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Bio efficacy of some insecticides and acaricides against different insect and non-insect pests of chilli and their effect on natural enemies in chilli ecosystem

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Abstract
Bioefficacy of some new insecticides and acaricides against different insect and non-insect pests of chilli were carried out in the present study during 2016 at District Seed Farm (AB Block) of Bidhan Chandra Krishi Viswavidyalaya located at Kalyani, Nadia, West Bengal. Highest reduction of jassid population was noticed from the treatments Imidacloprid 17.8% SL @ 50 a.i. g/ha and The lowest percent reduction was observed in the plots treated with Chlorpyriphos 20% EC @ 200 a.i. g/ha @ 200 a.i. g/ha followed by Fipronil 5% SC @ 50 a.i. g/ha. Maximum reduction of aphid (88.58%) was recorded from Imidacloprid 17.8% SL @ 50 g a.i./ha and Chlorpyriphos 20% EC @ 200 a.i. g/ha and fipronil 5% SC @ 50 a.i. g/ha are comparatively less effective against aphid recorded 66.49% and 67.44% reduction respectively at one day after spraying. Highest reduction of thrips was noticed from the treatments Imidacloprid 17.8% SL @ 50 a.i. g/ha and the lowest percent reduction was observed in the plots treated with Chlorpyriphos 20% EC @ 200 a.i. g/ha followed by Fipronil 5% SC @ 50 a.i. g/ha. In acaricidal management The mean of the first spray revealed that the plots treated with Pataka-a combinition product of Profenophos 40.00%+Cypermethrin4.00% showed lowest no of mites i.e (2.60/three leaves), followed by Fosmite (2.76/three leaves) and in 2nd spray the results on mean population of mites revealed that the least population was obtained by treating the plots with Pataka-a combination product of Profenofos 40.00% and Cypermethrin 4.00%, followed by Ethion followed by Kaka-a bio acaricide with mite population as (2.68/three leaves),(2.80/three leaves)and (3.31/three leaves) respectively with all the treatments to be significantly at par with control(7.51/three leaves).The observations were recorded 10 days after each spray and mean population was worked out for overall comparison. After ten days of application, lowest numbers of coccinellids mean population (0.88 per plant) was recorded in the plot treated with Profenophos 50% EC @ 750 a.i. g/ha and maximum number of populations was observed in the treatment imidacloprid @ 25 a.i. g/ha (1.54 per plant) as well as untreated plot (1.89 per plant).

Keywords: Chilli, mite, thrips, aphids, jassids, acaricides, insecticides, management

Introduction
Chilli (*Capsicum annuum* L.) is an important spice crop as well as vegetable crop grown all over India. In India, chilli is cultivated in an area of 7.67 lakh hectares and the production is estimated at 12.34 lakh tones. India is the largest producer of dry chillies and peppers in the world (Anonymous 2012) [1]. Among the different insect pests of chilli, aphid (*Aphis gossypii* Glov.), whitefly (*Bemisia tabaci* Genn.), thrips (*Scirtothrips dorsalis* Hood) mite (*Polyphagotarsonemus latus* Banks), and jassid (*Amrasca bigutula bigutula*.), were most important to cause substantial damage to chilli plant. Chilli leaf curl complex is one of the most destructive syndrome affecting chilli in India and is considered to be caused by thrip, mites and virus. Thrips cause necrosis of tissues by extracting contents from the epidermal cells. Both nymphs and adults suck the sap from tender crop canopy, resulting in shriveling of leaves, Heavy infestation of chilli thrips causes “chilli leaf curl” also called “Murda disease”. Whitefly damages the plants in three ways- firstly by causing chlorosis, leaf withering, premature leaf fall and wilting, secondly by excreting honey dew, which leads to development of sooty mould thus reducing the effective leaf area for photosynthesis, third and the most important one is the transmission of chilli leaf curl virus which accounts for major yield losses. The aphids and jassids can accumulate in high densities on young tender parts of the plants and suck the sap especially from the underside of the young leaves. Feeding damage of chilli mite also causes terminal leaves and flower buds to become cupped and distorted. So the present investigation is oriented towards development of an appropriate management strategy for management of the important pests of Chilli.

The bioefficacy of different insecticides and acaricides conducted against the insect pests helps use to find out an effective management strategy against the insect pests. A suitable management strategy should be directed in such a way that it should be safer to natural enemies as well as should focus on higher yield of the crop.

Material and Methods

Location

The experiment was conducted at the District Seed Farm (A-B Block) of Bidhan Chandra Krishi Viswavidyalaya located at Kalyani, Nadia, West Bengal in experimental field during the year 2016-2017. The geographical details of the site are 23° N latitude, 89° E longitude and 9.75 meter above mean sea level (MSL).

Soil

The soil of the experimental field was typically gangetic alluvial soil (Entisol) having sandy clay loam texture with good drainage facility, neutral in reaction and moderate in fertility

Lay out of the experiment

The experiment was conducted in a Randomized Block Design (RBD) with 3 replications and 8 treatments.

Planting materials

For the experiment, chilli cultivar named-Bullet (*Capsicum annum* var. *annum* L.; Family- Solanaceae) was considered which is a very common cultivar used by the farmers of West Bengal. Bullet Chillies are well known due to their bullet like shape and size, these are a Jalapeno type popular in Indian cuisine for the hot, light and fresh flavor.

Statistical Analysis

The count data of insects before spraying and after spraying with different formulations of insecticides had been used to work out the corrected per cent mortality due to Henderson and Tilton (1955).

$$\text{Percent reduction} = [1 - (T_a \times C_b)/ (T_b \times C_a)] \times 100$$

Where

T_a = Population in treated plants after treatment
C_b = Population in treated plants before treatment
T_b = Population in control plots after treatment
C_a = Population in control plots before treatment

The corrected per cent mortality data of insects on chilli was taken at different dates after spraying with different formulations of pesticides and it was then transformed using angular transformation value. Once the transformation had been made, the transformed data then subjected for RBD analysis and testing for the significance of treatment was made. DMRT [Duncan Multiple Range Comparision] test was done to compare the means. Similar alphabet was used to designate the homogeneous means groups.

Methodology

The present experiment was conducted at "AB" Block Farm (Seed Farm) of Bidhan Chandra Krishi Vishwavidyalaya, Kalyani, Nadia, West Bengal ($22^0$58‘52‖ N; $88^0$26‘30‖E, 10 m above sea level) during the period of 2015-16 crop season to evaluate the bio-efficacy of Imidacloprid 17.8% SL, Chlorpyriphos 20%EC,Profenofos 50%EC and Fipronil 5%SC against the pests of chilli, jassid (*Amrasca biguttula biguttula*), aphid (*Myzus persicae*) and thrips (*Scirtothrips dorsalis*). Three round spraying were done during the crop season by using 500 litres of spray solution per hectare with high volume knapsack sprayer. The data of target pests were recorded from randomly selected five plants in each plot. Observations of total number of jassid, aphid and thrips were recorded from five top young leaves of each plant per plot. First count was taken one day before first spray and post treatment counts were recorded on 1, 3, 7 and 14 days after each spray. Different species of natural enemies like coccinellid beetle, predatory mite and spider were found and hence their pre-count and post count (10 DAS) population was recorded

To study the bioefficacy of acaricides the present experiment was laid in a randomized block design (RBD) in plot size of 3.5 x 3.0 m with 3 replications and 8 treatments. Two round sprays was applied at 15 days interval. Bioefficacy of Chlorfenapyr 10% SC, Ethion 50% EC, Bio Eon, Pataka (profenopho40% + cypermethrin 4%), Perfect Plus and Kaka were tested against chilli mite. For recording data on mite population, 3 leaves from each of the 5 plants was considered in each plot.The leaves were taken to laboratory by wrapping within closed mouth polypropylene packets stored in an ice box.A four sq cm block made of iron wire was used and it was placed on three different spots randomly on the ventral surface of the representative leaf and then the population was counted under stereo zoom binocular microscope. Periodic observation of insects and mite population after 1,3,7,11,14 days of each spray was recorded.

Results and Discussion

Bio efficacy of insecticides

Efficacy against chilli jassid

Among the different pests attacked the chilli crop, jassid was one of the most dominating and damaging pests recorded during the period of investigation. One day before spray jassid population ranged from 4.66 to 5.67 per 3 leaves and it was statistically non significant showing equal distribution (Table-3). Highest reduction of jassid population was noticed from the treatments Imidacloprid 17.8% SL @ 50 a.i. g/ha. No statistical variation was observed on percent reduction of jassid at 1, 3, 7 and 14 days after spray for both the treatments of Imidacloprid 17.8% SL @ 50 a.i. g/ha and 37.5 a.i. g/ha and recorded maximum reduction of 82.01% and 81.59% respectively at 3 days after spray. The treatment Imidacloprid 17.8% SL @ 25 a.i. g/ha was rendering satisfactory result. Similar trend of percent reduction of jassid was observed at 1, 7 and 14 days after spray as well as second and third round of spray. The lowest percent reduction was observed in the plots treated with Chlorpyriphos 20% EC @ 200 a.i. g/ha @ 200 a.i. g/ha followed by Fipronil 5% SC @ 50 a.i. g/ha.

Efficacy against Chilli aphid

Chilli aphid is considered to be the most notorious pest causing extensive damage throughout the year. It is very difficult to manage due to its capacity of rapid multiplication. The pre-count population of aphid was ranging from 8.23 to 9.67 per leaf which was statistically non-significant and observed a uniform distribution (Table-4). Efficacy of imidacloprid 17.8% SL was noticed after spraying at three different doses *viz*. 25 g, 37.5 g and 50 g a.i. /ha. Maximum reduction of aphid (88.58%) was recorded from Imidacloprid 17.8% SL @ 50 g a.i./ha which was statistically at par with Imidacloprid 17.8% SL @ 37.5 g a.i./ha 85.01% at 1 day after

spray. Similarly no statistical variation was observed on percent reduction of aphid at 3, 7 and 14 days after spray for both the treatments of Imidacloprid 17.8% SL @ 50 a.i. g/ha and 37.5 a.i. g/ha. The treatment Imidacloprid 17.8% SL @ 25 a.i. g/ha was rendering satisfactory result. Chlorpyriphos 20% EC @ 200 a.i. g/ha @ 200 a.i. g/ha and fipronil 5% SC @ 50 a.i. g/ha are comparatively less effective against aphid recorded 66.49% and 67.44% reduction respectively at one day after spraying. Similar trend of result has been found at 3, 7 and 14 days after spraying as well as second and third round of spray. The results were confirmed by Kumar *et al.*, (2001) [3] and Nayak *et al.*, (2014) [4].

Efficacy against chilli thrips

Among the different pests attacked the chilli crop, thrips was the most dominating and damaging pest recorded during the period of investigation. One day before spray thrips population ranged from 10.67 to 11.51 per leaf and it was statistically non-significant showing equal distribution (Table-5). Highest reduction of thrips was noticed from the treatments Imidacloprid 17.8% SL @ 50 a.i. g/ha. No statistical variation was observed on percent reduction of thrips at 1, 3. 7 and 14 days after spray for both the treatments of Imidacloprid 17.8% SL @ 50 a.i. g/ha and 37.5 a.i. g/ha and recorded maximum reduction of 96.13% and 94.96% respectively at one day after spray. The treatment Imidacloprid 17.8% SL @ 25 a.i. g/ha was rendering satisfactory result. Similar trend of per cent reduction of thrips was observed at 3, 7 and 14 days after spray as well as second and third round of spray. The lowest percent reduction was observed in the plots treated with Chlorpyriphos 20% EC @ 200 a.i. g/ha followed by Fipronil 5% SC @ 50 a.i. g/ha. The results were confirmed by Patel *et al*., (2009) and Nayak *et al. (*2014) [4].

Effect on natural enemies

The chilli crop was observed to harbor coccinellid beetle and spider as natural enemies. Result shows that the population of natural enemies in treatments comprising of imidacloprid were more or less similar to that of untreated control plot. Before spray predatory population *viz.,* coccinellids and spider population were found to be uniform. The observations were recorded 10 days after each spray and mean population was worked out for overall comparison. After ten days of application, lowest numbers of coccinellids mean population (0.88 per plant) was recorded in the plot treated with Profenophos 50% EC @ 750 a.i. g/ha and maximum number of populations was observed in the treatment imidacloprid @ 25 a.i. g/ha (1.54 per plant) as well as untreated plot (1.89 per plant. Similar trend of population was observed in case of spider at 10 days after spray (Table: 6-7). It was also observed that the activities of honey bees were occasional and uniform in the insecticidal treated and control plots during the experimental period.

Bio efficacy of Acaricides

Results of First Spray

The first spray was accompanied by observations taken at 1, 3, 7, 11 and 14 days after spraying. Observations taken after 1 day after 1st spray revealed that the plots treated with Fosmite were observed to be with least no of mites i.e 2.89/three leaves, followed by Pataka-a combination product of Profenfos + Cypermethrin (3.15/three leaves) and Kaka-a bio-acaricide (3.44/three leaves). It was then followed by Perfect Plus (4.22/three leaves) and Bio-eon (4.57/three leaves). All the treatments were found to be statistically at par with the control (13.08/three leaves). The results obtained from 3rd days after spraying revealed that the least no of mites were found in plots treated with Bio Eon (2.67/three leaves), followed by Fosmite and Pataka in the second place with 3.00 mites /three leaves, and then followed by Kaka with 3.33mites/three leaves. With all the treatments being statistically at par with the control (8.00/three leaves). Observations from 11 DAS revealed that lowest population of mites were recorded from Pataka (1.89/three leaves) and Perfect plus (1.89/three leaves), followed by kaka (2.33/three leaves), Fosmite (2.67/three leaves) and Bioeon (2.78/three leaves), with all the treatments significantly at par with control(6.96/three leaves). After 14DAS it was found that, the lowest population of mites was recorded by Bio eon (2.56/three leaves), followed by Perfect plus (2.81/three leaves), followed by Kaka-a bio acaricide (3.33/three leaves), and then Pataka (3.52/three leaves) and Fosmite (3.56/three leaves).

The mean of the first spray was calculated and subjected to statistical analysis which revealed that the plots treated with Pataka showed lowest no of mites i.e(2.60/three leaves), followed by Fosmite (2.76/three leaves), then followed by Kaka- a bio acaricide (2.82/three leaves), Bio-eon (2.91/three leaves), and Perfect-Plus (3.02/three leaves) respectively. All treatments were found to be statistically at par with control (8.67/three leaves).

Results of second spray

Observations taken after 1DAS of second spray states that lowest mite population was recorded in the plots that were treated with Fosmite (2.63/three leaves), followed by Pataka-a combination product of Profenfos+ Cypermethrin (2.82/three leaves), and then by Perfect plus (3.00/three leaves) and Kaka (3.89/three leaves) respectively. The results from 3DAS reveals that lowest population was offered by Pataka (1.74/three leaves), followed by Safaya (2.00/three leaves), Kaka (2.22/three leaves), then by Perfect plus and Fosmite with 2.44 mites/three leaves respectively. After 7DAS the observations recorded states that lowest population was recorded from plots treated with Fosmite, Kaka and Pataka with population of mites recorded as (2.44/three leaves), (2.67/three leaves) and (2.78/three leaves) respectively. Spraying of Fosmite offered lowest population of mitesi.e (2.67/three leaves) after 11 DAS followed by Pataka (2.74/three leaves) and then by Kaka (3.56/three leaves). The results obtained from 14 DAS stated the least population of mites in the plots treated by Pataka followed by Fosmite then followed by Kaka with, mote populations as (3.33/three leaves), (3.82/three leaves) and (4.22/three leaves) respectively. All the treatments were significicantly at par with the control (8.11/three leaves).

The results on mean population of mites revealed that the least population was obtained by treating the plots with Pataka-a combination product of Profenophos and Cypermethrin, followed by Ethion followed by Kaka-a bio acaricide with mite population as (2.68/three leaves), (2.80/three leaves) and (3.31/three leaves) respectively with all the treatments to be significantly at par with control (7.51/three leaves).

The overall mean of the two sprays calculated depicts Pataka-a combination product of Profenfos + Cypermethrin showed best results against the mites followed by Fosmite and Kaka – a bio acaricide with mean population of mites as (2.72/three leaves), (2.81/three leaves) and (2.96/three leaves)

respectively. It was then followed by Perfect Plus (3.64/three leaves) and Bio-eon (3.85/three leaves). All treatments were found to be statistically at par with control when subjected to statistical analysis after different days after spraying in both the sprays.

Table 1: Showing different insecticides (Treatments) and their concentration used

Sl. No	Treatments	Dose a.i. (g/ha)	Dosage Formulation (ml/ha)
1	T1= Imidacloprid 17.8% SL	25	125.0
2	T2= Imidacloprid 17.8% SL	37.5	187.5
3	T3= Imidacloprid 17.8% SL	50	250.0
4	T4= Chlorpyriphos 20% EC	200	1875.0
5	T5=Profenofos 50% EC	750	1125.0
6	T6= Fipronil 5% SC	50	1000
7	T7= Untreated control	-	----

Table 2: Showing different acaricides (Treatments) and their concentration used

R_1		R_2		R3	
T8	**Control**	**T1**	**Chlorfenapyr 10% SC 1ml/lt**	**T8**	**Control**
T5	Pataka (Profenofos 40% + Cypermethrin 4%) 1ml/ lt	T2	Ethion 50% EC 1.5 ml/lt	T7	Kaka 1.5ml/lt
T6	Perfect Plus 1.25ml/lt	T3	Bio Eon 1.25 ml/lt	T6	Perfect Plus 1.25ml/lt
T7	Kaka 1.5ml/lt	T4	Safaya 1.25 ml/lt	T5	Pataka (Profenofos 40% + Cypermethrin 4%) 1ml/ lt
T1	Chlorfenapyr 10% SC 1ml/lt	T5	Pataka (Profenofos 40% + Cypermethrin 4%) 1ml/ lt	T4	Safaya 1.25 ml/lt
T2	Ethion 50% EC 1.5 ml/lt	T6	Perfect Plus 1.25ml/lt	T3	Bio Eon 1.25 ml/lt
T3	Bio Eon 1.25 ml/lt	T7	Kaka 1.5ml/lt	T2	Ethion 50% EC 1.5 ml/lt
T4	Safaya 1.25 ml/lt	T8	Control	T1	Chlorfenapyr 10% SC 1ml/lt

Table 3: Efficacy of some insecticides against Jassid in Chilli during Experiment 2016

Treatments	Pre spray jassid population/ 3 leaves	Percent reduction of Jassid population after 1st round of spray				Percent reduction of Jassid population after 2nd round of spray				Percent reduction of Jassid population after 3rd round of spray			
		1 DAS	3 DAS	7 DAS	14 DAS	1 DAS	3 DAS	7 DAS	14 DAS	1 DAS	3 DAS	7 DAS	14 DAS
Imidacloprid 17.8% SL 25 a.i g/ha	4.66	64.37 (53.41)	71.84 (58.15)	52.21 (46.80)	46.05 (42.73)	67.13 (55.14)	69.18 (56.36)	51.85 (46.35)	43.04 (40.73)	68.92 (56.22)	70.33 (57.31)	51.71 (46.27)	43.39 (41.17)
Imidacloprid 17.8% SL 37.5 a.i g/ha	4.99	74.86 (60.24)	81.59 (64.96)	69.37 (56.71)	54.00 (47.58)	75.05 (60.37)	82.21 (65.43)	64.05 (53.46)	51.85 (46.35)	76.68 (61.46)	80.59 (64.22)	67.76 (55.71)	52.30 (46.60)
Imidacloprid 17.8% SL 50 a.i g/ha	5.67	76.99 (61.68)	82.01 (65.28)	71.43 (58.01)	58.11 (49.96)	77.81 (62.24)	84.26 (67.02)	65.73 (54.47)	53.45 (47.27)	77.81 (62.24)	81.92 (65.21)	69.37 (56.71)	54.00 (47.58)
Chlorpyriphos 20% EC@200 a.i g/ha	5.33	61.60 (52.00)	62.39 (52.23)	40.61 (39.58)	20.03 (26.94)	59.09 (50.53)	61.60 (52.00)	40.22 (39.34)	23.09 (29.06)	61.76 (52.10)	63.44 (52.86)	41.17 (39.88)	29.69 (33.33)
Profenophos 50% EC@750 a.i g/ha	4.99	64.37 (53.41)	67.44 (55.51)	55.04 (48.18)	34.94 (36.63)	66.67 (54.89)	69.37 (56.71)	54.70 (47.74)	29.69 (33.33)	69.18 (56.36)	70.33 (57.31)	53.02 (46.80)	38.55 (38.24)
Fipronil 5% SC 50 a.i g/ha	5.22	64.62 (53.57)	65.73 (54.47)	53.02 (46.80)	29.16 (32.53)	67.13 (55.14)	68.54 (55.93)	49.47 (44.70)	34.39 (35.79)	65.99 (54.41)	65.99 (54.41)	53.02 (46.80)	26.97 (31.09)
Untreated Control	5.37	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)
S.E m (±)		1.53	0.76	1.25	1.35	0.84	1.31	1.70	0.75	1.39	1.15	1.63	2.04
CD (0.05)		4.73	2.33	3.85	3.89	2.57	4.04	5.00	2.30	4.01	3.31	4.68	6.28

Values in the parenthesis are angular transformed, DAS: Days after spray

Table 4: Efficacy of some insecticides against Aphid in Chilli during Experiment 2016

Treatments	Pre spray aphid populations/ leaf	Per cent reduction of aphid population after 1st round spray				Per cent reduction of aphid population after 2nd round spray				Per cent reduction of aphid population after 3rd round spray			
		1 DAS	3 DAS	7DAS	14DAS	1 DAS	3 DAS	7DAS	14DAS	1 DAS	3 DAS	7DAS	14DAS
Imidacloprid 17.8% SL 25 a.i g/ha	9.67	73.46 (59.14)	71.84 (58.15)	60.87 (51.37)	52.21 (46.80)	74.86 (60.24)	72.00 (58.17)	63.25 (52.74)	43.39 (41.17)	73.42 (59.29)	70.33 (57.31)	58.55 (50.26)	46.79 (43.13)
Imidacloprid 17.8% SL 37.5 a.i g/ha	8.23	85.01 (67.36)	85.78 (68.26)	69.37 (56.71)	63.25 (52.74)	82.87 (65.93)	82.21 (65.43)	72.33 (58.44)	48.74 (44.27)	83.84 (66.58)	85.01 (67.36)	67.76 (55.71)	62.39 (52.23)
Imidacloprid 17.8% SL 50 a.i g/ha	8.67	88.58 (70.70)	87.59 (69.61)	74.86 (60.24)	66.68 (54.85)	85.78 (68.26)	84.26 (67.02)	75.57 (60.58)	53.45 (47.27)	88.69 (70.80)	89.79 (71.84)	69.37 (56.71)	64.37 (53.41)
Chlorpyriphos 20% EC@200 a.i g/ha	9.33	66.49 (54.63)	65.29 (54.21)	54.70 (47.74)	37.92 (38.30)	65.76 (54.71)	59.03 (50.29)	51.67 (46.24)	34.94 (36.63)	63.44 (52.86)	63.44 (52.86)	44.15 (41.93)	29.69 (33.33)
Profenophos 50% EC@750 a.i g/ha	8.66	74.86 (60.24)	72.82 (58.90)	63.25 (52.74)	49.47 (44.70)	71.40 (57.99)	73.81 (59.55)	65.29 (54.21)	45.84 (42.90)	73.46 (59.14)	72.82 (58.90)	60.00 (51.06)	53.02 (46.80)
Fipronil 5% SC 50 a.i g/ha	8.79	67.44 (55.51)	65.73 (54.47)	50.20 (45.40)	37.92 (38.30)	71.50 (58.05)	68.54 (55.93)	49.47 (44.70)	34.39 (35.79)	70.60 (57.48)	65.99 (54.41)	53.02 (46.80)	35.12 (36.64)
Untreated Control	9.56	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)
S.E m (±)		1.69	1.53	1.11	1.41	0.90	1.31	2.00	1.25	1.39	1.15	1.71	2.04
CD (0.05)		5.22	4.73	3.42	4.35	2.78	4.04	6.17	3.85	4.01	3.31	5.26	6.28

Values in the parentheses are angular transformed, DAS: Days after spray

Table 5: Efficacy of some insecticides against Thrips in Chilli Crop during 2016

Treatments	Pre spray thrips populations/ leaf	Per cent reduction of thrips population after 1st round of spray				Per cent reduction of thrips population after 2nd round of spray				Per cent reduction of thrips population after 3rd round of spray			
		1 DAS	3 DAS	7 DAS	14 DAS	1 DAS	3 DAS	7 DAS	14 DAS	1 DAS	3 DAS	7 DAS	14 DAS
Imidacloprid 17.8% SL 25 a.i g/ha	11.33	81.62 (65.30)	82.51 (68.21)	63.69 (54.10)	52.21 (46.80)	76.82 (61.87)	75.31 (60.65)	63.25 (52.74)	48.23 (43.98)	81.62 (65.30)	79.21 (62.87)	63.25 (52.74)	46.79 (43.13)
Imidacloprid 17.8% SL 37.5 a.i g/ha	11.23	94.96 (78.06)	87.59 (69.61)	74.86 (60.24)	66.68 (54.85)	95.12 (77.25)	91.14 (73.19)	82.21 (65.43)	67.76 (55.71)	97.13 (81.45)	89.30 (71.15)	81.62 (65.30)	63.25 (52.74)
Imidacloprid 17.8% SL 50 a.i g/ha	10.67	96.13 (79.45)	90.14 (72.19)	80.97 (64.23)	69.37 (56.71)	96.55 (79.61)	93.96 (77.06)	84.26 (67.02)	69.37 (56.71)	99.16 (84.35)	92.14 (74.19)	86.80 (68.75)	67.76 (55.71)
Chlorpyriphos 20% EC@200 a.i g/ha	10.96	76.82 (61.87)	72.51 (58.10)	54.70 (47.74)	43.48 (41.44)	75.82 (60.94)	69.37 (56.71)	55.58 (48.21)	46.79 (43.13)	72.51 (58.10)	69.37 (56.71)	50.23 (45.14)	44.15 (41.93)
Profenophos 50% EC@750 a.i g/ha	11.15	83.55 (66.12)	80.80 (64.53)	63.25 (52.74)	52.21 (46.80)	79.21 (62.87)	76.82 (61.87)	65.29 (54.21)	45.84 (42.90)	80.80 (64.53)	81.62 (65.30)	65.99 (54.41)	53.02 (46.80)
Fipronil 5% SC 50 a.i g/ha	10.84	72.51 (58.10)	70.83 (57.39)	50.20 (45.40)	37.92 (38.30)	71.50 (58.05)	72.51 (58.10)	51.91 (46.11)	34.39 (35.79)	70.60 (57.48)	71.50 (58.05)	53.02 (46.80)	35.12 (36.64)
Untreated Control	11.51	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)
S.E m (±)		2.58	2.13	1.11	1.67	1.53	1.86	1.71	2.00	1.39	2.25	1.40	2.53
CD (0.05)		7.94	6.33	3.42	5.06	4.73	5.63	5.26	6.17	4.01	6.75	4.17	7.59

Values in the parentheses are angular transformed, DAS: Days after spray

Table 6: Effect of Imidacloprid on the Population of Natural Enemies (Coccinellids)

Treatments	Dose a.i g/ha	Coccinellids (No. per plant)				
		PT	10 days after 1st spray	10 days after 2nd spray	10 days after 3rd spray	Mean of three sprays
T1=Imidacloprid 17.5 SL	25	1.63 (1.46)	1.63	1.43	1.57	1.54^{b} (1.43)
T2= Imidacloprid 17.5 % SL	37.5	1.60 (1.46)	1.50	1.33	1.43	1.42^{bc} (1.39)
T3= Imidacloprid 17.5 %SL	50	1.53 (1.40)*	1.40	1.27	1.33	1.33^{c} (1.35)
T4=Chlorpyroiphos 20% EC	200	1.67 (1.48)	1.57	1.40	1.63	1.53^{b} (1.42)
T5=Profenophos 50 % EC	750	1.73 (1.49)	0.97	0.77	0.90	0.88^{d} (1.18)
T6=Fipronil 5 % SC	50	1.67 (1.48)	1.50	1.47	1.37	1.44bc (1.39)
T7= Untreated control	-	1.70 (1.48)	1.87	2.03	1.77	1.89^{a} (1.55)

Similar alphabets represents the homogeneous means group due to Duncan˝s Multiple Test range
*Values in the parentheses are square root transformed, PT = Pre-treatment population

Table 7: Effect of Imidacloprid on the Population of Natural Enemies (Spiders)

Treatments	Dose a.i g/ha	Spiders (No. per plant)				
		PT	10 days after 1st spray	10 days after 2nd spray	10 days after 3rd spray	Mean of three sprays
T1=Imidacloprid 17.5 SL	25	1.83 (1.53)	1.77	1.60	1.30	1.56^{b} (1.44)
T2= Imidacloprid 17.5 % SL	37.5	1.80 (1.52)	1.67	1.57	1.13	1.46^{bc} (1.40)
T3= Imidacloprid 17.5 %SL	50	1.83 (1.52)	1.60	1.43	1.17	1.37^{cd} (1.37)
T4=Chlorpyroiphos 20% EC	200	1.77 (1.51)	1.57	1.43	1.27	1.42^{cd} (1.39)
T5=Profenophos 50 % EC	750	1.77 (1.50)	1.20	0.83	0.73	0.92^{e} (1.19)
T6=Fipronil 5 % SC	50	1.80 (1.52)	1.47	1.33	1.17	1.32^{d} (1.35)
T7= Untreated control	-	1.83 (1.53)	2.20	2.03	1.43	1.89^{a} (1.55)

Similar alphabets represents the homogeneous means group due to Duncan˝s Multiple Test range
*Values in the parentheses are square root transformed, PT = Pre-treatment population

Table 8: Efficacy of different acaricides against Mites in Chilli during Experiment 2016

Sl. No	Treatments	Dose (ml/litre)	Pre-treatment	Mite population after 1st round of spray					Mean	Mite population after 2nd round of spray					Mean	Mean of two sprays	Yield t/ha
				1 DAS	3 DAS	7 DAS	11 DAS	14 DAS		1 DAS	3 DAS	7 DAS	11 DAS	14 DAS			
1.	Chlorfenapyr	1	14.22	5.89 (2.53)	5.27 (2.40)	5.20 (2.39)	4.44 (2.22)	4.96 (2.34)	5.15	4.96 (2.34)	4.20 (2.17)	5.30 (2.41)	6.00 (2.55)	6.55 (2.66)	5.40	5.28	4.16
2.	Fosmite	1.5	13.00	2.89 (1.84)	3.00 (1.87)	1.67 (1.47)	2.67 (1.78)	3.56 (2.01)	2.76	2.63 (1.77)	2.44 (1.71)	2.44 (1.71)	2.67 (1.78)	3.82 (2.08)	2.80	2.81	5.40
3.	Bio Eon	1.25	15.33	4.57 (2.25)	2.67 (1.78)	2.00 (1.58)	2.78 (1.81)	2.56 (1.75)	2.91	4.11 (2.15)	3.85 (2.09)	5.22 (2.39)	4.71 (2.28)	6.07 (2.56)	4.79	3.85	3.95
4.	Safaya	1.25	13.67	8.31 (2.97)	5.13 (2.37)	4.02 (2.13)	4.26 (2.18)	4.48 (2.23)	5.24	4.22 (2.17)	2.00 (1.58)	5.40 (2.43)	5.82 (2.51)	6.62 (2.67)	4.81	5.02	3.84
5.	Pataka	1	13.23	3.15 (1.91)	3.00 (1.87)	1.44 (1.39)	1.89 (1.55)	3.52 (2.00)	2.60	2.82 (1.82)	1.74 (1.50)	2.78 (1.81)	2.74 (1.80)	3.33 (1.96)	2.68	2.72	5.81
6.	Perfect plus	1.25	14.33	4.22 (2.17)	4.96 (2.34)	1.22 (1.31)	1.89 (1.55)	2.81 (1.82)	3.02	3.00 (1.87)	2.44 (1.71)	4.66 (2.27)	5.41 (2.43)	5.75 (2.50)	4.25	3.64	4.26
7.	Kaka	1.5	13.45	3.44 (1.98)	3.33 (1.96)	1.67 (1.47)	2.33 (1.68)	3.33 (1.96)	2.82	3.89 (2.10)	2.22 (1.65)	2.67 (1.78)	3.56 (2.01)	4.22 (2.17)	3.31	2.96	4.96
8.	Control	-	13.00	13.08 (3.69)	8.00 (2.92)	6.56 (2.66)	6.96 (2.73)	8.74 (3.04)	8.67	8.22 (2.95)	5.00 (2.35)	7.56 (2.84)	8.67 (3.03)	8.11 (2.93)	7.51	8.09	3.37

	2.58	2.13	1.11	0.86	0.52	0.62	0.52	0.43	0.68	0.69	0.53	0.55	-	0.08
	7.94	6.33	3.42	2.56	1.54	1.80	1.56	1.25	2.01	2.06	1.55	1.59	-	0.25

Values in the parenthesis are angular transformed, DAS: Days after spray

Conclusion

The result revealed that the treatment Imidacloprid 17.8% SL @ 25 a.i. g/ha was rendering satisfactory result against chilli thrips, aphid and Jassid management. Maximum population of natural enemies like spider and coccinelid were recorded in the treatment imidacloprid @ 25 a.i. g/ha as well as untreated control.

In case of Acaricidal management the pooled mean of the two sprays calculated depicts Pataka-a combination product showed best results against the mites followed by Fosmite and Kaka: A bio acaricide with mean population of mites as (2.72/three leaves), (2.81/three leaves) and (2.96/three leaves) respectively. It was then followed by Perfect Plus (3.64/three leaves) and Bio-eon (3.85/three leaves). All treatments Wer found to be statistically at par with control when subjected to statistical analysis after different days after spraying in both the sprays.

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