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Evaluation of certain acaricides against yellow mite, *Polyphagotarsonemus latus* (Banks)

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Abstract
An experiment was carried out to evaluate the efficacy of seven acaricides against yellow mite *Polyphagotarsonemus latus* (Banks) in chilli during 2013, at the Department of Entomology, Jorhat, Assam. All the seven acaricides tested were significantly superior in controlling *P. latus* as compared to the untreated control. The highest reduction of the mite was obtained with fenpyroxymate 5 SC @ 30 g.a.i/ha (100%) up to 14th day after second spraying and was at par with ethion 50 EC @ 500 g.a.i/ha (96.90%), profenofos 50 EC @ 500 g.a.i/ha (96.88%), etoxazole 10 SC @ 40 g.a.i/ha (95.77%), spiromesifen 240 SC @ 240g.a.i/ha (93.26%), and fenazaquine 10 EC @ 125 g.a.i/ha (92.35%). On the other hand propargite 57 EC @ 570 g.a.i/ha registered the lowest reduction of mite population i.e. (63.16%) as compared to other acaricides. The highest mean yield of 5681.8 kg/ha was obtained from fenpyroxymate 5 SC @ 30 g.a.i/ha treated plots and lowest yield of 909.09 kg/ha was obtained from control plots. The benefit cost ratio was worked out and fenpyroxymate registered the highest benefit cost ratio of 5.76 over the control. Hence considering the control of mites and benefit-cost ratio fenpyroxymate 5 SC @ 30 g.a.i/ha was the best treatment against yellow mite, *P. latus* in chilli.

Keywords: *Polyphagotarsonemus latus*, efficacy, acaricides, chilli

Introduction
Chilli is an important spice crop belonging to the genus Capsicum under the solanaceae family. Chilli is a good source of vitamin A, C and E. The fruits contain an alkaloid 'Capsaicin' which imparts pungency and has high medicinal properties [1]. The native home of chilli is considered to be Mexico with the secondary origin being Guatemala. Chilli was first introduced by the Portuguese traders to India, Indonesia and other parts of Asia, around 450-500 years ago [2] and since then, it has gained importance as an important spice and vegetable crop earning valuable foreign exchange. India is the largest producer and consumer of chillies in the world [3]. India contributes one fourth of the world's production of chilli with 10.18 lakh tonnes on an area of 9.15 lakh hectares [4]. During 2010-11, chilli was grown in an area of 794.10 thousand hectare with a production of 1304.40 thousand tonnes and the yield was 1.64 tonnes per hectare (Directorate of Arecanut and spices Development, DASD). The three Asian countries *viz*., India China and Pakistan occupy the top three positions as the largest producer of chilli in the world, respectively. Although chilli is cultivated in almost all parts of the country, Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu and Orissa constitute about 85 percent of total production.

The production, productivity and market for chilli are affected by various limiting factors among which consequences of damage to quantity as well as quality caused by insect pests are significant ones. A complex of more than 293 insects pest associated with chilli have been reported [5], among which sucking pests like thrips, mite and whiteflies are important ones. Leaf curl caused by mites and thrips is serious [6] and yield losses due to these two pests are estimated to the tune of 50 percent [7, 8]. Under favourable weather situations, the yield loss due to yellow mite alone may go up to 96.39 percent, leading sometimes to complete crop failure [9].

The yellow mite; *Polyphagotarsonemus latus* (Banks) also known as a broad mite, is an important pest of chilli from the family Tarsonemidae. It was first described by Banks (1904) as *Tarsonemus latus* [10] from the terminal buds of mango, in Washington, D.C., USA [11]. Broad mite is polyphagous, frequently encountered, and widely distributed in the tropics and subtropics. They infest plants throughout the year in major chili growing areas of Karnataka and their infestation rate is very high compared to other pests. It is considered as a major pest

and one of the responsible factors for the spread of virus, causing leaf curl in chilli. This destructive pest causes malformation of terminal leaves and flower buds. The mite's toxic saliva causes twisted, hardened and distorted growth in the terminal parts of the plant [12]. They are usually seen on the newest leaves and small fruits. Leaves curl downward and coppery or purplish. Although the commonly used insecticides with some acaricidal action gives some control, it is reported that the application of commonly used insecticides aimed at checking sucking pests like thrips and aphids caused a resurgence of *P. latus* on chilli [13, 14] and sometimes at high dose they turn out to be a threat to beneficial insects. But as the conditions of outbreak and sever infestation require us to pick chemical control as the first line of defence against these pests to minimize economic loss it is therefore imperative to evaluate some acaricides which are ecosafe, economic and effective at low application rates.

2. Materials and Methods

2.1 Experimental site and location

The Field experiment was conducted to assess the efficacy of seven different acaricides against yellow mite, *P. latus*, on chilli. The experiment was conducted under field condition having homogeneous fertility and uniform textural makeup in the Department of Entomology. The experiment was laid out in a Randomized Block Design with 8 treatments and three replications each. The variety selected was Pusa Juwala which is susceptible to yellow mite was selected and grown by following all the recommended package and practices of Assam.

2.2 The treatment details are as follow

T_1: Propargite 57 EC @ 570 g *a.i*/ha
T_2: Fenazaquine 10 EC @ 125 g *a.i*/ha
T_3: Etoxazole 10 SC @ 40 g *a.i*/ha
T_4: Fenpyroxymate 5 EC @ 30 g *a.i*/ha
T_5: Spiromesifen 240 SC@ 240 g *a.i*/ha
T_6: Ethion 50 EC @ 500 g *a.i*/ha
T_7: Profenofos 50EC @ 500 g *a.i*/ha (as check treatment)
T_8: Control (Untreated)

2.3 Application of treatment

All the treatments were applied on chilli crop with hand sprayer at the rate of 500 litres of water per hectare. Polythene sheet partitions were raised at the time of spraying between the adjacent plots so as to prevent drift of acaricidal spray. First spraying was done at the first appearance of the symptoms and number of mites count (mites/leaf). The sprayer was washed thoroughly prior to the application of each treatment. Second spray was repeated at 15 days interval.

2.4 Sampling and method of observation

To evaluate the effect of foliar spray of various treatments on the population of mites, mite counts were made on four randomly selected plants from each plot. Three randomly selected leaves from the upper, middle and lower canopy of each selected plant were plucked and held in separate, properly labelled polythene bags and brought to the laboratory for counting mite population (live) under a stereo zoom binocular microscope at 4X magnification. Pre-treatment count was done one day before spraying and post treatment counting were made on 1, 3, 7, 14 days after spraying (DAS). The data so obtained on mite count were summed up and converted to number of mite per leaf basis. The yield of green chilli (fruits/plot) was recorded from all the staggered harvesting and total yield per ha in kilogram was worked out.

2.5 Statistical Analysis

The data were statistically analysed using fisher test after square root transformation so as to compare the effectiveness of acaricides against the yellow mite, *P. latus.* Finally all the transformed values were analyzed by using analysis of variance (ANOVA) for Randomized Block Design [15].

2.6 Estimation of reduction or increase in yellow mite population

The reduction or increase in yellow mite population was done by the formula given below:

$$0\text{Reduction (-) / increase (+)} = \frac{\text{Number of mites at Pre spraying count} - \text{number of mites at 1, 3, 7, 14 DAS}}{\text{Number of mites at pre spraying count}} \times 100$$

2.7 Benefit-cost ratio

The benefit cost ratio was worked out over control as shown below.

$$\text{Benefit - Cost ratio} = \frac{\text{Return in treatment (kg/ha)}}{\text{Return in control (kg/ha) + cost of acaricides and labour (kg/ha)}}$$

3. Results and discussion

Efficacy of certain acaricides were tested against yellow mite, *P. latus* during 2013. The highest mean number of mites recorded was 9.45 per leaf and the minimum was 5.72 per leaf, which was above ETL *i.e* 1 mite/leaf. Data presented in Table 1 showed that there was no significant difference in mite population among the plots one day before spraying.The data are presented as the reduction of mites in the number basis (Table 1 & Table 3) and percent reduction (Table 2 & Table 4).

The data offered significant difference among the treatments. The most effective result in reducing mite population up to seven days after first spraying was observed with fenpyroximate 5 EC (30 g *a.i*/ha), fenazaquine 10 EC (125 g *a.i*/ha) and spiromesifen 240 SC (240 g *a.i*/ha), all of which recorded 100 percent reduction in mite population and were statistically at par with etoxazole 10 SC (40 g *a.i*/ha), ethion 50 EC (500 g *a.i*/ha), and profenofos 50 EC (500 g *a.i*/ha), which recorded 99.33, 99.18 and 96.50 percent reduction and 0.80 0.06 and 0.20 mean number of mites, respectively. Whereas propargite 57 EC (570 g *a.i*/ha) was significantly different from the rest of the treatments and resulted in 64.02 percent reduction and 3.40 mean number of mites (Table 1 and Table 2). The data recorded after fourteen days of first spraying, revealed that etoxazole 10 SC (98.56% & 0.13), fenpyroximate 5 EC (98.57% & 0.13), spiromesifen 240 SC (97.38% & 0.20), and ethion 50 EC (99.18% & 0.06), were at par in reducing mite population in basis of percentage and mean number of mites basis, respectively. Whereas there was significant difference among the treatment Fenazaquine 10 EC (78.72% & 0.53), profenofos 50 EC (59.43% & 14.10) and propargite 57 EC (23.17% & 12.30) in reducing the mite population in basis of percentage and mean number of mites (Table1 & Table 2). The increase in mite population on the fourteenth day may be due to movement of mite from untreated plots to those treated plots or due to the non-persistency of the acaricides.

After the second spraying of acaricides against *P. latus* it was observed that all the treatments significantly reduced the *P. latus* population per leaf as compared to control. The perusal of data recorded after seven days of the second spraying reveled superiority of fenpyroximate 5 EC (100% and 0), fenazaquine 10 EC (100% and 0) and spiromesifen 240 SC (100% & 0), in reducing mite population in percent and number basis which was at par with etoxazole 10 SC (96.47% & 0.05), ethion 50 EC (98.57%) and profenofos 50 EC (97.97% & 0.06). However, propargite 57 EC was significantly different from the rest of the treatments and resulted in 63.16 percent reduction of mite population. (Table 3 and Table 4). Fenpyroximate 5 EC (30 g a.i/ha) maintained its superiority upto fourteenth day after second spraying and showed 100 percent reduction of mite population and was at par with fenazaquine 10 EC, etoxazole 10 SC, spiromesifen 240 SC, ethion 50 EC, and profenofos 50 EC which resulted in 92.35, 95.77, 93.26, 96.90 and 96.88 percent control respectively. Whereas propargite 57 EC, showed significant difference and recorded an increase in mite population by 4.37 percent which might be due to migration of mite from the nearby untreated control plots or due to non-persistency of the acaricides. The present findings are in accordance with Shrinivasa *et al.* [16] who evaluated the field efficacy of certain newer acaricide molecules against *P. latus* and found that, dicofol (2.5 ml/lit), sulphur (4 ml/lit) and fenazaquine (2 ml/lit) were found most effective in reducing mite population and were at par with abamectin (0.4 ml/lit). The present findings are also similar to Pathipati *et al.* [17] they evaluated certain new acaricides/ insecticides against chilli mite and found fenpyroximate 5 EC recorded (92.55%) reduction of yellow mite population. Again Tomar and Singh [18] evaluated the efficacy of two new acaricides viz., propargite 57 EC @ 750, 1000 and 2000 ml/ha, fenpyroxymate 5 EC @ 100, 200, 500 ml/ha against two spotted spider mite, *Tetranychus urticae* Koch and found fenpyroxymate 5 EC @ 500ml/ha was highly effective to combat *T. urticae* followed by propargite 57 EC (Omite) @ 1000ml/ha. Similarly Jeyarani *et al.* [19] conducted field experiment to evaluate the efficacy of propargite 57 EC against *P. latus* on the variety K-2 hybrid and reported propargite @ 570 g a.i/ha resulted in 65.78 percent cumulative mean reduction of mites.

The benefit cost ratio was worked out which revealed that maximum yield /ha were obtained from fenpyroximate 5 EC, treated plots *i.e* 5681.81 kg/ha. The minimum green chilli yield was obtained from the control plot *i.e* 909.09 kg/ha. Fenpyroximate 5 EC recorded the highest benefit cost ratio of 5.76 which marks fenpyroximate as the best treatment. These findings are in accordance with those of Pathipati *et al.* [17] where he reported that fenpyroxymate 5 EC @ 500 ml/ha treated plot recorded highest yield compared to control (Table 4).

Table 1: Efficacy of certain acaricides against yellow mite, *P. latus* infesting chilli after 1st spraying during 2013

Treatment	Dose (g a.i/ha)	Mean number of mites per leaf (Pre-treatment)	Mean number of mites per leaf at different days after 1st spraying (post-treatment)			
			1 DAS	3 DAS	7 DAS	14 DAS
T_1 : Propargite 57 EC	570	9.45 (3.13)	5.40 (2.41)	4.66 (2.26)	3.40 (1.97)	12.30 (3.75)
T_2 : Fenazaquine 10 EC	125	6.25 (1.95)	0.13 (0.79)	0.06 (0.75)	0 (0.70)	0.53 (0.99)
T_3 : Etoxazole 10 SC	40	9.05 (3.08)	0.06 (0.75)	0.40 (0.93)	0.80 (1.39)	0.13 (0.79)
T_4 : Fenpyroxymate 5 EC	30	9.13 (3.07)	0.06 (0.75)	0 (0.70)	0 (0.70)	0.13 (0.79)
T_5 : Spiromesifen 240 SC	240	7.64 (2.84)	0.40 (0.93)	0.20 (0.83)	0 (0.70)	0.20 (0.83)
T_6 : Ethion 50 EC	500	7.38 (2.79)	0.13 (0.79)	0.33 (0.90)	0.06 (0.75)	0.06 (0.75)
T_7 : Profenofos 50 EC	500	5.72 (2.44)	0.93 (1.16)	0.20 (0.83)	0.20 (0.70)	14.10 (3.05)
T_8 : Control	Water spray	8.19 (2.90)	11.93 (3.85)	16.80 (4.14)	22.60 (4.35)	16.86 (4.15)
S.Em(±)		NS	(0.18)	(0.16)	(0.30)	(0.43)
CD(0.05)		-	(0.39)	(0.35)	(0.64)	(0.92)

DAS: Days after spray; Figures in the parenthesis are square root transformed values

Table 2: Population reduction of mites due to acaricidal spray after 1st spraying, 2013

Treatment	Dose (g a.i/ha)	Percent reduction of mites per leaf at different days after1st spraying			
		1 DAS	3 DAS	7 DAS	14 DAS
T_1 : Propargite 57 EC	570	42.85	50.68	64.02	23.17+
T_2 : Fenazaquine 10 EC	125	97.92	100	100	78.72
T_3 : Etoxazole 10 SC	40	91.16	95.58	99.33	98.56
T_4 : Fenpyroxymate 5 EC	30	99.34	100	100	98.57
T_5 : Spiromesifen 240 SC	240	94.76	97.38	100	97.38
T_6 : Ethion 50 EC	500	94.76	95.52	99.18	99.18
T_7 : Profenofos 50 EC	500	83.74	96.50	96.50	59.43+
T_8 : Control	Water spray	31.34+	51.25+	63.76+	51.42+

± : Represents the percent increase and other values represent percent reduction in population, DAS: Indicate Days after spraying

Table 3: Efficacy of certain acaricides against the yellow mite, *P. latus* infesting chilli after 2nd spraying during 2013

Treatment	Dose (g a.i/ha)	Mean number of mites per leaf (Pre-treatment)	Mean number of mites per leaf at different days after 2nd spraying (post-treatment)			
			1 DAS	3 DAS	7 DAS	14 DAS
T_1 : Propargite 57 EC	570	14.66 (3.88)	8.19 (2.90)	7.64 (2.84)	5.72 (2.44)	15.33+ (3.93)
T_2 : Fenazaquine 10 EC	125	1.70 (1.46)	0.13 (0.79)	0.06 (0.75)	0 (0.70)	0.13 (0.79)
T_3 : Etoxazole 10 SC	40	1.42 (1.02)	0.13 (0.79)	0.06 (0.75)	0.05 (0.73)	0.06 (0.75)
T_4 : Fenpyroxymate 5 EC	30	0.68 (1.28)	0.06 (0.75)	0 (0.70)	0 (0.70)	0 (0.70)
T_5 : Spiromesifen 240 SC	240	1.93 (1.46)	0.06 (0.75)	0.06 (0.75)	0 (0.70)	0.13 (0.78)
T_6 : Ethion 50 EC	500	4.20 (2.10)	0.33 (0.90)	0.24 (0.86)	0.06 (0.75)	0.13 (0.79)
T_7 : Profenofos 50 EC	500	12.83 (3.64)	0.40 (1.06)	0.33 (0.90)	0.26 (0.82)	0.40 (0.93)
T_8 : Control	Water spray	14.06 (3.81)	14.86 (3.90)	5.40 (2.41)	9.20 (3.08)	10.90 (3.34)
S.Ed(±)		(0.42)	(0.25)	(0.40)	(0.21)	(0.25)
CD(0.05)		(0.89)	(0.54)	(0.85)	(0.46)	(0.54)

DAS: Days after spray; Figures in the parenthesis are square root transformed values

Table 4: Population reduction of mites due to acaricidal spraying and economics of the treatment, 2013

Treatment	Dose (g a.i/ha)	Percent reduction of mites per leaf at different days after 2nd spraying				Yield/plot (kg/ha)	Benefit cost ratio
		1 DAS	3 DAS	7 DAS	14 DAS		
T_1 : Propargite 57 EC	570	44.74	47.88	63.16	4.37+	2045	2.08
T_2 : Fenazaquine 10 EC	125	92.35	96.47	100	92.35	4318.18	4.31
T_3 : Etoxazole 10 SC	40	90.84	95.77	96.47	95.77	3863.6	4.09
T_4 : Fenpyroxymate 5 EC	30	91.17	100	100	100	5681.8	5.76
T_5 : Spiromesifen 240 SC	240	96.89	96.89	100	93.26	3863.6	3.77
T_6 : Ethion 50 EC	500	92.14	94.28	98.57	96.90	3954.5	4.17
T_7 : Profenofos 50 EC	500	96.88	97.42	97.97	96.88	4090.9	4.24
T_8 : Control	Water spray	5.38+	61.59	34.56+	22.47+	909.09	-

+ : Represents the percent increase and other values represent percent reduction in population, DAS: Indicate Days after spraying

4. Conclusion

The study revealed that Fenpyroximate 5 EC @ 30 g *a.i*/ha was the best treatment in reducing *P. latus* population upto 14 days of spraying. It also registered highest benefit cost ratio of 5.76 over control. Therefore on the basis of the present findings of population reduction of mites and the benefit- cost ratio, fenpyroximate 5 EC @ 30 g *a.i*/ha may be recommended against yellow mite, *P. latus* on chilli.

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