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Population Dynamics of Chilli Mite and their Management with Certain Newer Insecticide Combination Formulations

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Abstract
Field experiments were conducted during the 2016-17 at the Vegetable Research Farm, B.H.U., Varanasi to study the population dynamics of chilli mite and evaluate the efficacy of certain newer insecticide combination formulations *viz.*, Fipronil 5% + Buprofezin 20% SC @ 100+400g a.i./ha, Fipronil 5% + Buprofezin 20% SC @ 50+200g a.i./ha, Fipronil 5% + Buprofezin 20% SC @ 37.5+150g a.i./ha, Indoxacarb 14.5% + Acetamiprid 7.7% SC @ 58+30.8g a.i./ha, Diafenthuiron 50% WP, Buprofezin 25% SC, Fipronil 5% SC, Quinolphos 25% EC @ 750 g a.i./ha, Quinolphos @ 375 g a.i./ha with untreated control. The chilli mite population was first recorded on 38th SW with mean population of 0.75 mites per leaf and attaining its peak population 17.85 mites per leaf during 42nd SW. The correlation analysis revealed that positive significant correlation with maximum temperature and positive non-significant correlation with minimum temperature. However, negative significant correlation with morning and evening relative humidity and negative non-significant correlation with rainfall. The overall data of efficacy revealed that all insecticidal treatments were significantly superior over untreated control. However, the plots treated with Fipronil 5% + Buprofezin 20% SC @ 100+400g a.i./ha has recorded the lowest number of chilli mite population (4.44 and 2.18 mite per leaf) after first and second insecticidal sprays, respectively, followed by Fipronil 5% + Buprofezin 20% SC @ 50+200g a.i./ha (5.84 and 3.53 mite per leaf, respectively). Whereas, sole treatments of Fipronil 5% SC and Buprofezin 25% SC were recorded as third and fourth best treatments, respectively.

Keywords: Chilli, Polyphagotarsonemus latus, Population dynamics, Insecticides and Efficacy

Introduction
Chilli (*Capsicum annum* L.) is considered as one of the most important vegetable crop among the vegetables of Solanaceaeous family which cultivated in sub-tropic and tropics areas where both ripe and unripe fruits are used vegetable crop as well as spices. Although there is a scope to enhance the productivity of chilli, a number of limiting factors have been attributed to the productivity. Among them insect and mite pests are of prime importance affecting both quality and production. Fifty one species of insects and two species of mites belonging to 27 families under 9 orders were recorded on chilli crop. The yield losses range from 50-90 per cent due to these insect pests of chilli (Nelson and Natrajan, 1994, Kumar, 1995) [10, 6]. As per the result of the survey conducted by Asian Vegetable Research and Development Committee in Asia indicated that the key insect pests of chilli are aphids, *Aphis gossypii* (Glover), thrips, *Scirtothrips dorsalis* (Hood) and mites, *Polyphagotarsonemus latus* (Banks), and fruit borer, *Helicoverpa armigera* (Hubner) and *Spodoptera litura* (Fab.) are the most vital production constraints.

Chilli mites *Polyphagotarsonemus latus* (Banks) the yellow mite was first recorded in India by (Mann *et al.*, 1920) [9] on potato and later it was reported on chilli crop by Kulkarni, 1922 [5]. It is widely distributed pest of chilli in India and occurs in all chilli growing areas under diverse climatic condition. It causes an estimated crop loss of more than 60% in terms of chilli yield (Srinivasan *et al.*, 2003) [15]. The mites appear first on the terminal or auxiliary tender shoots of chilli plants. Nymphs and adults feed exclusively on the lower surface of the leaves. Leaves become brittle and roll downward, as inverted cup due to feeding by mites. The under surface of leaves become shiny, glossy bronzed and leaves turn dark green in colour. Heavy infestation results in defoliation, bud shedding and drying of growing points. The new growth may also be stunted or killed which forces out additional shoots due to toxic saliva of mites (Baker, 1997)[1]. Fruit is discolored, blistered, shriveled by feeding of the mite and in severe cases premature fruit drop may occur. Much of these symptoms can be easily confused with viral disease, micronutrient deficiency or herbicide injury. Severely damaged fruit is not salable in the fresh market but may be used for processing (Pena and Campbell, 2005) [12].

The information of the seasonal incidence and population development trend is help to forecasting the incidence of the mite on the crop which is used to timely management of mite. Among the various methods of pest control, application of insecticides is one of the most effective methods of pests control and it yields quick results, supporting its application in integrated pest management strategies. However, the persistent use of the repeated group of insecticide having same mode of action will become less effective against mite. Keeping in view of the above, the present studies was taken to seasonal incidence and evaluate the efficacy of certain newer insecticide combinations with different novel mode of action and their respective sole insecticide formulations against chilli mite.

Materials and Methods

Field experiments were conducted during the 2016-17 at the Vegetable Research Farm, B.H.U., Varanasi, India. In the experiments, chilli variety Bhagyalakshmi (G4) was raised in the nursery of the Vegetable Research Farm, BHU, Varanasi. Thirty day old seedlings were transplanted in the main field on September of 2016 with a plant spacing of 60×45 cm. Before transplanting the seedling were root dipped in the Carbendazim (0.1%) solution and all agronomical practices such as irrigation, fertilizer application and intercultural operations were followed as recommended for chilli crop in this area to raise the crop in experimental sites.

Population dynamics of chilli mite and impact of abiotic factors on its population

A bulk plot of 100 m^2 was raised to study the population dynamics of chilli mite. The observations of pest population was recorded in this unprotected plot at 7 days interval (Standard weeks) from the 7 days after transplanting (DAT) up to crop harvesting. For recording observations on mites three leaf samples were taken from upper, middle and lower portion of the plants and total l5 leaves were collected from each plot. The collected leaves are kept in separate polythene bags brought to the laboratory and observations were taken under stereo zoom binocular microscope. Weather data were recorded simultaneously from the meteorological observatory available at Agricultural Research Farm, Institute of Agricultural Sciences, BHU, Varanasi and correlated with the occurrence of the pest population. A correlation coefficient method was adopted to work out the relationship between the occurrence of the pest incidence and the weather parameters.

Efficacy of newer insecticide combination formulations against chilli mite

The experiment was laid out in a plot sized of 3 x 3 m^2 in randomized block design (RBD) with 3 replications. The experiments were consist ten treatments including control *viz.*, Fipronil 5% + Buprofezin 20% SC @ 100+400g a.i./ha, Fipronil 5% + Buprofezin 20% SC @ 50+200g a.i./ha, Fipronil 5% + Buprofezin 20% SC @ 37.5+150g a.i./ha, Indoxacarb 14.5% + Acetamiprid 7.7% SC @ 58+30.8g a.i./ha, Diafenthuiron 50% WP, Buprofezin 25% SC, Fipronil 5% SC, Quinolphos 25% EC @ 750 g a.i./ha, Quinolphos @ 375 g a.i./ha and untreated control were selected and applied at the recommended field concentration. All these insecticides were received from Gharda Chemicals Ltd., Thane, Maharashtra. Two sprays were done during entire crop season when pest population/ damage reaching the economic threshold level. The first insecticidal application was given when the mite population) crossed economic threshold level (ETL). Second insecticidal applications on the need basis were given at 15 day interval after the first one. Insecticide spray was done with the help of Knapsack sprayer and total spray volume was taken as 500 l/ha. The spraying work was done just before evening. The observation were recorded on number of mites during one day prior to spray and 2^{nd}, 5^{th}, 7^{th}, 10^{th} and 14^{th} day after spraying. Three leaf samples were taken from upper, middle and lower portion of the plants and total l5 leaves were collected from each plot. The collected leaves are kept in separate polythene bags brought to the laboratory and observations were taken under stereo zoom binocular microscope.

The data obtained on mite population were subjected to appropriate statistical analysis. Critical differences for various treatments were computed at 5% level of significance. The per cent field efficacy of various treatments against mites was calculated by using the formula suggested by Henderson and Tilton (1955) [4] as given below:

$$\% \text{ Reduction in pest population} = 1- \left[\frac{Ta}{Tb} \times \frac{Cb}{Ca}\right] \text{ X } 100$$

Where,
T_a = Population in the treated plot after spray.
T_b = Population in the treated plot before spray.
C_a = Population in the control plot after spray.
C_b = Population in the control plot before spray.

The per cent reduction over control was calculated for fruit borer damage and data were analyzed using angular transformation in RBD. The significance was tested by referring to ‘F’ table of Fisher and Yates (1963) [3].

Result and Discussion

Seasonal incidence of chilli mite, *P. latus* in relation to weather parameters:

The data recorded on the incidence of mites *P. latus* nymphs and adults revealed that the initial incidence was observed on 38^{th} SW *i.e.* at 12 days after transplantation with a mean population of 0.75 mites per leaf (Fig. 1). A peak population of 17.85 mites per leaf was noticed during 42^{nd} SW. The corresponding maximum and minimum temperature were 32.4 ^{0}C and 18.4 ^{0}C, respectively and a morning RH and evening RH of 74% & 43% respectively. Thereafter, the mite population gradually decreased reaching 0.02 as mean population of mites per leaf during second week of January. These observations in accordance with the study reported by Patil and Nandihalli (2009) [11] who observed that the maximum mites population during 42 standard week.

Correlation was worked out to find the relationship between mite population and the major weather parameters (Table 1). The results indicated that mite population showed a positive significant correlation ($r = 0.536^*$) with maximum temperature and positive non – significant correlation (r = 0.012) with minimum temperature. Whereas, the relationship between the mite population with morning RH ($r = -0.908^{**}$) and evening RH ($r = -0.687^{**}$) was negative significant correlation. However, rain fall was showed negative non-significant correlation (r = -0.300) with mites population. These results are close accordance with Patil and Nandihalli (2009) [11] who reported that the mite population showed a positive and significant correlation with maximum temperature and negative non-significant correlation with minimum temperature. Further, Lingeri *et al.*, (1998) [8] also reported that the high temperature, low humidity and lesser rain fall favours mite incidence. However, findings of Bokan *et al.*, (2015) [2] showed that correlation between maximum temperature and mite population was positive non-significant while correlation of minimum temperature, morning and evening relative humidity with mite population was negative non-significant.

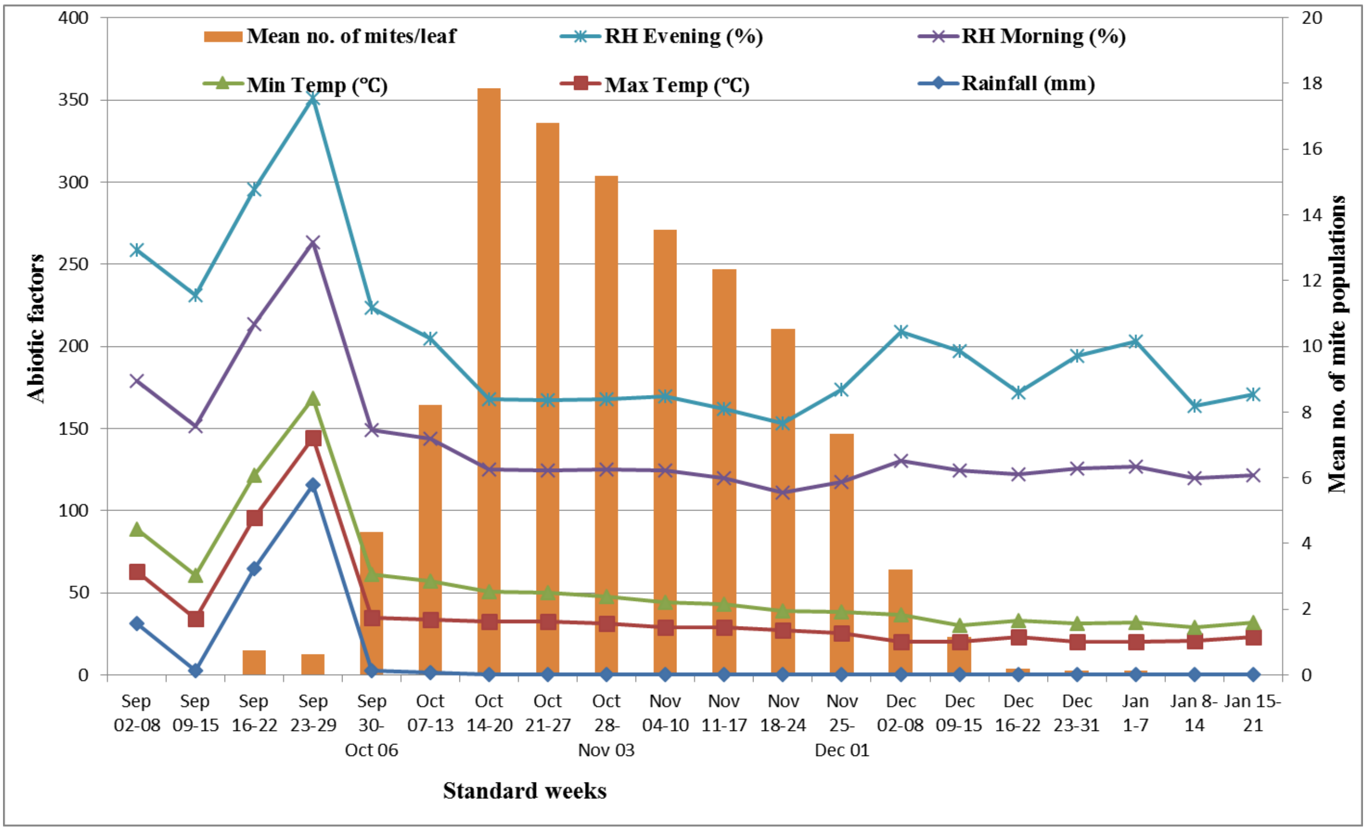

Fig 1: Influence of abiotic factors on the population dynamics of chilli mite

Table 1: Correlation coefficient (r) of chilli mite population on chilli with prevailing weather parameters during 2016-17

Insect Pests	Weather parameter				
	Rainfall (mm)	Relative Humidity (%)		Temperature (℃)	
		Morning	Evening	Maximum	Minimum
Chilli mite	-0.300	-.908**	-.687**	0.536*	0.012

*. Correlation is significant at the 0.05 level, **. Correlation is significant at the 0.01 level

Efficacy of newer insecticide combination formulations against chilli mite, *P. latus*

Impact of insecticidal treatments against *P. latus* after first insecticidal spray is shown in Table 2. The initial mean population of *P. latus* on various treatment plots and untreated control during one day prior to insecticidal spray was found to be in a range of 15.47 to 19.23 mites per leaf. On 2nd day after insecticidal spray, all insecticidal treatment were significantly superior over control and a lowest mean number of 5.61 mites/leaf were recorded in the plots treated with Fipronil 5% + Buprofezin 20% SC @100+400 g a.i./ha and differs significantly from rest of insecticidal treatment. Quinolphos 25% EC @375 g a.i./ha was observed to be least effective with a mean number of 14.66 mites/leaf. While, the mite population recorded in untreated control, 19.84 mites per leaf.

The plots treated with Fipronil 5% + Buprofezin 20% SC @ 100+400 g a.i./ha recorded again lowest mean mite population, 2.51 mites per leaf on 5th day after insecticidal spray which is statistically superior over other insecticide treated plots and the plots treated with Fipronil 5% + Buprofezin 20% SC at two doses viz; 50+200 & 37.5+150 g a.i./ha recorded a mean population of 3.64 and 4.55 mites per leaf respectively. However, a mean population, 5.79, 6.83 and 8.01 mites per leaf were recorded in the plots treated with Fipronil 5% SC, Diafenthuiron 50% WP and Buprofezin 25% SC, respectively. Further, Quinolphos 25% EC @ 375 g a.i./ha treated plots recorded a highest mean number of 11.21 mites per leaf. All the treatments were significantly superior over control and statistically different from each other. Again lowest mean population, 3.37 mites per leaf was recorded in plot treated with Fipronil 5% + Buprofezin 20% SC @ 100+400 g a.i./ha during the 7th day after insecticidal spray which is statistically different from other insecticidal treatment. However, Quinolphos 25% EC @ 375 g a.i./ha treated plot recorded a highest mean mites population of 12.74 mites per leaf. During10thand 14thday after the insecticidal spray a low mean population, 4.48 and 6.23 mites/leaf, respectively was recorded in the Fipronil 5% + Buprofezin 20% SC @ 100+400 g a.i./ha treated plots and differed significantly from rest of insecticidal treatments. Quinolphos 25 % EC @375 g a.i./ha was least effective with a mean population, 15.38 and18.31 mites/leaf, respectively. All the treatments were significantly superior over control and statistically different from each other. However plot treated with Quinolphos 25% EC @ 750 g a.i./ha and Quinolphos 25% EC @ 375 g a.i./ha were found to be at par.

Impact of insecticidal treatments on the infestation of mites was also assessed in terms of per cent field bio-efficacy. The overall mean per cent field efficacy was highest in case of Fipronil 5% + Buprofezin 20% SC @100+400 g a.i./ha treated plot (77.10%) followed by Fipronil 5% + Buprofezin 20% SC @ 50 + 200 g a.i./ha (70.09%), Fipronil 5% + Buprofezin 20% SC @ 37.5 + 150 g a. i./ha (66.61%), Fipronil 5% SC @ 50 g a.i./ha (61.50%), Diafenthuiron 50% WP @ 300 g a.i./ha (56.32%), Buprofezin 25% SC @ 150 g a.i./ha (50.74%), Indoxacarb 14.5 % + Acetamiprid 7.7 % SC @ 58 + 30.8 g a.i./ha (46.60%). Quinolphos 25% EC @ 750 g a.i./ha (43.13%) and Quinolphos 25% EC @375 g a.i./ha (39.36%) (Table 2).

Table 2: Impact of insecticidal treatments against *P. latus* after first insecticidal spray

Treatment	Dosage g a.i. / ha	Pre-spray count (mites/leaf)	Mean no. of mites / leaf											
			2 DAS	PFE	5 DAS	PFE	7 DAS	PFE	10 DAS	PFE	14 DAS	PFE	Overall Mean	Overall mean PFE
Fipronil 5% + Buprofezin 20% SC	100+400	15.47* (4.06)**	5.61 (2.57)	65.38	2.51 (1.87)	85.75	3.37 (2.07)	82.46	4.48 (2.34)	78.69	6.23 (2.68)	73.24	4.44	77.10
Fipronil 5% + Buprofezin 20% SC	50+200	15.58 (4.07)	7.01 (3.84)	57.05	3.64 (2.15)	79.49	4.27 (2.39)	75.60	5.79 (2.60)	72.66	8.05 (3.00)	65.67	5.84	70.09
Fipronil 5% + Buprofezin 20% SC	37.5+150	16.43 (4.17)	8.05 (3.00)	53.23	4.55 (2.35)	75.69	5.52 (2.55)	72.94	6.98 (2.82)	68.74	9.28 (3.20)	62.47	6.88	66.61
Indoxacarb 14.5% + Acetamiprid 7.7% SC	58+30.8	18.14 (4.37)	12.72 (3.70)	33.06	9.21 (3.20)	55.42	10.49 (3.39)	53.43	12.81 (3.72)	48.04	15.54 (4.06)	43.08	12.15	46.60
Diafenthuiron 50% WP	300	17.09 (4.25)	10.24 (3.35)	42.80	6.83 (2.80)	64.91	8.35 (3.06)	60.65	9.55 (3.25)	58.89	11.74 (3.57)	54.36	9.34	56.32
Buprofezin 25% SC	150	17.37 (4.28)	11.41 (3.52)	37.30	8.01 (3.00)	59.51	9.75 (3.28)	54.80	11.14 (3.48)	52.81	13.24 (3.77)	49.32	10.71	50.74
Fipronil 5% SC	50	16.95 (4.24)	9.14 (3.18)	48.53	5.79 (2.60)	70.01	6.99 (2.82)	66.79	8.15 (3.02)	64.62	10.82 (3.44)	57.59	8.18	61.50
Quinolphos 25% EC	750	19.23 (4.49)	13.94 (3.86)	30.80	10.54 (3.39)	50.88	11.85 (3.58)	50.37	14.84 (3.98)	43.22	17.54 (4.30)	39.40	13.74	43.13
Quinolphos 25% EC	375	18.99 (4.47)	14.66 (3.96)	26.31	11.21 (3.49)	48.17	12.74 (3.70)	45.97	15.38 (4.04)	40.41	18.31 (4.39)	35.94	14.46	39.36
Control		15.76 (4.09)	16.51 (4.18)	-	17.95 (4.35)	-	19.57 (4.53)	-	21.42 (4.73)	-	23.72 (4.97)	-	19.83	-
SEm (±)		-	0.017		0.03		0.04		0.04		0.03			
CD(P=0.05)		-	0.05		0.09		0.13		0.14		0.10			

DAS= Day after spray, PFE= Per cent field efficacy, *Mean of three replications, **Figures in parenthesis are square root transformed value

During second spray, the mean population of *P. latus* on various treatment plots and untreated control during one day before insecticidal spray was found to be in a range of 8.43 to 26.60 per leaf (Table 3). On 2nd day after insecticidal spray, all insecticidal treatment were significantly superior over control and a lowest mean number of 3.09 mites/leaf were recorded in the plots treated with Fipronil 5% + Buprofezin 20% SC @ 100+400 g a.i./ha and differed significantly from rest of insecticidal treatments. Quinolphos 25% EC @ 375 g a.i./ha was observed to be least effective with a mean number of 16.99 mites/leaf.

Table 3: Impact of insecticidal treatments against *P. latus* after second insecticidal spray

Treatment	Dose g a.i. / ha	Pre-spray count (mites/leaf)	Mean no. of mites / leaf											
			2 DAS	PFE	5 DAS	PFE	7 DAS	PFE	10 DAS	PFE	14 DAS	PFE	Overall Mean	Overall mean PFE
Fipronil 5% + Buprofezin 20% SC	100+400	8.43* (3.07)**	3.09 (2.02)	66.23	1.27 (1.50)	86.44	1.62 (1.61)	83.61	2.24 (1.80)	79.13	2.72 (1.93)	75.79	2.18	78.24
Fipronil 5% + Buprofezin 20% SC	50+200	10.15 (3.34)	4.55 (2.35)	58.70	2.31 (1.82)	79.51	2.85 (1.96)	76.05	3.42 (2.10)	73.53	4.51 (2.34)	66.66	3.53	70.89
Fipronil 5% + Buprofezin 20% SC	37.5+150	10.95 (3.45)	5.35 (2.51)	54.99	3.01 (2.00)	75.25	3.46 (2.11)	73.05	4.21 (2.28)	69.80	5.31 (2.51)	63.62	4.27	67.34
Indoxacarb 14.5% + Acetamiprid 7.7% SC	58+30.8	17.65 (4.32)	12.75 (3.70)	33.45	8.94 (3.15)	54.40	10.04 (3.32)	51.48	11.75 (3.57)	47.71	13.84 (3.85)	41.17	11.46	45.64
Diafenthuiron 50% WP	300	13.24 (3.77)	8.15 (3.02)	43.29	5.04 (2.45)	65.73	5.92 (2.63)	61.86	6.75 (2.78)	59.95	7.94 (2.99)	55.01	6.67	57.17
Buprofezin 25% SC	150	14.94 (3.99)	10.05 (3.32)	38.03	6.94 (2.82)	58.18	7.75 (2.96)	55.75	8.85 (3.14)	53.47	9.79 (3.28)	50.84	8.68	51.25
Fipronil 5% SC	50	12.41 (3.66)	6.84 (2.80)	49.22	4.11 (2.26)	70.18	4.85 (2.42)	66.66	5.45 (2.54)	65.50	6.84 (2.80)	58.65	5.62	62.04
Quinolphos 25%EC	750	20.14 (4.59)	15.45 (4.05)	29.33	11.04 (3.47)	50.65	12.21 (3.63)	48.29	14.65 (3.95)	42.86	16.64 (4.20)	38.01	14.00	41.83
Quinolphos 25% EC	375	21.66 (4.76)	16.99 (4.24)	27.74	12.24 (3.64)	49.12	13.95 (3.87)	45.06	16.54 (4.18)	40.02	18.82 (4.45)	34.81	15.71	39.35
Control		26.60 (5.25)	28.87 (5.46)	-	29.54 (5.53)	-	31.18 (5.67)	-	33.86 (5.90)	-	35.45 (6.04)	-	31.78	-
SEm (±)		-	0.02		0.014		0.02		0.01		0.02			
CD(P=0.05)		-	0.07		0.04		0.07		0.04		0.05			

The same efficacy was maintain in plots treated with Fipronil 5% + Buprofezin 20% SC @ 100+400 g a.i./ha recorded a lowest on 5th, 7th, 10th and 14th day after insecticidal spray with mean mite population, 1.27, 1.62, 2.24 and 2.72 mites/leaf respectively which is statistically superior over other insecticide treated plots and the highest population was recorded from Quinolphos 25% EC @ 375 g a.i./ha treated plots with 12.24, 13.95, 16.54 and 18.82 mites/leaf respectively.

Impact of insecticidal treatments on the infestation of mites was also assessed in terms of per cent field bio-efficacy. In the entire insecticidal treatments maximum per cent field efficacy was observed during 5th day after insecticidal spray. The overall mean per cent field efficacy was highest (78.24%) in Fipronil 5% + Buprofezin 20% SC @100+400 g a.i./ha treated plot followed by plot treated with Fipronil 5% + Buprofezin 20% SC @ 50 + 200 g a.i./ha (70.89%), Fipronil 5% + Buprofezin 20% SC @ 37.5 + 150 g a. i./ha (67.34%), Fipronil 5% SC @ 50 g a.i./ha (62.20%), Diafenthuiron 50% WP @ 300 g a.i./ha (57.17%), Buprofezin 25% SC @ 150 g a.i./ha (51.25%), Indoxacarb 14.5 % + Acetamiprid 7.7 % SC @ 58 + 30.8 g a.i./ha (45.64%), Quinolphos 25% EC @ 750 g a.i./ha (41.83%) and Quinolphos 25% EC @375 g a.i./ha (39.35%) (Table 3).

The above finding showed that the Fipronil 5% + Buprofezin 20% SC was the best and significantly superior over all other treatments in bringing down the mites population. Similarly Kumar *et al*., (2015) [7] reported that Fipronil 5% SC are most effective compared to diafenthuiron 50% WP for managing the mite population in chilli. Sontakke *et al.*, (2014) [14] also concluded that Buprofezin 25% SC in both the doses was the most effective in checking mite population. Similarly in the present study, combination of Fipronil 5% + Buprofezin 20% SC was most effective in managing mites. While, Quinolphos 25% EC was found to be least effective against *P. latus* as compared to other treatment and this results share similarity with Reddy *et al*., (2007) [13] who reported that Quinalphos 25 EC and indoxacarb 14.5SC were least effective against mites.

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References

1. Baker JR. Cyclamen mite and broad mite. Ornamental and Turf Insect Information Notes, 1997; 6:41-46.
2. Bokan SC, Jadhav KM, Zamwar PR, Bhosle BB. Studies on population dynamics of major pests of chilli and its correlation with weather parameter. Journal of Entomological Research, 2015; 39(1):61-64.
3. Fisher RA, Yates F. Statistical Tables for Biological, Agricultural and Medical Research (6th ED.), Oliver and Boyd., 1963.
4. Henderson CT, Tilton EW. Tests with acaricides against the brown wheat mite. Journal of Economic Entomology, 1955; 48:157-161.
5. Kulkarni GS. The “Murda” disease of chilli (*Capsicum)*. Agricultural Journal of India, 1922; 22(1):51-54.
6. Kumar NKK. Yield loss in chilli and sweet pepper due to *Scirtothripsdorsalis* Hood. (Thysanoptera: Thripidae). Pest Management in Horticultural Ecosystems, 1995; 1(2):61-69.
7. Kumar V, Swaminathan R, Singh H. Bio-efficacy of newer insecticides against sucking insect pests of Chilli. Annals of Plant Protection Sciences, 2015; 23(1):69-73.
8. Lingeri MS, Awaknavar JS, Lingappa S, Kulkarni KA. Seasonal occurrence of chilli mites (*Polyphagotarsonemuslatus* Banks) and thrips (*Scirtothripsdorsalis*Hood). Karnataka Journal of Agricultural Sciences, 1998; 11(2):380-385.
9. Mann HH, Nagpurkar SD, Kulkarni GS. The Tambera Disease of Potato. Agricultural Journal of India, 1920; 15(3):282-288.
10. Nelson SJ, Natarajan S. Economic threshold level of thrips in Semi-dry chilli. South Indian Horticulture, 1994; 42(5):336-338.
11. Patil RS, Nandihalli BS. Seasonal incidence of mite pests on brinjal and chilli. Karnataka Journal of Agricultural Sciences, 2009; 22(3):729-731.
12. Pena JE, Campbell CW. Broad mite. EDIS. New Delhi, India: Malhotra Publishing House, **25:**944-949. Plant Archives**,** 2005; 15(1):493-497.
13. Reddy AV, Srihari G, Kumar AK. Efficacy of certain new insecticides against pest, complex of chilli (*Capsicum annum* L.). Asian Journal of Horticulture, 2007; 2(2): 94-95.
14. Sontakke BK, Mohapatra LN. Bio-efficacy of buprofezin 25 SC against, *Scirtothripsdorsalis* (Hood) and yellow mite, *Polyphagotarsonemus latus* (Banks) infesting chilli. Indian Journal of Entomology, 2014; 76**(**3):177-180.
15. Srinivasan MR, Natrajan N, Planiswamy S. Evaluation of Buprofezin 25% SC and Fenpyroximate 5% SC against chilli mites (*polyphagotersonamus latus*). Indian journal of Plant Protection, 2003; 31(2):116-117.