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Management of chilli mites using newer formulations

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Abstract

Chilli (*Capsicum annuum* L.) is native to the Mexican region, an inevitable part of the Indian culinary world and renowned for its medicinal uses, and India is the world's leading chili grower and exporter. The present investigation was carried out at the Institute of Agricultural Sciences, Banaras Hindu University, vegetable research farm, Varanasi to study "management of major sucking pests of chilli (*Capsicum annuum* L.) with newer combination product*"*. Mite infestation started from first week of December and the peak was observed during the last week of December, mites showed a negative but significant correlation with maximum and minimum temperature and there was a positive non-significant correlation between mite population and relative humidity (morning and evening) and wind, there was negative non-significant correlation between rainfall and the population of mite. The newer molecules used to determine bio-efficacy of mite are spirotetramat, fenpropathrin and diafenthiuron along with combination of spirotetramat + diafenthiuron in different doses, it was observed that (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (75+300) g a.i./ha, gave an overall per cent population reduction of 65.06% in mites. Along with bio-efficacy of insecticide, its yield treatment wise found that the plot treated with spirotetramat + diafenthiuron @ (75+300) g a.i./ha gave maximum yield 4.35 tonnes/ha and about 39.04% increase in yield compared to untreated plot. Such combination products can fit into the insect pest management programme of chilli.

Keywords: Chilli, mite, spirotetramat, diafenthiuron, fenpropathrin, bio-efficacy

Introduction

Chilli (*Capsicum annuum* L.) is an important vegetable from solanaceous crops as it has made an important position in the culinary arts since 7,500 BC, its roots can be traced back to north-eastern Mexico, the spread of chili to Asia was the most awaited phenomenon of its introduction by Portuguese merchants who knew its commercial value and promoted its trade in Asian spice. It was introduced in India by the Portuguese during late 15th century; today these are grown all over the world except the cold regions. Today chillies are an indispensable part of Indian cookeries especially the Goan region as Portuguese had strong hold on it. Chillies is used in preparation of wide verities of cuisines and medicine, these can also be used in preparation of irritant weapons and also in protecting crop and food [1]

In Neuralgia, Lumbago, and Rheumatic Disorders, it may be used for medical purposes other than culinary use as a counterpart to irritant. If consumed at a higher quantity it can induce gastroenteritis, chili enzymes are used in the treatment of some forms of cancer, dehydrated green chilies are excellent vitamin C source. chillies are rich source of provitamine A and vitamin C, along this these are good source of vitamin B, and vitamin B_6 to be particular these are the very high source of potassium, magnesium and iron supplements [2]

Losses in Chilli crop are mostly due to the attack of insect pests and pathogens. Chilli is more susceptible to insect pests due to their tenderness and softness compared to other crops and absences of resistance make it more susceptible because of exhaustive hybrid cultivation. The insect pest causes losses to an extent of 40% in vegetable production. Surveys of the main pests targeting chili are aphids (*Myzus persicae* Sulzer, *Aphis gossypi* Glover), mites (*Polyphagotarsonemus latus* banks), and thrips (*Scirtothrips dorsalis* Hood) [3]. Losses in yield ranges from 50-90% caused by the chilli pests [4, 5]. Among all yellow mite is a serious non-insect pest of chilli in all tropical and sub-tropical area. Arthropod pests caused a total decline in yield of upto 76.68% joint infestation of *P. latus* (Banks), *Spodoptera dorsalis* causes a loss of 34.14% [6]

Chilli Yellow mite *Polyphagotarsonemus latus* Banks (Acarina: Acari: Tarsonemidae) is a polyphagous pest widely distributed in tropics and sub tropics and belong to the family Tarsonemidae, the broad mite was first described by Banks (1904) as *Tarsonemus latus* from the terminal bud of mango in a greenhouse in Washington D.C., USA. This microscopic pest found to infest other major horticultural crops like grapes, apple and other fruits; it has distributed worldwide and has many common names. In India and Sri Lanka it is known as yellow tea mite, while those in Bangladesh call it as yellow jute mite. In some European countries it is called as broad spider. In parts of South America, it is called as tropical mite or the broad rust mite [7]. These are microscopic eight legged arthropod females are about 0.2 mm long and oval in shape, these are light yellow or amber or green in colour these also contain a stripe which forks at the end of the body. Males are similar in colour but lack the strip. The hind legs of female are modified/reduced as whip like structure. Males are comparatively small and measure about 0.11 mm and are fast moving than females, males enlarged hind legs are used to hold females for mating purpose. Eggs are translucent and elliptical in shape and measures about 0.08 mm long, young mites or larvae have only 3 pair of legs and are about 0.1-0.2 mm long, later the nymph stage lasts for a day [8].

Mite causes terminal buds and leaves to become malformed, the toxic in saliva cause twisted hardened and distorted growth of terminal part of plant on severe cases leaves turn coppery and purplish and turn downward, the lateral buds break than normal and internode shortens and the growth stunts, fruits usually discolour in some cases premature dropping is seen many damaged fruits can't be sold in market but can be undergone for processing purpose. Look for malformed leaves and fruits as mite hide in crevices and buds if seen go for management practice

Keeping in view the present investigation "Management of major sucking pests of chilli (*Capsicum annuum* L.) with newer combination product" is carried out with the following objectives.

1. Bio-efficacy of newer insecticide combination on mites pests of chilli
2. Impact of insecticidal treatments on the yield of chilli

Materials and Methods

The trail was more concentrated on the efficacy of the newer molecules from Bayer company like spirotetramat (15.31% OD) in potentiation mixture with diafenthiuron (50% WP) in different concentration viz. (45+180), (60+240), (75+300), along with fenpropathrin (30% EC).

Table 1: Details of layout plan of the experiment

Sl. No.	Particular	Details
1	Design of experiment	RBD
2	No. of treatments	7
3	No. of replications	3
4	Plot size (net)	2.9×3.4 m
5	Distance between replication	1 m
6	Distance between plot to plot	0.40
7	Irrigation channel (width)	1m
8	Block border space	1 m
9	Row to row spacing	56cm
10	Plant to plant spacing	56cm

The field was prepared thoroughly with the addition of FYM @ 150-200 quintals, spread and mixed well in the soil 15-20 days before sowing and ridges and furrows were formed. Irrigated the furrows and transplanted 40-45 days old seedlings, with the ball of earth on the ridges.

Seeds of chilli (*Capsicum annum* L.) verity Kashi Anmol were raised in the nursery. Forty two day old seedling are transplanted in well prepared main field, before transplanting the seedling were root dipped in the Bavistin (Carbendazim) 0.1% solution to prevent the initial fungal damage to the seedling.

The fertilizer Urea, Single Super Phosphate (SSP) and Muriate of Potash (MOP) were applied to provide a recommended dose of 60 kg N, 75 Kg P_2O_5 and 60 Kg K_2O / ha respectively. The total amount of the nitrogenous fertilizer applied in three split doses. One-third amount of the urea, total amount of SSP and total amount of MOP were applied in all the plots as basal application. The remaining dose of nitrogen was applied in two splits in form of foliar application, one after first intercultural operation and second at 60 days after transplanting.

First irrigation was given immediately after transplanting and later at an interval of 10 days, hence optimum moisture level was maintained

Two to three hand weeding at 20 and 40 days after transplanting was done. Hoeing was done twice on 20 and 45 days after transplanting. The earthing-up operation was made to cover the crop root carefully and weeding was done whenever necessary during the crop season.

The spraying was done during evening hours with high volume knapsack sprayer (spray fluid 500 litres/ha approximately). The spraying was done on when the mite population was at its peak i.e. at economic threshold level (ETL) and the crop was about the 2.5-month-old. During the time of spraying protective cloth, mask and gloves were used avoid the contact of chemicals drift from plot to plot. The spraying work was done just before the evening with minimal or zero drift to other plots. The amount of insecticide or proprietary ingredient required is calculated by using the following formula:

A= B x C/D

Where: -
A= Amount of pesticides in g/ml.
B= Desired concentration.
C= Amount of spray fluid required.
D= per cent toxicant in formulation.

Table 2: Bio-efficacy of newer molecules against *Polyphagotasonemus latus* after first insecticidal spray during Rabi 2018-19.

Sl. No.	Treatments	Dosage (g a.i./ha.)	Pre-count (mites/leaf)	Mean% reduction of Mites at Different Days After 1st Insecticidal Spray				% reduction mean
			1DBS	1DAS	3DAS	7DAS	10DAS	
1	Untreated control	0	6.53	-	-	-	-	-
2	Spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC	45+180	9.53	78.05 (62.04)*	79.56 (63.1)	58.87 (50.09)	61.77 (51.79)	69.56
3	Spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC	60+240	17.06	88.66 (70.29)	89.52 (71.09)	78.69 (62.48)	82.55 (65.29)	84.86
4	Spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC	75+300	10.06	84.01 (66.41)	89.75 (71.3)	77.12 (61.4)	77.04 (61.35)	81.98
5	Spirotetramat 15.31% OD	75	11.66	76.56 (61.02)	76.81 (61.19)	59.23 (50.3)	65.63 (54.09)	69.56
6	Diafenthiuron 50% WP	300	7.66	49.48 (44.69)	49.75 (44.84)	28.58 (32.3)	45.26 (42.26)	43.27
7	Fenpropathrin 30% EC	75	11	78.01 (62.01)	81.67 (64.62)	62.55 (52.25)	65.63 (54.09)	71.97
S.Em. ±			0.332	0.07	0.054	0.052	0.027	
C.D. at 5%			NS	0.216	0.165	0.16	0.082	

Table 3: Bio-efficacy of newer molecules against *Polyphagotasonemus latus* after second insecticidal spray during Rabi 2018-19.

Sl. No.	Treatments	Dosage (g. a.i./ha.)	Pre-count (mites/leaf)	Mean% reduction of Mites at Different Days After 2nd Insecticidal Spray				% reduction mean
			1DBS	1DAS	3DAS	7DAS	10DAS	
1	Untreated control	0	4.05	-	-	-	-	-
2	Spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC	45+180	1.275	45.62 (42.47)*	54.51 (47.57)	30.29 (33.38)	2.18 (8.49)	33.15
3	Spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC	60+240	0.825	55.31 (48.03)	50.3 (45.15)	36.32 (37.04)	34.93 (36.22)	44.215
4	Spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC	75+300	0.975	56.85 (48.92)	55.11 (47.91)	44.41 (41.77)	36.16 (36.95)	48.1325
5	Spirotetramat 15.31% OD	75	1.35	45.68 (42.51)	39.08 (38.68)	21.28 (27.46)	17.67 (24.85)	30.9275
6	Diafenthiuron 50% WP	300	1.5	42.32 (40.57)	13.1 (21.21)	8.35 (16.79)	13.2 (21.29)	19.2425
7	Fenpropathrin 30% EC	75	0.6	58.11 (49.65)	76.05 (60.67)	19.62 (26.28)	20.36 (26.81)	43.535
S.Em. ±			0.082	0.128	0.172	0.172	0.161	
C.D. at 5%			0.027	0.042	0.056	0.056	0.052	

* Figures in parenthesis are Arc Sine transformed values
DAS= Days after spraying
DBS= Days before spraying

Table 4: Overall efficacy of newer molecules against *Polyphagotasonemus latus* after two insecticidal spray during Rabi 2018-19.

Sl. No.	Treatments	Dosage (g a.i./ha.)	% Mean reduction of mites		Overall% reduction of population
			1st spray	2nd spray	
1	Untreated control	0	-	-	-
2	Spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC	45+180	69.56	33.15	51.36
3	Spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC	60+240	84.86	44.215	64.54
4	Spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC	75+300	81.98	48.1325	65.06
5	Spirotetramat 15.31% OD	75	69.56	30.9275	50.24
6	Diafenthiuron 50% WP	300	43.27	19.2425	31.26
7	Fenpropathrin 30% EC	75	71.97	43.535	57.75

Results and Discussion

The population comprised with alive adults and nymphal stages of mites, the observation was taken with the help of stereoscopic binocular microscope under laboratory at 1, 3, 7, and 10 days after 1st and 2nd spray schedules. The insecticides like fenpropathrin and difenthiuron were also proved to be effective against chilli mite *Polyphagotarsonemus latus* (Banks) [9, 10, 11].

Result of 1st spray (table-2), maximum reduction in mite population was shown (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (60+140) g a.i./ha, and (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC@ (75+300) g a.i./ha. The insecticides were ranked as following order based on their overall performance in reduction of mite population from chilli plant, after first spray (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (60+240) g a.i./ha > and (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC@ (75+300) g a.i./ha. > (fenpropathrin 30% EC) @ 75 g a.i./ha > (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (45+180) g a.i./ha = (spirotetramat 15.31% OD) @ 75 g a.i./ha > diafenthiuron 50% WP @ 300 g a.i./ha. The study on efficacy of insecticide against yellow tea mite *polyphagotarsonemus latus* on chilli crop indicates that, the maximum mean per reduction of yellow mite was occurred when treated with (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (60+140) g a.i./ha, (84.86%), and (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (75+300) g a.i./ha (81.98%), (fenpropathrin 30% EC) @ 75 g a.i./ha (71.97%).Moderate control or reduction in population was obtained with application of (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (45+180) g a.i./ha (69.56%), spirotetramat 15.31% OD @ 75 g a.i./ha (69.56%) and diafenthiuron 50% WP @ 300 g a.i./ha (43.27%) and the experiment also revealed that, the decrease in yellow mite population by the chemicals is statistically significant at 5 per cent probability level in comparison to control.

Kumar *et al*., (2015) [12] reported that the highest proportion of Fipronil 5% SC are most effective compared to diafenthuiron 50% WP for managing the mite population in chilli.

The result of second spray (table-3) Maximum reduction in mite population was shown (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (75+300) g a.i./ha, and (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC@ (60+240) g a.i./ha. The insecticides was ranked as following order based on their overall performance in reduction of mite population from chilli plant, after first spray (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (75+300) g a.i./ha > (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC@ (60+240) g a.i./ha. > (fenpropathrin 30% EC) @ 75 g a.i./ha > (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (45+180) g a.i./ha > (spirotetramat 15.31% OD) @ 75 g a.i./ha > diafenthiuron 50% WP @ 300 g a.i./ha. The study on efficacy of insecticide against yellow tea mite *polyphagotarsonemus latus* on chilli crop indicates that, the maximum mean per cent reduction of yellow mite was occurred during second spray when treated with (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (75+300) g a.i./ha, (48.13%), and (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (60+240) g a.i./ha (44.21%), (fenpropathrin 30% EC) @ 75 g a.i./ha (43.53%).Moderate control or reduction in population was obtained with application of (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (45+180) g a.i./ha (33.15%), spirotetramat 15.31% OD) @ 75 g a.i./ha (30.92%) and diafenthiuron 50% WP @ 300 g a.i./ha (19.24%) and the experiment also revealed that, the decrease in yellow mite population by the chemicals is statistically significant at 5 per cent probability level in comparison to control.

When we compare per cent reduction of mite population with different insecticidal concentration treatments after first and second spray during *Rabi* 2018-19 (table-4) it was observed that (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (75+300) g a.i./ha, and (spirotetramat 30g/l +diafenthiuron 120 g/l w/v SC) @ (60+240) g a.i./ha were on-par to each other with 65.06% and 64.54% overall% reduction respectively. Both of the treatments found to be effective in both first and second spray. Vanisree *et al*. (2013) [13] have reported that among some novel insecticides Spinosad 0.015% proved most effective against S. dorsalis followed by Diafenthiuron 0.045%, Pymetrozine 0.02% and Fipronil 0.01%.

Conclusion

Evaluation of bio-efficacy was our major goal in this experiment as the need of hour dwells in requirement of newer and better molecule than that of existing one hence we tested bio-efficacy of fewer newer molecules like fenpropathrin, diafenthiuron along with spirotetrmat and also there was combination of two chemicals spirotetrmat + diafenthiuron in different concentration *viz.* (45+180), (60+240), and (75+300) g a.i./ha. The chemicals like fenpropathrin, diafenthiuron, and spirotetrmat were tested under field condition and were seen to perform well, and was reported by many but there is little to no work has been done for spirotetramat + diafenthiuron combination. From our experimental findings it was found that there was an expected outcome of chemical whereas the treatment comprising spirotetramat + diafenthiuron @ (75+300) g a.i./ha gave maximum control as compared to that of other chemicals.

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