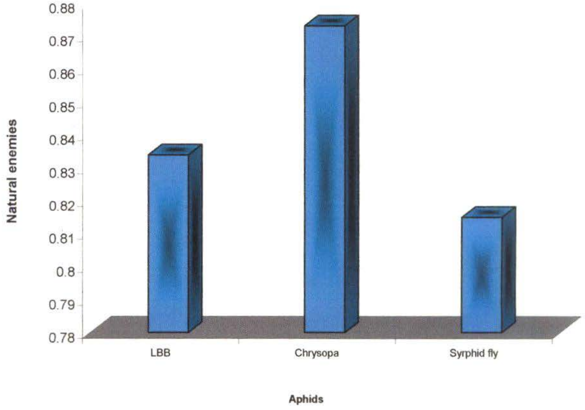

Fig.20.Correlation between population of safflower aphid and natural enemies

was initiated in 51st MW (7 aphids/5cm twig) and continuously increased up to 3rd MW (19.90 aphids/5cm twig) and there after reduced i.e. 16 aphids/5 cm twigs. They also reported negative correlation between aphid incidence and temperature. Mallapur et al (2005) also reported significantly negative correlation with maximum temperature and aphid population.

Akashe et al (1995) reported that the population of aphid build up in Solapur region of Maharashtra started at the end of October and reached a peak by January first week when maximum and minimum temperature and morning and evening relative humidity were 31.1°C, 12.9° C and 67 and 39 per cent, respectively.

Kute et al. (2005) and Upadhayay et al. (1980) also reported the peak incidence of safflower aphid during 3 MW.

Arya et al (1996) showed that a safflower crop was infested with a peak population of *U. compositae* (372 aphids/plant) in the 12 th week of crop growth, when the maximum temperature was 29.4 °C and the minimum temperature was 16.4 °C. Thereafter, the population was declined with increasing maximum temperature and decreasing minimum temperature and relative humidity.

Patil et al. (2008) reported that predatory coccinellids, *C. septempunctata* Linn. and *Menochilus sexamaculatus* Fab. and the green lace wing *Chrysoperla carnea* Stephens were observed starting from initiation of aphid infestation till its disappearance on the crop. The maximum coccinellids (0.69/plant) and chrysopids larvae (0.62/plant) were recorded at aphid peak incidence i.e on 3rd standard week or 11th week of crop growth. The mean maximum temperature and relative humidity together exerted a negative significant influence (r=0.63) and maximum temperature with all other variables dipicited negative and non-significant association in aphid population at 5 per cent. The population of coccinellids, chrysopids and aphid exhibited a negative and significant corelation (r= 0.79) and (r= 0.81) at 1 per cent level with minimum temperature. The positive and non significant impact was observed with relative humidity and rainfall whereas relative humidity had negative and non-significant association with both predators on aphids density. Coccinellids and chrysopids alone and together exerted a positive and highly significant (r=0.97) (r= 0.93) and (0.93), respectively influence on aphid population. The multiple regressions also indicated highly positive corelation between aphid population and number of coccinellids and chrysopids.

Patil et al. (2008) also reported the influence of crop phenology on population dynamics aphid *U. compositae* and its predators in safflower. Severe infestation of aphid reached during pre-flowering stage when the crop was 70 days old. Crop phenology of two months i.e 3rd standard week was crucial for survival and multiplication of safflower aphid. The temperature ranging from 13.2°C to 28.4°C. Coupled with 84.4 per cent RH proved conducive for aphid multiplication coinciding with crop reproductive stage.

Findings of present investigation are in line with the findings of above research workers.

CHAPTER V

SUMMARY AND CONCLUSSION

Investigations on "Evaluation of newer insecticides against safflower aphid *Uroleucon compositae* Theobald" were undertaken during *Rabi* season of 2012-13 on the field of Oilseeds Research unit Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The trial comprised nine treatments replicated thrice in Randomized Block Design (RBD).

The different treatments consisting of spray application with thiamethoxam 25 WG 0.006%, acetamiprid 20 SP 0.004, imidacloprid 17.8 SL 0.007, difenthiuron 50 WP 0.6%, lambada cyhalothrin 2.5 SC 0.005, fipronil 5 SC 0.01%, acephate 75 SP 0.12% and dimethoate 30 EC 0.03% along with untreated control.

First and second sprays were undertaken at 40 DAE and 55 DAE respectively. Observations were recorded on nimber of aphid/5 cm apical twig/plant on randomly selected 5 plants/plot at one day before spraying and 3 DAS, 7 DAS and 10 DAS days after spraying. Seasonal incidence of safflower aphid was recorded and correlated with weather parameters. The population of natural enemies viz. lady bird beetle, chrysopa and syrphid fly was also recorded simultaneously. Yield was recorded per plot and transformed into kg per hectare. The data so obtained were subjected to statistical analysis after suitable transformation. The ICBR was also worked out. The results thus obtained are summarized below.

The overall efficacy of different insecticides against aphids after first and second spraying are summarized below.

5.1 Cumulative effect of different insecticides on population of safflower aphid after 1st and 2nd spraying

3rd DAFS & DASS

All treatments were found to be significantly superior over untreated control. Significantly lowest population of safflower aphid was observed in thiamethoxam 25 WG @ 0.006% (1.23 aphids/5 cm apical twig/ plant) which was found statistically at par with acetamiprid 20 SP @ 0.04%(1.53 aphids /5 cm apical twig/ plant) and imidacloprid 17.8 SL @ 0.007%(2.23 aphids /5 cm apical twig/ plant)

The next effective treatment was acephate 75 SP @ 0.12 % followed by dimethoate 30 EC @ 0.03%, difenthiuron 50 WP @ 0.06%, which were statistically at par with each other.

7th DAFS & DASS

All treatments found significantly superior over untreated control. Significantly lowest population of safflower aphid was observed in thaimethoxam 25 WG @ 0.006% (2.10 aphids/5 cm apical twig/ plant) which was found statistically at par with acetamiprid 20 SP @ 0.004%(2.33 aphids /5 cm apical twig/ plant), imidacloprid 17.8 SL @ 0.007% (3.50 aphids/5 cm apical twig/ plant) and acephate 75 SP @ 0.12% (4.23 aphids/5 cm apical twig/ plant).

The next effective treatments were dimethoate 30 EC@ 0.03 %, difenthiuron 50 WP @ 0.06%, fipronil 5 SC @ 0.01% and lambada cyhalothrin 2.5 EC @ 0.005% which were found statistically at par with each other recording 5.80, 7.27, 8.10 and 8.47 aphids per 5 cm apical twig per plant, respectively. Significantly maximum population of safflower aphid was recorded in untreated control (52.63 aphids/5 cm apical twig/plant)

10th DAFS & DASS

Significantly lowest population of safflower aphid was observed in thiamethoxam 25 WG @ 0.006% (7.00 aphids/5 cm apical twig/ plant) which was statistically at par with acetamiprid 20 SP @ 0.004 %(8.10 aphids/5 cm apical twig/ plant). The next effective treatment was imidacloprid 17.8 SL @ 0.007% (10.03 aphids /5 cm apical twig/plant), acephate @ 0.12 %(11.83 aphids/5 cm apical twig/plant).

Other effective treatments were dimethoate 30 EC @ 0.03% (14.57 aphids/5 cm apical twig/plant), difenthiuron 50 WP @ 0.06 %(15.77 aphids/5 cm apical twig/ plant), fipronil 5 SC @ 0.01 % (17.06 aphids/5 cm apical twig/ plant) and lambada cyhalothrin 2.5 EC @ 0.005 % 18.43 aphids/5 cm apical twig/ plant) which were statistically at par with each other. However significantly maximum population of safflower aphid was recorded in untreated control (60.00 aphids/5 cm apical twig/plant).

5.2 Cumulative effect of different insecticides on population of Lady Bird beetle after 1st and 2nd spraying

3rd DAFS & DASS

Significantly maximum population of lady bird beetle was observed in untreated control (2.00 LBB/5 plant). Among the insecticidal treatments. However significantly maximum population of lady bird beetle was observed in thiamethoxam 25 WG @ 0.006% (0.83 LBB/5 plant) over acephate75 SP @ 0.12% (0.20 LBB/5 plant). However, it was at par with rest of the insecticidal treatments.

7th DAFS & DASS

Significantly maximum population of lady bird beetle was observed in untreated control (2.10 LBB/ 5 plant). Among the insecticidal treatments. However significantly maximum population of lady bird beetle was observed in thiamethoxam 25 WG @ 0.006% (0.87 LBB/5 plant), over acephate75 SP @ 0.12% (0.20 LBB/5 plant). However, it was at par with rest of the insecticidal treatments.

10th DAFS & DASS

Significantly maximum population of lady bird beetle was observed in untreated control (2.20 LBB/5 plant). Among the insecticidal treatments. However significantly maximum population of lady bird beetle was observed in thiamethoxam 25 WG @ 0.006% (1.17 LBB/5 plant), over acephate 75 SP @ 0.12% (0.73 LBB/5 plant) and difenthiuron 50 WP@ 0.06% (0.42 LBB/ 5 plants). However, it was at par rest of the insecticidal treatments.

Over all efficacy by considering mean lady bird beetle population at 3, 7 and 10 days after first and second spraying indicated that significantly maximum population was observed in untreated control (2.10 LBB/5 plant). Among the insecticidal treatments.Significantly maximum population of lady bird beetle was observed in treatment thiamethoxam 25 WG @ 0.006% (0.96 LBB/5 plant), over acephate 75 SP @ 0.12% (0.26 LBB/5 plant). However it was at par with rest of the insecticidal treatments.

10th DAFS & DASS

Significantly maximum population of lady bird beetle was observed in untreated control (2.20 LBB/5 plant). Among the insecticidal treatments. However significantly maximum population of lady bird beetle was observed in thiamethoxam 25 WG @ 0.006% (1.17 LBB/5 plant), over acephate 75 SP @ 0.12% (0.73 LBB/5 plant) and difenthiuron 50 WP@ 0.06% (0.42 LBB/ 5 plants). However, it was at par rest of the insecticidal treatments.

Over all efficacy by considering mean lady bird beetle population at 3, 7 and 10 days after first and second spraying indicated that significantly maximum population was observed in untreated control (2.10 LBB/5 plant). Among the insecticidal treatments.Significantly maximum population of lady bird beetle was observed in treatment thiamethoxam 25 WG @ 0.006% (0.96 LBB/5 plant) over acephate 75 SP @ 0.12% (0.26 LBB/5 plant). However it was at par with rest of insecticidal treatments.

5.3 Cumulative effect of different insecticides on population of Chrysopa after 1st and 2nd spraying

3rd DAFS & DASS

Significantly maximum population of Chrysopids was observed in untreated control (1.53 chrysopa/5 plants). Among the insecticidal treatments. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006% (0.90 chrysopa/5 plants) over acephate 75 SP @ 0.12 %(0.27 chrysopa/5 plants). However, it was at par with rest of the insecticidal treatments.

7th DAFS & DASS

Significantly maximum population of Chrysopids was observed in untreated control (1.60 chrysopa/5 plant). Among the insecticidal treatment. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006% (0.83 chrysopa/5 plant), over acephate 75 SP @ 0.12 %(0.17 chrysopa/5 plant). However, it was at par with rest of the insecticidal treatments.

10th DAFS & DASS

Significantly maximum population of Chrysopids was observed in untreated control (1.77 chrysopa/5 plant). Among the insecticidal treatment. Significantly maximum population of Chrysopa was observed in treatment thiamethoxam 25 WG @ 0.006% (1.00 chrysopa/5 plants), over acephate 75 SP @ 0.12 % (0.27 chrysopa/5 plants). However, it was at par with imidacloprid 17.8 SL @ 0.007% (0.87 chrysopa /5 plants), acetamiprid 20 SP @ 0.04% (0.77 chrysopa/5 plants), dimethoate 30 EC @ 0.03%(0.67 chrysopa/5 plants), difenthiuron 50 WP @ 0.06%(0.57 chrysopa/5 plants), fipronil 5 SC @ 0.01%(0.57 chrysopa/5 plants) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.47 chrysopa/5 plants)

Over all efficacy by considering mean Chrysopids population at 3, 7 and 10 days after first and second spraying, indicated that significantly maximum population was observed in untreated control (1.63 chrysopa/5 plants). Among the insecticidal treatment. Significantly maximum population of Chrysopa was observed in treatment thaimethoxam 25 WG @ 0.006 %(0.91 chrysopa/5 plants) over acephate 75 SP @ 0.12% %(0.23 chrysopa/ plants). However, it was at par with imidacloprid 17.8 SL @ 0.007% (0.80 chrysopa/5 plants), acetamiprid 20 SP @ 0.04%(0.72 chrysopa/5 plants), dimethoate 30

EC @ 0.03%(0.59 chrysopa/5 plant), fipronil 5 SC @ 0.01%(0.56 chrysopa /5 plants), difenthiuron 50 WP @ 0.06%(0.52 chrysopa/5plants) and lambada cyhalothrin 2.5 EC @ 0.005 %(0.42 chrysopa /5 plants).

5.4 Cumulative effects of different insecticides on population of Syrphid fly after 1st and 2nd spraying

3rd DAFS & DASS

Significantly maximum population of Syrphid was observed in untreated control (1.53 syrphid/5 plant). Among the insecticidal treatments. Significantly maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.70 syrphid/5 plants) over acephate 75 SP @ 0.12 @ (0.13 syrphid/ 5 plants). However, it was at par with acetamiprid 20 SP @ 0.04%(0.63 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.53 syrphid /5 plant), dimethoate 30 EC @ 0.03%(0.47 syrphid /5 plant), difenthiuron 50 WP @ 0.06%(0.43 syrphid /5 plants) and fipronil 5 SC @ 0.01%(0.40 syrphid /5 plant), lambada cyhalothrin 2.5 EC @ 0.005 %(0.30 syrphid /5 plants).

7th DAFS & DASS

Significantly maximum population of Syrphid was observed in untreated control (1.63 syrphid/5 plant). Among the insecticidal treatments. Significantly maximum population of Syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.63 syrphid /5 plants), over lambada cyhalothrin 2.5 EC @ 0.005 % (0.20 syrphid /5 plants) and acephate 75 SP @ 0.12 % (0.10 syrphid/ 5 plant). However, it was at par with acetamiprid 20 SP @ 0.04% (0.57 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.47 syrphid /5 plants), dimethoate 30 EC @ 0.03% (0.40 syrphid /5 plants), difenthiuron 50 WP @ 0.06%(0.33 syrphid /5 plants) and fipronil 5 SC @ 0.01%(0.30 syrphid /5 plants).

10th DAFS & DASS

Significantly maximum population of syrphid was observed in untreated control (1.80 syrphids /5 plants). Among the insecticidal treatments. Significantly maximum population of syrphid was observed in treatment thiamethoxam 25 WG @ 0.006% (0.87 syrphid /5 plants) over lambada cyhalothrin 2.5 EC @ 0.005 % (0.33 syrphid /5 plants) and acephate 75 SP @ 0.12 % (0.23 syrphid/ 5 plant) However, it was at par with acetamiprid 20 SP @ 0.04% (0.73 syrphid /5 plants), imidacloprid 17.8 SL @ 0.007% (0.57 syrphid /5 plants), difenthiuron 50 WP @ 0.06%(0.53 syrphid /5 plants), dimethoate 30 EC @ 0.03%(0.50 syrphid /5 plants) and fipronil 5 SC @ 0.01%(0.43 syrphid /5 plants).

Over all efficacy by considering mean Syrphid population at 3, 7 and 10 days after first and second spraying indicated that significantly maximum population was observed in untreated control (1.66 syrphid /5 plant). Among the insecticidal treatments significantly maximum population of Syrphid was observed in treatment thaimethoxam 25 WG @ 0.006%(0.73 syrphid /5 plant), acetamiprid 20 SP @ 0.04%(0.64 syrphid /5 plant), imidacloprid 17.8 SL @ 0.007% (0.52 syrphid /5 plant), dimethoate 30 EC @ 0.03%(0.46 syrphid /5 plant), difenthiuron 50 WP @ 0.06%(0.43 syrphid /5 plant) and fipronil 5 SC @ 0.01%(0.38 syrphid /5 plant).

5.5 Effect of different treatment on yield and ICBR

The data in respect of incremental cost benefit ratio obtained due to various treatments. It is revealed that treatment with thiamethoxam 25 WG 0.006% recorded higher ICBR (1:1.87) followed by acetamiprid 20 SP 0.004% with dimethoate 30 EC 0.03% (1:6.03), imidacloprid 17.8 SL 0.007% (1:5.67), lambada cyhalothrin 2.5 EC 0.005% (1:5.07), acephate 75 SP 0.12% (1:4.72), fipronil 5 SC 0.01% (1:2.50) and difenthiuron 50 WP 0.06% (1:1.56).

Thus it can be concluded that thiamethoxam 25 WG 0.006% proved to be most economical treatment followed by acetamiprid 20 SP 0.004%.

5.6 Seasonal incidence of aphid, *Uroleucon compositae* Theobald on safflower and population of their predators in relation to weather parameters

Observations on population of safflower aphid were recorded at weekly intervals starting from emergence to harvest. The summarized data is presented in the Table 17 and Fig.15

First incidence of safflower aphid was noticed in 46 MW (2 aphid/ 5 cm twig). Incidence of safflower aphid varied from 2 to 98.5 safflower aphid / 5cm twig/ plant. The highest population was recorded in 3rd MW (98.5 aphids/5 cmtwig)

5.6.1 Incidence of aphid

First incidence of safflower aphid was noticed in 46 MW (2 aphid/ 5 cm twig). Incidence of safflower aphid varied from 2 to 98.5 safflower aphid / 5cm twig. Significantly higher population was recorded in 3 MW (98.5 aphid plot) which favoured by temperature ranged from 9.10 °C to 28°C and relative humidity 16 % (morning) to 68 % (evening) RH and no rainfall.

5.6.2 Correlation between weather parameters and safflower aphid population

The results brought out significant negative correlation between number of aphid population per plant and minimum temperature ($r = -0.666^{**}$) and maximum temperature ($r = -0.586^{*}$), However correlation between aphid population and relative humidity (morning) was positively non significant. Correlation between aphid population and relative humidity (evening) and rainfall were negatively non significant.

5.6.3 Correlation between weather parameters and population of natural enemies

The results brought out significant negative correlation between Lady Bird beetle and minimum temperature (r= -0.668**), maximum temperature (r = 0.698**). There were non-significant correlation between lady bird beetle and other weather parameters.

Significantly negative correlations were observed between chrysopids and minimum temperature (r = -720**) and maximum temperature(r = -720**).There were non significant correlations between chrysopids and rest of the weather parameters recorded.

Significantly negative correlations were observed between syrphid and minimum temperature (r = -697**) and maximum temperature (r = -573*).There were non significant correlation between population of sryphid fly and rest of the weather parameters recorded.

5.6.4 Correlation between population of safflower aphid and natural enemies

Significant positive correlation between safflower aphid and lady bird beetle (r=0.834**), Chrysopa (0.873**) and Syrphid fly (0.815**) was observed during *rabi* season 2012-13.

Conclusions

1. Two sprays of thiamethoxam 25 WG 0.006% or acetamiprid 20 SP 0.004% or imidacloprid 17.8 SL0.007% at 40 and 55 DAE were found to be effective for management safflower aphid, *U. compositae* Theobald.
2. Thiamethoxam 25 WG 0.006% and acetamiprid 20 SP 0.004% were found to be relatively safer against predators of safflower aphid.
3. Maximum safflower yield was recorded due to the treatment thiamethoxam 25 WG 0.006% (1477 kg/ha) followed by acetamiprid 20 SP 0.004 %(1324 kg/ha), imidacloprid 17.8 SL 0.007% (1307 kg/ha) and dimethoate 30 EC 0.03% (1286 kg/ha).
4. Maximum ICBR was obtained due to treatment thiamethoxam 25 WG 0.006% (1:7.87), followed by acetamiprid 20 SP 0.004% (1:7.47),

dimethoate 30 EC 0.03% (1:6.03) and imidacloprid 17.8 SL 0.007% (1:5.67).

5. Incidence of aphid was initiated in 46 MW and it attained its Peak in 3 MW, Maximum incidence of aphid was observed during 50 MW to 3 MW (84 to 98.5 aphids per 5 cm twig). There was negatively significant correlation between number of aphid population and minimum temperature (r = - 0.666**) and maximum temperature (r = - 0.586*).

Thiamethoxam 25 WG 0.006% was found to be effective, safer and economical treatment in management of safflower aphid followed by acetamiprid 20 SP 0.004% and imidacloprid 17.8 SL 0.007%.

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CHAPTER VI

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(Jagatp Rahul Krushnarao)

APPENDIX I

Weekly weather Data for the Year 2012 recorded at Agromet. Observatory, Dr. PDKV, Akola

Weeks	Dates	T MAX (°C)		T MIN (°C)		BSH (hrs)		WS (km/hr)		RH I (%)		RH II (%)		Evap (mm)		RF (mm)		CRF (mm)	Rainy Days	
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A		N	A
26	25-1Jul	33.8	37.71	24.3	26.44	4.8	6.6	12.8	12.35	80	71.28	55	36.85	7.4	12.51	43.4	20.6	20.6	2.2	1.0
27	2-8	33.2	30.71	24.0	23.91	4.8	2.2	12.0	5.81	81	90	58	72.28	6.5	4.05	39.4	101	121.6	2.2	5.0
28	9-15	32.3	31.84	23.8	24.6	3.8	3.95	11.2	7.44	83	86.57	60	57	5.5	5.31	42.8	20.3	141.9	2.5	3.0
29	16-22	31.9	33.08	23.6	24.95	4.0	2.62	10.4	8.85	84	80.85	63	58.28	5.2	5.77	52.8	46.1	188	2.4	4.0
30	23-29	31.3	26.71	23.3	23.18	4.0	0.0	10.8	9.12	86	87	64	82.85	4.8	2.55	43.4	91.1	279.1	2.6	5.0
31	30-5 Aug	30.9	28.04	23.3	23.01	3.5	0.15	10.6	8.04	86	84.4	67	77	4.6	2.97	49.6	30.1	308.1	2.4	4.0
32	6-12	29.9	28.12	23.0	23.35	3.2	1.02	10.9	9.32	88	89.85	70	80	4.1	4.05	61.0	15.9	324	2.8	2.0
33	13-19	30.4	28.67	23.0	23	4.0	1.15	12.4	5.6	87	90.14	67	75.85	4.5	3.64	35.9	18.4	342.4	2.0	2.0
34	20-26	30.4	29.12	22.8	23.02	4.1	3.35	11.9	4.91	87	93.85	67	71.57	4.3	3.91	42.5	25.8	368.2	1.9	3.0
35	27-2 Sep	30.5	30.9	22.7	23.61	4.2	3.52	9.3	2.08	87	94.14	66	68.71	4.6	3.68	42.4	44.9	413	2.1	3.0
36	3-9	31.0	30.07	22.5	23.44	5.3	4.28	8.6	5.5	87	88.57	62	67.71	5.3	4.47	33.6	93.8	506.9	1.5	5.0
37	10-16	32.1	30.22	22.4	22.92	6.6	5.0	8.0	4.24	85	84.71	57	61	5.1	3.91	22.0	10.4	517.3	1.1	2.0
38	17-23	32.9	31.67	22.4	23.02	6.8	4.98	6.4	2.5	84	86.42	55	54.28	5.2	4.21	23.7	23.8	541.1	1.4	1.0
39	24-30	33.5	32.5	22.1	22.6	7.3	7.05	5.1	1.18	84	84.85	50	45.42	5.0	4.05	24.4	9.3	550.4	1.4	2.0
40	1-7 Oct	33.7	33.05	21.2	22.54	7.6	7.65	4.8	2.6	82	87.71	47	48.27	5.4	5.07	23.4	40.9	591.3	1.1	2.0
41	8-14	34.0	33.57	19.8	16.2	8.1	7.65	4.5	0.3	78	84.57	40	32.57	5.3	4.71	13.1	1.5	592.8	0.7	0.0
42	15-21	33.7	34.05	18.3	17.62	8.2	7.07	4.6	1.22	76	78.42	37	24.14	5.3	5.57	6.1	0.0	592.8	0.4	0.0
43	22-28	33.1	32.95	16.8	18.58	8.3	4.78	4.4	1.02	74	76.14	34	28.28	5.3	5.57	7.6	0.0	592.8	0.4	0.0
44	29-4 Nov	32.7	31.38	16.0	14.37	8.4	4.97	4.1	1.72	73	75.42	32	35.42	5.3	5.07	2.3	0.0	592.8	0.2	0.0
45	5-11	32.3	32.05	15.2	14.82	8.4	7.65	3.9	1.28	71	72.42	32	23.14	5.1	5.21	3.0	0.0	592.8	0.2	0.0
46	12-18	31.6	31.02	14.6	11.94	8.3	7.57	3.9	1.18	73	73	32	21.14	4.8	4.5	5.3	0.0	592.8	0.2	0.0
47	19-25	31.0	30.65	13.3	13.02	8.4	7.58	3.7	1.25	72	72.85	30	26.25	4.6	3.97	7.7	0.0	592.8	0.3	0.0
48	26-2 Dec	30.5	31.82	12.8	15.52	8.4	6.95	3.6	1.24	71	74	32	28	4.4	3.94	5.5	0.0	592.8	0.3	0.0
49	3-9	30.0	31.11	11.9	15.08	8.4	7.54	3.8	1.22	71	64.57	30	21.42	4.3	4.54	1.0	0.0	592.8	0.1	0.0
50	10-16	29.6	31.42	10.9	15.08	8.4	7.47	3.6	0.8	71	75.85	28	26	4.2	3.72	0.8	0.0	592.8	0.1	0.0
51	17-23	29.5	29.24	10.8	11.88	8.5	7.07	3.8	1.02	70	78.71	29	27.14	4.1	4.14	0.9	0.0	592.8	0.1	0.0
52	24-31	29.1	28.12	10.65	12.17	8.3	8.23	4.5	0.81	71	71.87	30	27.25	4.2	3.97	2.8	0.0	592.8	0.2	0.0
											Total RF June to Dec					636.2	592.8	592.8	34.2	44