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Survey on insect pest complex and bioefficacy of certain insecticide molecules against aphids, *Myzus persicae* (Sulz.) on capsicum under poly house conditions

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ABSTRACT: Surveys conducted in Telangana and Andhra Pradesh states during 2013-14 on insect pests of capsicum revealed that population levels of insect pests and per cent damage were higher in open field conditions, moderate in shade net conditions and lowest in poly house condition. Bioefficacy of seven insecticides viz., spinosad @ 125 ml ha^{-1}, flubendiamide @ 200 ml ha^{-1}, chlorantraniliprole @ 200 ml ha^{-1}, Diafenthiuron 25 WP @ 750 g ha^{-1}, spiromesifen @ 750 ml ha^{-1}, thiamethoxam @150 g ha^{-1} and triazophos @ 1250 ml ha^{-1} along with untreated check were evaluated against the aphid, *Myzus persicae* (Sulz.) during 2013-14 and 2014-15 under poly house conditions. Mean aphid population in pre count ranged from 2.48 to 9.90 and post count population was less with thiamethoxam (1.02 aphids/leaf) followed by diafenthiuron (1.24 aphids/leaf) which were at par with each other and significant superior over other treatments and untreated check (11.38 aphids/leaf). The descending order (based on population) of efficacy with the other treatments was chlorantraniliprole (5.05 aphids/leaf) >flubendiamide (6.28 aphids/leaf) >spinosad (6.46 aphids/leaf) >spiromesifen (6.91 aphids/leaf) >triazophos (7.38 aphids/leaf) were significantly superior over untreated check. Leaf curl index was in order of its efficacy of insecticides.

Keywords: Capsicum, aphids, thiamethoxam,diafenthiuron

INTRODUCTION

Capsicum (*Capsicum annuum* L. var. grossum Sendt.) is also called as bell pepper or sweet pepper and is one of the most popular and highly remunerative annual herbaceous vegetable crop. It is different from chilli (*Capsicum annuum* L. var. longum) in size and shape of the fruits, capsanthin content and usage and belongs to the family Solanaceae. It is known by other names such as shimlamirch and green pepper. Capsicum is cultivated in most parts of the world, especially in temperate regions of Central and South America and European countries, tropical and subtropical regions of Asian continent mainly in India and China.

In India, capsicum is included under non-traditional category of vegetables and mainly cultivated during *rabi* and *kharif* seasons in Jharkand, Karnataka, Maharashtra, Tamil Nadu and extensively cultivated in hills of Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir and Nilgiri hills during summer months. Capsicum cultivation is in limited scale in Kerala, Telangana,Andhra Pradesh, Maharastra, West Bengal, Gujarat and Goa (Hand Book of Horticultural Statistics, 2014). In India, it is cultivated in an area of 30,000 ha with production of 1.71 lakh tons (National Horticultural Board, 2014-15). Jharkand is the major capsicum cultivating state with an area of 1,960 ha and production of 0.2 lakh tons followed by Karnataka, Himachal Pradesh and Jammu and Kashmir (Directorate of Areca nut and Spices Development Board, 2014). In Telangana, in and around Hyderabad, Rangareddy, Medak districts and in Andhra Pradesh, Guntur, Chittur, Ananthapoor are the major capsicum cultivating districts. In India, 26°-28° C day and 16°-18° C night temperatures are ideal for capsicum cultivation under open field conditions. Under poly house conditions, cultivation of capsicum gives early and prolonged yield compared to open field cultivation (Singh *et al.*, 2004). Various biotic (pest and diseases), abiotic (rainfall, temperature, relative humidity and light intensity) and phenological factors (flower and fruit drop) limits

the yield and fruit quality of capsicum (Hebbar *et al.*, 2011). Among the biotic factors, insect pests reduces the quality of produce and even a small blemish on the fruit will drastically reduce its market value. Butani (1976) reported over 20 insect species on chillies (*Capsicum* spp.) from India of which aphid, *Myzus persicae* (Sulz.) is a important pest in poly house and cause 20 to 30 per cent yield loss through transmission of chilli mosaic virus (Reddy and Kumar, 2006b).In Andhra Pradesh and Telangana states there was no report on incidence of insect pest on capsicum and effective insecticide to manage the aphids under poly house conditions. Hence the present experiments were carried out.

MATERIALS AND METHODS

Survey on insect pests of capsicum: The fixed plot survey on the occurrence of major insect pests of capsicum was conducted in open field and poly house conditions in Telangana and roving survey in Guntur district of Andhra Pradesh during 2013 - 14. Data on insect population (mean population per leaf (sucking pests) and per cent damage per plant (non sucking pests) and per cent damage was recorded at fortnight interval from one week after transplanting (September Ist FN) to the harvest of the crop (February IInd FN) from three villages in Chevella, one village in Vikarabad, one village in Shabadmandals of Ranga Reddy of Telangana, in which capsicum is cultivated under poly house conditions. In all these five villages, a total of nine poly houses were surveyed. Four villages in Shamshabad mandal were surveyed, in which capsicum is cultivated under open field conditions. In Andhra Pradesh, in nine villages viz., Nadendla,Yedlapadu, Thimmapuram, Chilakaluripeta, Sathuluru villages in Chilakaluripeta mandal, Sathenapalli, Thubadu villages of Sathenapalli mandal and Narakoduru of Tenalimandal, respectively the survey was conducted. In Guntur district, capsicum is cultivated under shade net conditions and data on insect population and per cent damage was recorded in each location at three crop stages., viz., nursery, vegetative and reproductive stages of the crop. A questionnaire was used to collect the data scientifically for statistical analysis. The pooled data was analyzed by using simple statistical tools like mean and standard deviation (SD).

Bioefficacy of insecticides: The poly house studies (2013 - 14 and 2014 - 15) were conducted at Horticulture Garden, Department of Horticulture, College of Agriculture, Professor Jayashankar Telangana State Agricultural University (PJTSAU), Rajendranagar, Hyderabad. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments including untreated control were replicated three times. Crop was raised by recommended package of practices of Indian Institute of Horticultural Research (IIHR), Bengaluru. Different groups of chemicals were selected as treatments and the dosages were applied as foliar sprays The first spray was applied when the aphid population reached economic threshhold levels (ETL) (aphids - 2 no./leaf) (Kumar *et al.*, 2007)and second spray was given at 7 days after first spray. A total of three sprays were applied during the entire experimentation in both the years of study.

Observations on aphid populations were recorded in ten randomly tagged plants, from five terminal leaves (2 from top, 2 from middle and 1 from bottom) per plant. Pre count (1 day before spray) and post count (1,3,5 and 7 days after spray) of the aphids was recorded by using destructive sampling procedure. Per cent reduction over control was calculated by using the following formula (Flemming and Retnakaran, 1985).

$$\text{Percent population reduction} = 1 - \frac{\text{Post treatment population in treatment}}{\text{Pre treatment population in treatment}} \times \frac{\text{Pre treatment population in untreated control}}{\text{Post treatment population in untreated control}} \times 100$$

Table 1. Scoring procedure for aphid damage

Score	Symptom
0	No symptoms
1	1-25% leaves/plant showing curling
2	25-50% leaves/plant showing curling, moderately damaged
3	51-75% leaves/plant showing curling, heavely damaged, malformation of growing points and reduction in plant height
4	>76% leaves/plant showing curling,severe and complete destruction of growing points, drastic reduction in plant height, defoliation and severe malformation

Pre count (1 DBS) and post count (mean of 1,3,5 and 7 DAS) population and per cent reduction over control were calculated after each spray. Cumulative mean of three sprays in 2013-14 and 2014-15 under poly house conditions and pooled mean of two years are represented in tables and discussed. Leaf Curl Index (LCI) was recorded one day before and 10 days after each spray following the methodology of Kumar *et al.*, (1996) (Table 1. and Fig. 1.).

RESULTS AND DISCUSSION

Survey on Insect pests of capsicum: Telangana: The cumulative means of insect population and damage caused by the pests under four open fields and nine poly house conditions are discussed here under. (Table 2). During the crop season of 2013-14, the mean population of thrips (no./leaf) ranged from 9.60±0.47 to 12.24±1.20 and for mites 5.94±0.79 to 10.64±2.34, respectively. The per cent damage per plant caused by cut worm, blossom midge and fruit borer ranged from 2.12±0.78 to 5.33±0.56, 2.75±0.49 to 9.26±3.19 and 5.26±0.91 to 17.8±3.89, respectively under open field conditions. In poly house the mean population of thrips, mites, aphids and whiteflies ranged from 1.87±0.66 to 4.99±1.75, 1.10 ±0.65 to 4.56±1.42, 0.68±0.77 to 2.94±2.06 and 0.05±0.3 to 1.13±0.45, respectively. The per cent damage per plant caused by cut worm ranged from 1.01±0.70 to 4.04±0.98,blossom midge,0.66±0.59 to 4.05±1.53 and fruit borer, 1.03±0.59 to 5.42±0.8181, respectively during crop season (Table 2).

The incidence of thrips and mites recorded under open field conditions in the present survey is in line with the findings of Manjunatha *et al.*, (2001) who observed that maximum thrips count ranged from zero to 7.80 per leaf while yellow mite counts ranged from zero to 20.40 per leaf. Reddy and Kumar (2005) and Reddy and Kumar (2006a) also reported chilli thrips, *S. dorsalis,* and mite, *P. latus* as serious pests of capsicum under open field conditions.Similar reports by Kumar *et al.*, (2007) Sunitha *et al.*, (2007) Manyam and Byadgi (2013), Shah *et al.*, (2013) and Kumar and Gupta (2014). All the above findings confirm the present reports on thrips and mite incidence under open field conditions in Telangana.

The present survey conducted on the incidence of cut worm under open field conditions are in line with findings of Sunitha *et al.*, (2007) who made fixed plot survey in and around Dharwad and Belgaum, Karnataka and reported the occurrence of cutworm, *A. ipsilon* (30 to 40%) on capsicum under open field conditions. Nandini *et al.*, (2010) reported incidence up to 15 DAT from Dharwad.

Survey reports on the incidence of blossom midge on capsicum under open field conditions were not available, but Basavaraj and Sreenivas (2014) conducted roving survey in Karnataka and reported the extent of fruit damage in chilli which ranged from 3.57 to 25.50 per cent.

Fruit borer was observed damaging the fruits of capsicum during reproductive stage causing maximum per cent damage of 17.8±3.89 in all the four open fields during the survey period. Sunitha *et al.*, (2007) also reported 20.68 per cent fruit damage at reproductive stage of capsicum in the open field conditions by fruit borer. The present findings are also in line with the observations made by Nandini *et al.*, (2010) who reported up to 12.50 per cent damage caused by *S. litura*.

The over all observations recorded on the pest incidence in capsicum under poly house conditions are in line with the findings of Sumit *et al.*, (2013) who reported the incidence of *T. vaporariorum*, *M. persicae*, *S. litura*, *H. armigera* and *S. dorsalis* in 82 poly houses of Himachal Pradesh. The present survey carried out on fruit borer is in agreement with the findings of Vos and Frinkling (1998), Wood *et al.*, (1987), Sunitha *et al.*, (2007) and Nandini *et al.*, (2010) who recorded 20.00, 20.68, 26.16 and 20.00 per cent damage, respectively by fruit borer on sweet pepper under protected conditions.

During the survey carried out in Telangana on capsicum pests under poly house cultivation revealed that in addition to thrips and mites, aphids and whiteflies were found to damage the capsicum.

Comparison of population levels in open field and poly house conditions in Telangana revealed that higher population levels of sucking pests were recorded in open field conditions than in poly house. Similar observations were reported by Krishna Kumar (1995) and Kumar *et al.*, (1996) who stated that the thrips damage was higher in open field conditions (1.52-1.92) as compared to protected cultivation (0.63-0.72). Reddy and Kumar (2006b) also reported that aphid transmitted viral diseases were more prevalent in open field (48.57%) than green house (13.78%).

Andhra Pradesh: Roving survey in the Guntur district of Andhra Pradesh revealed that, at farmers level

Table 2. Population and damage levels of insect pests under open field, poly house and shade net conditions of Telangana and Andhra Pradesh

Name of the Insect Pest	Telangana				Andhra Pradesh					
					Shade					
	Open Field		Poly House		Seedling Stage		Vegetative Stage		Reproductive stage	
	Mean±SD		Mean±SD		Mean±SD		Mean±SD		Mean±SD	
	Lower limit$	Upper limit$	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit
Thrips*	9.60±0.47	12.24±1.2	1.87±0.66	4.99±1.75	1.25±0.47	2.71±0.59	2.06±-0.07	5.29±-0.41	0.19±0.15	0.76±0.15
Mites *	5.94±0.79	10.64±2.34	1.10±0.65	4.56±1.42	0.00	0.00	0.70±0.33	3.71±0.75	0.00	0.00
Aphids *	0.00	0.00	0.68±0.77	2.94±2.06	0.56±0.49	1.89±0.77	0.59±-0.45	2.23±-0.26	0.66±0.04	0.70±3.06
Whiteflies*	0.00	0.00	0.05±0.30	1.13±0.45	1.24±0.19	2.36±0.23	1.23±-0.33	2.78±-0.50	0.00	0.00
Cut worm#	2.12±0.78	5.33±0.56	1.01±0.70	4.04±0.98	1.35±0.22	2.91±0.53	0.00	0.00	0.00	0.00
Blossom midge #	2.75±0.49	9.26±3.19	0.66±0.59	4.05±1.53	0.00	0.00	0.00	0.00	1.14±0.54	2.32±0.34
Fruit Borer #	5.26±0.91	17.8±3.89	1.03±0.59	5.42±0.81	0.00	0.00	0.00	0.00	2.58±0.44	9.21±2.05

*Mean population per leaf/plant, # Per cent damage per plant. $ Lower and upper limit of insect pest population.

Score-1

Score-2

Score-3

Score-4

Fig. 1. Leaf curl index (LCI) for aphids, *M. persicae* on capsicum

capsicum cultivation was done under shade net conditions only and there was no cultivation of capsicum in open field and poly house conditions. High day temperatures observed in the Guntur district, were not ideal for capsicum cultivation under open field conditions. The observations recorded in survey are presented and discussed here unde. At seedling stage, thrips, *S. dorsalis,* aphids, *M. persicae,* whitefly, *B. tabaci* and cut worm, *A. ipsilon* incidence was recorded, whereas, at vegetative stage,thrips, *S. dorsalis,* mite, *P. latus*, aphids, *M. persicae,* whiteflies, *B. tabaci* were observed. At reproductive stage, thrips, *S. dorsalis,* mite, *P.latus*, blossom midge, *A. capsici* and fruit borer, *S. litura* incidence was recorded. The cumulative means of pest population and incidence recorded undernine shade nets are discussed here under (Table 2). At seedling stage, the mean population (no./leaf) of thrips, aphids and whiteflies ranged from 1.25±0.47 to 2.71±0.59, 0.56±0.49 to 1.89±0.77 and 1.24±0.19 to 2.36±0.23, respectively. There was no incidence of mite, *P. latus* at seedling stage in all the shade nets surveyed in Guntur district. Mean per cent damage caused by cut worm, *A. ipsilon* ranged from 1.35±0.22 to and 2.91±0.53. There was no incidence of blossom midge, *A. capsici* and fruit borer, *S. litura* at seedling stage. At vegetative stage, mean population (no./leaf) of thrips, *S. dorsalis* ranged from 2.06±0.07 to 5.29±0.41, where as, for other pests viz., mite, *P. latus*0.70±0.33 to 3.71±0.75, aphids, *M. persicae* 0.59±0.45 to 2.23±0.26, whiteflies, *B. tabaci* 1.23±0.33 to 2.78±0.50, respectively. No incidence of cut worm, *A. ipsilon,* blossom midge, *A. capsici* and fruitborer, *S. litura* were observed at vegetative stage was reported. At reproductive stage, mean population (no. of/leaf) of

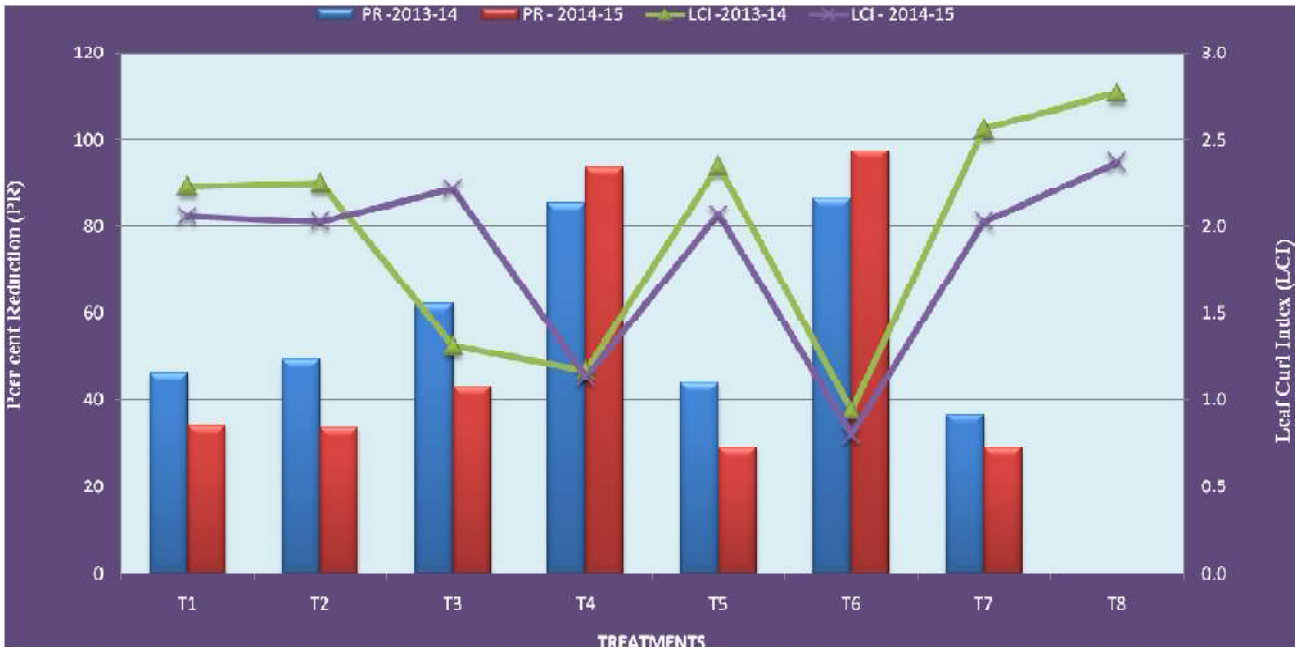

Fig. 2. Bioefficacy of insecticides against aphids, *Myzus persicae* (Sulz.) under poly house condition

thrips, *S. dorsalis* ranged from 0.19±0.15 to 0.76±0.15, whereas for aphids, *M. persicae* 0.66±0.04 to 0.36±0.70, blossom midge, *A. capsici* 1.14±0.54 to 2.32±0.34 and fruit borer, *S. litura* 2.58±0.44 to 9.21±2.05 were reported. No incidence of mite, *P. latus,* whitefly, *B. tabaci*, cut worm, *A. ipsilon* was reported at reproductive stage. (Table-2)

Survey carried out at seedling stage of capsicum under shade net conditions at Guntur district revealed that the sucking pests, thrips, *S. dorsalis,* aphids, *M. persicae*, whitefly, *B. tabaci* were major sucking pests and cut worm, *A. ipsilon* were damaging the capsicum. Similar observations were reported by Reddy and Puttaswamy (1984), Sunitha *et al*., (2007), Sunitha *et al*., (2007), Reddy and Puttaswamy (1984) and Sunitha *et al.,* (2007).

Comparison of the population levels of insect pests in three locations, *i.e* open, poly and shade net conditions, indicated that moderate population levels were recorded under shade net condition when compared to the population observed in the open and poly house conditions. As partial shade is maintained in the shade nets, where as, under poly house conditions controlled atmosphere is maintained and under open field, direct exposure to weather conditions and fluctuation in temperature and humidity favours the build-up of insect population.

Bioefficacy of insecticides against aphids

The results with regard to the pooled mean of three sprays showed significant difference between the tested insecticides in pre count and post count aphid population (Table 3). Mean no. of aphids per leaf in pre count ranged from 3.32 to 12.36 while the post count varied from 1.86 to 14.16. Among the various insecticides tested against aphids, thiamethoxam (1.86 aphids/leaf) was most effective and was at par with diafenthiuron (2.03 aphids/leaf). Both the insecticides were significantly superior over other treatment by recording lowest aphid population and highest per cent reduction (86.57% and 85.46%) over untreated check. Next best treatment was chlorantraniliprole (5.17 aphids/leaf, 62.11%) which was on par with flubendiamide (6.93 aphids/leaf, 49.42%). Spinosad (7.31 aphids/leaf, 46.30%), spiromesifen (7.76 aphids/leaf, 43.78%) and triazophos (8.69 aphids/leaf, 36.65%) and were significantly superior over untreated check with respect to per cent reduction of aphid population. The insecticidal application exhibited significant effect in lowering the intensity of leaf curl index (LCI) (leaf curling and crinkling) caused by *M. persicae*.

Mean of the three sprays revealed that, LCI (1.34) at one DBS significantly reduced to 0.94 at 10 DAS in thiamethoxam treated plants. It was followed by diafenthiuron (1.52 to 1.17) and chlorantraniliprole (1.63

Table 3. Cumulative efficacy of certain insecticide molecules against aphid, *M. persicae* on capsicum under poly house conditions during 2013-14 and 2014-15.

Tr. No.	Treatments	Dose (g or ml.ha^{-1})	2013-14 Mean of three sprays# Pre count (1 DBS)*	2013-14 Post count (1,3,5,7 DAS mean)*	2013-14 Per cent Reduction$^{\$}$	2014-15 Mean of three sprays# Per cent (1 DBS)*	2014-15 Post count (1,3,5,7 DAS mean)*	2014-15 Per cent Reduction$^{\$}$	Mean of 2013-14 and 2014-15 Per cent (1 DBS)*	Mean of 2013-14 and 2014-15 Post count (1,3,5,7 DAS mean)*	Mean of 2013-14 and 2014-15 Per cent Reduction$^{\$}$
T_1	Spinosad 45 SC	125 ml	6.44 (2.72)bcd	7.31 (2.88)b	46.30 (42.86)c	5.37 (2.52)a	5.60 (2.56)a	34.09 (35.70)d	5.91 (2.62)abc	6.46 (2.73)b	40.20 (39.33)bc
T_2	Flubendiamide 480 SC	200 ml	7.05 (2.83)bc	6.93 (2.81)b	49.42 (44.65)bc	5.38 (2.52)a	5.63 (2.57)a	33.71 (35.47)d	6.22 (2.68)abc	6.28 (2.69)b	41.57 (40.13)bc
T_3	Chlorantraniliprole 20 SC	200 ml	5.64 (2.57)bcd	5.17 (2.48)b	62.11 (51.98)b	4.85 (2.41)a	4.92 (2.43)a	43.03 (40.97)c	5.25 (2.50)abc	5.05 (2.46)b	52.57 (46.45)b
T_4	Diafenthiuron 25 WP	750 g	3.69 (2.16)cd	2.03 (1.74)c	85.46 (67.55)a	1.87 (1.69)b	0.45 (1.20)b	93.73 (75.46)b	2.78 (1.94)bc	1.24 (1.49)c	89.60 (71.15)a
T_5	Spiromesifen 22.9 SL	750 ml	7.40 (2.89)ab	7.76 (2.96)b	43.78 (41.41)c	5.71 (2.59)a	6.06 (2.65)a	28.99 (32.56)d	6.56 (2.75)ab	6.91 (2.81)ab	36.39 (37.08)c
T_6	Thiamethoxam 25 WG	150 g	3.32 (2.07)d	1.86 (1.69)c	86.57 (68.47)a	1.63 (1.62)b	0.17 (1.08)b	97.63 (81.11)a	2.48 (1.86)c	1.02 (1.42)c	92.10 (73.64)a
T_7	Triazophos 40 EC	1250 ml	7.91 (2.98)ab	8.69 (3.11)b	36.65 (36.70)c	5.69 (2.58)a	6.07 (2.65)a	28.86 (32.25)d	6.80 (2.79)a	7.38 (2.89)ab	32.76 (34.12)c
T_8	Untreated check	—-	12.36 (3.56)a	14.16 (3.81)a	0.00d	7.44 (2.80)a	8.59 (2.98)a	0.00e	9.90 (3.16)abc	11.38 (3.44)a	0.00d
		SEm±	0.20	0.18	2.52	0.18	0.21	4.00	0.23	0.18	2.62
		CD (P=0.05)	0.62	0.58	7.73	0.56	0.64	1.30	0.70	0.55	8.02
		CV (%)	12.93	12.20	9.89	13.70	15.07	15.43	15.76	12.51	10.62

No. of aphids/leaf, mean of five leaves per plant, ten plants per replication, three replications per treatment.

* Figure in the parenthesis are square root transformed values. $^{\$}$ Figure in the parenthesis are Arc-sin transformed values.

DBS : Days Before Spray., DAS : Days After Spray., NS : Non significant., DOS :Istspray: 11-1-2014: IInd Spray:17-1-2014: IIIrd spray: 21-1-2014.,

DMRT : Means followed by a common letter are not significantly different (P= 0.05)

Table 4. Leaf curl index (LCI) Score caused by aphids, *M. persicae* on capsicum under poly house conditions during 2013-14 and 2014-15

Treatment		2013-14		2014-15		Pooled	
		1 DBS	10 DAS	1 DBS	10 DAS	1 DBS	10 DAS
T_1	Spinosad 45 SC	2.18 (1.78)*	2.23 (1.79)abc	1.96 (1.72)	2.06 (1.74)ab	2.07 (1.75)	2.15 (1.77)ab
T_2	Flubendiamide 480 SC	2.19 (1.78)	2.25 (1.80)abc	1.99 (1.72)	2.03 (1.74)ab	2.09 (1.75)	2.14 (1.77)ab
T_3	Chlorantraniliprole 20 SC	1.63 (1.62)	1.31 (1.52)abc	1.92 (1.70)	2.22 (1.79)a	1.78 (1.66)	1.77 (1.66)ab
T_4	Diafenthiuron 25 WP	1.52 (1.58)	1.17 (1.47)bc	1.63 (1.62)	1.13 (1.45)ab	1.58 (1.60)	1.15 (1.46)ab
T_5	Spiromesifen 22.9 SL	2.22 (1.79)	2.35 (1.83)ab	1.97 (1.72)	2.07 (1.75)ab	2.10 (1.76)	2.21 (1.79)a
T_6	Thiamethoxam 25 WG	1.34 (1.53)	0.94 (1.39)c	1.53 (1.59)	0.80 (1.34)b	1.44 (1.56)	0.87 (1.36)b
T_7	Triazophos 40 EC	2.42 (1.84)	2.56 (1.88)ab	1.99 (1.72)	2.03 (1.74)ab	2.21 (1.79)	2.30 (1.81)a
T_8	Untreated check	2.50 (1.81)	2.77 (1.89)a	2.23 (1.73)	2.37 (1.77)a	2.37 (1.77)	2.57 (1.83)a
SEm+	0.26	0.53	0.36	1.08	0.22	0.62	
CD	NS	1.58	NS	3.89	NS	1.88	
CV %	13.14	12.53	10.36	11.08	12.08	13.65	

* Figure in the parenthesis are square root transformed values.

DMRT: Means followed by a common letter are not significantly different (P= 0.05)

DBS: Day Before Spray., DAS: Days After Spray., NS: Non significant

to 1.31), whereas LCI significantly increased from 1DAS to 10 DAS in flubendiamide (2.19 to 2.25), spinosad (2.18 to 2.23), spiromesifen (2.22 to 2.35) and triazophos (2.42 to2.56) and untreated check (2.50 to 2.77) (Table 3 and Fig.1).

The results with regard to the pooled mean of three sprays showed significant difference between the tested insecticides in pre count and post count observations (Table 3). Mean no. of aphids per leaf in pre count ranged from 1.63 to 7.44, while the post count varied from 0.17 to 8.59. Among the insecticides tested against aphids, thiamethoxam was found to be most effective and significantly superior over other treatments except diafenthiuron by recording lowest aphid population (0.17 aphids/leaf) and highest per cent reduction (97.63%) over all other treatments. Diafenthiuron (0.45 aphids /leaf and 93.73%), chlorantraniliprole (4.92 aphids/leaf and 43.03%) were significantly superior over other insecticides and untreated check in reducing the aphid population. Flubendiamide (5.63 aphids/leaf and 33.71%), spinosad (5.60 aphids/leaf and34.09%), spiromesifen (6.06 aphids/leafand 28.99%) and triazophos (6.07 aphids/leaf and 28.86%), respectively, were significantly superior over untreated check (8.59 aphids/leaf and 0.00%) (Fig. 2).

Mean of the three sprays revealed that, LCI (1.53) at one DBS significantly reduced to 0.80 at 10 DAS in thiamethoxam treated plants.It was followed by

diafenthiuron (1.63 to 1.13), whereas LCI significantly increased from 1 DAS to 10 DAS in chlorantraniliprole (1.92 to 2.22), flubendiamide (1.99 to 2.03), spinosad (1.96 to 2.06), spiromesifen (1.97 to 2.07) and triazophos (1.99 to 2.03) and untreated check (2.23 to 2.37) (Table 4 and fig.1).

Pooled mean of 2013-14 and 2014-15: The results with regards to overall cumulative mean efficacy of the treatments against aphids, *M. persicae* during the two years under poly house conditions are presented in Table 3. Mean aphid population in pre count ranged from 2.48 to 9.90 and post count population was less with thiamethoxam (1.02 aphids/leaf) followed by diafenthiuron (1.24 aphids/leaf) which were at par with each other and significant superior over other treatments and untreated check (11.38 aphids/leaf). The descending order (based on population) of efficacy with the other treatments was chlorantraniliprole (5.05 aphids/leaf) >flubendiamide (6.28 aphids/leaf) >spinosad (6.46 aphids/ leaf) >spiromesifen (6.91 aphids/leaf) >triazophos (7.38 aphids/leaf) were significantly superior over untreated check.

The percent reduction over untreated check in the order of efficacy of insecticides *i.e.* the highest per cent reduction of aphid population was recorded in thiamethoxam (92.10%) followed by diafenthiuron (89.60%) which were at par with each other and significantly superior over rest of the treatments and untreated check. The descending order of efficacy with the other treatments was chlorantraniliprole (52.57%) >flubendiamide (41.57%) >spinosad (40.20%) >spiromesifen (36.39%) >triazophos (32.76%), respectively and were significantly superior over untreated check (Fig. 2).

The mean of two years revealed that LCI at one DBS (1.44) was significantly reduced to 0.87 in thiamethoxam treated plants which was followed by diafenthiuron (1.58 to 1.15), chlorantraniliprole (1.78 to 1.77). Where as, significant increase in LCI from one DBS to 10 DAS was in spinosad (2.07 to 2.15) flubendiamide (2.09 to 2.14), spiromesifen (2.10 to 2.21), triazophos (2.21 to 2.57) and untreated check (2.37 to 2.57) (Table 4 and Fig 1).

From the results, it is observed that thiamethoxam and diafenthiuron were found to be effective in reducing aphid population. The present findings are in line with Smriti *et al.*, (2015) who evaluated the bio-efficacy of insecticides against aphid on capsicum in protected cultivation. Among, the flonicamid 50WG @ 150 and 200 g ha^{-1}, and thiamethoxam 25 WG @ 75 and 100 g ha^{-1}, lowest no. of aphids (0.17 aphids/ten plants) were recorded with thiamethoxam than flonicamid (3.33 aphids/ ten plants). The literature on bioefficacy of thiomethoxam and diafenthiuron against aphids was scanty.

The whole experiment is concluded as Capsicum cultivation in Telangana is taken up under open field and poly house conditions. Whereas in Guntur district of Andhra Pradesh it is taken up under shade net conditions. Population levels of insect pests are higher in open field conditions, moderate in shade net conditions and lowest in poly house condition of capsicum cultivation. Among the insecticides tested against aphids in 2013-14 and 2014-15 under poly house conditions, highest per cent reduction of aphid population was recorded with thiamethoxam 25 WG 150 g ha^{-1} and diafenthiuron 25 WP @ 750 g ha^{-1}. These insecticides can include in IPM of capsicum to manage the aphids under poly house conditions.

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