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Evaluation of Novel and Conventional Acaricides against Yellow Mite, *Polyphagotarsonemus latus* (Banks) on Chilli and their Effect on Prevailing Natural Enemies, *Amblyseius* sp. in Varanasi Region

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A B S T R A C T

Eleven acaricides including one control, were evaluated at field condition on the chilli yellow mite and on its natural enemies *Amblyseius* sp. in Varanasi, U. P. The numbers of yellow mites were recorded in 1 cm^2 area at four spots on 30 leaves per treatments at 1, 3, 7 and 14 days interval after the spray and the predatory mite populations were counted on weekly interval after spray. Among treatments, Abamectin recorded highest yellow mite mortality with 89.94%, followed by Diafenthiuron (82.27%) and Milbemectin (77.27%). In case of the predator *Amblyseius* sp., cent percent mortality was seen by Fenzaquin10 EC, followed by Ethion 50 EC. The pesticides like Diafenthiuron 50 SC (3.02), Sulphur 80 WP and Azadirachtin 10000 PPM were proved to be safer to *Amblyseius* sp., so could be recommended for use in integrated chilli mite pest management practices.

Introduction

Yellow mite, *Polyphagotarsonemus latus* (Banks) (Acari; Tarsonemidae) represent economically important pests of chilli in greenhouses and crop fields all over the world. Chilli is leading vegetable as well as important commercial spice crops of India. The Yellow mite, *Polyphagotarsonemus latus* (Banks) (Acari; Tarsonemidae) is a well-known agricultural pest of chilli crop. It is the most injurious polyphagous pest infesting chilli crop in the field at its multiple stages. Yellow mite is difficult to control with pesticides due to inaccessibility of lower leaf surfaces, short life cycle, high reproductive capacity and ability to develop resistance to acaricides.

Chilli occupies the first position among the spices produced in India, with a production share of 30% under main spices in India. Chilli is cultivated in 775 thousand hectare with total production of chilli is 1482 thousand metric ton and productivity of chilli is 1.9 million ton per hectare (Data base-2014,

National Horticulture Board). Heavy menance of pests is the major constraint in the production and productivity of chilli. *Polyphagotarsonemus latus* (Banks) may even cause 100% loss under glass house condition (Liu *et al.,* 1991). Infestation by the yellow mite during the early pre-flowering stage culminates in the failure of ascending flower bud and petiole. Incidence of Chilli Yellow Mite is becoming very severe particularly in Varanasi and Mirzapur district in Uttar Pradesh of India. The oviposition punctures inflicted by nymphalas well as adult female might turn the plant fragile and weak, causing premature falling to a tune of 10-90%, depending on the intensity of devastation and management competence. This destructive pest causes terminal leaves and flower buds to become malformed. The mite's toxic saliva causes twisted, hardened and distorted growth in the terminal of the plant (Baker, 1997). Mites are usually seen on the newest leaves and small fruit. Leaves turn downward and turn coppery or purplish. Internodes shorten and the lateral buds break more than normal. The blooms abort and plant growth is stunted when large populations are present (Denmark, 1980; Wilkerson *et al.,* 2005; Anonymous, 2010).

Pesticide residues are the major problems in increasing our exports. Buyers expect a high degree of hygiene and sanitation in processing and preparation of chillies for export. The consumers in importing countries insist on 'clean spices'. This can be accomplished only through an integrated approach with the collective efforts of farmers, processors and traders (Thamaraikannan *et al.,* 2011). Due to this notorious pest farmers are facing great loss in there income in Varanasi and its nearby regions of Uttar Pradesh. So this study on chilli mite on chilli cultivar (KA-2) was conducted, to study the infestation of this mite and its comparative best management by some novel and conventional pesticides.

Materials and Methods

Field experiments were conducted during *Kharif* seasons of 2010-2012 in a randomized block design with eleven treatments replicated three times at the Institute of Agricultural sciences, Banaras Hindu University, Varanasi. The treatments included Diafenthiuron 50SC, Abamectin 1.9 EC, Milbemectin 1EC, Propargite 57 EC, Fenzaquin 10EC, Fenpropathrin 30 EC, Dicofol 18.5EC, Ethion 50 EC, Sulphur 80WPand Azadirachtin 10000 PPM for foliar spray at fortnightly interval. The mean per cent reduction data of yellow mite was recorded at 1, 3, 7, and 14th days after spraying of pesticides. Chilli variety KA-2 was planted in plots of size 3m x 3m at spacing of 30cm x 45cm with recommended package of practices except other insecticidal applications. Foliar application of pesticides was done by hand compression sprayer, when mite population was at pick.

The observations were recorded from five plants selected from each plot those were tagged and numbered. Two leaves were taken from upper, middle and lower portion of the tagged plants (total of 06 leaves) collected from each plant and 30 leaves from each plot and kept in a separate polythene bag and brought the leaves in a laboratory. The population comprised with alive adults and nymphal stages of mites were counted with the help of stereoscopic binocular microscope on pretreatment, after 1, 3, and 7 and 14 days of spraying in the treatment. The data of reduction of mite population in field experiments were calculated in to per cent reduction by using following Abbot's formula (1925).

The per cent reductions in mite population at various days were transformed in to Arc Sine √percentage. The number of natural enemies, *Amblyseius* sp was also counted like yellow mite on 10 randomly selected plants as pre-

treatment count and post-treatment count (after 7 DAS). The treatment effect was analysed by analysis of variance between treatments and mite population with CD at 5% level of significance. All the statistical analysis was performed by using the online analysis programme OPSTAT.

Results and Discussion

Effect on Yellow mite (*P. latus*)

In the research conducted to judge the bioefficacy of the novel pesticides against *P. latus* and its predatory mite revealed that, overall percent reduction increase mean of two applications of chilli mite/leaf before application of pesticides varied between 16.21-18.33. Pre-treatment counts of mite made a day before first spray did not exhibit significant variation in population among different treatments. The results were represented in Table-1 consist of mean comparison of the data, regarding the treatment effect on yellow mite population and percent reduction, at different post-treatment intervals. It was noticed that during first round of spraying maximum mortality in mite population was showed in Abamectin 1.9 EC (62.58%), followed by Fenpropathrin 30EC (60.20%), Propargite 57 EC(60.00%), the Milbemectin 1 EC (59.60%) and Diafenthiuron 50 SC (58.12%) respectively. Whereas Fenzaquin10 EC (46.72%) and Dicofol 18.5 EC (46.03%) showed moderate mean per cent reduction in mite population. Ethion 50 EC (35.00%), Azadirachtin10000 PPM (17.36%) and Sulphur 80WP (12.79%) poorly performed and showed less efficacy against mite population.

After the third day of spraying, Abamectin1.9 EC showed mite reduction of (72.54%), Diafenthiuron 50 SC (67.05%), and Milbemectin1 EC (64.16%) and performed very good with maximum reduction in mite population (Table 1). The Propargite 57 EC (62.44%), Fenpropathrin 30 EC (60.40%) and Fenzaquin10 EC (47.93%) showed moderate performance on mite population. Dicofol 18.5 EC (42.94%), Ethion 50 EC (38.17%), Azadirachtin 10000 PPM (23.73%) and Sulphur 80WP (17.36%) poorly performed and showed less effect on mite population. The Abamectin (76.31%), Diafenthiuron (67.70%) and Fenpropathrin 30 EC (62.58%) were given maximum mean per cent reduction in mite population on the seventh day of spraying. Moderate performance showed in Milbemectin1 EC (61.96%), Propargite 57 EC (59.93%), Fenzaquin10 EC (48.62%), Dicofol 18.5 EC (44.26%), Ethion 50EC (46.26%), Azadirachtin10000 PPM (17.36%) and Sulphur 80 WP (35.55%) showed very less effect on mite population. The Abamectin (77.48%), Diafenthiuron 50 SC (68.36%) and Milbemectin1 EC (60.40%), were given maximum mean per cent reduction in mite population on the 14th day of spraying. Moderate performance showed in Dicofol 18.5 EC (51.30%), Propargite (50.18%), Ethion 50 EC (46.26%) and Azadirachtin 10000 PPM (44.54%). The Fenpropathrin 30 EC (41.50%), Sulphur 80% WP (39.58%) and Fenzaquin 10 EC (37.88%) showed poor effect on mite population.

Mean percent reduction over control in pooled data of two spray both the years the result showed that all the novel and conventional acaricides were effective with mean percent mortality in the range of 19.91 to 71.47 in first and second spray percent mortality over control. Abamectin recorded highest mortality with 62.58, 72.54, 76.31 and 77.48 percent after 1, 3, 7 and 14 days after spray and lowest protection was given by sulphur with 12.79, 17.36, 35.55 and 39.58 percent mortality over control respectively.

Table.1 Evaluation of novel and conventional acaricides against Yellow mite, *P. latus* (Banks) on chilli

Acaricides	Dose	Pre-spraying mean population per leaf	*Mean per cent reduction in mite population day after spraying				*Mean	*Mean Yield (qt/ha)	% increase in yield over control
			1 DAS	3 DAS	7 DAS	14 DAS			
Diafenthiuron 50 SC	0.75 gm/lit	17.38	72.11 (58.12)	84.84 (67.05)	85.68 (67.70)	86.47 (68.36)	82.27 (65.05)	25.67	63.65
Abamectin 1.9 EC	0.70 ml/lit	16.21	78.89 (62.58)	91.06 (72.54)	94.47 (76.31)	95.34 (77.48)	89.94 (71.47)	24.75	62.30
Milbemectin 1 EC	0.75 ml/lit	18.33	74.47 (59.60)	81.06 (64.16)	77.94 (61.96)	75.64 (60.40)	77.27 (61.48)	21.83	57.26
Propargite 57 EC	2.0 ml/lit	16.76	75.01 (60.00)	78.63 (62.44)	74.97 (59.93)	59.08 (50.18)	71.92 (57.99)	23.75	60.71
Fenpropathrin 30 EC	0.5 ml/lit	16.56	75.39 (60.20)	75.64 (60.40)	78.89 (62.58)	37.74 (37.88)	66.91 (54.88)	20.67	54.86
Fenzaquin10 EC	2.0 ml/lit	16.49	46.72 (43.11)	55.19 (47.93)	56.31 (48.62)	43.96 (41.50)	50.54 (45.29)	13.67	31.74
Dicofol 18.5 EC	2.7 ml/lit	16.90	51.82 (46.03)	46.40 (42.94)	48.74 (44.26)	60.94 (51.30)	51.97 (46.09)	23.17	59.73
Ethion 50 EC	2.00 ml/lit	16.40	32.90 (35.00)	38.20 (38.17)	46.61 (43.05)	52.23 (46.26)	42.48 (40.63)	14.43	35.34
Sulphur 80 WP	3.12gm/Kg	16.51	4.98 (12.79)	8.95 (17.36)	33.82 (35.55)	40.65 (39.58)	22.10 (28.04)	17.70	47.28
Azadirachtin 10000 PPM	2.0 ml/lit	16.88	8.95 (17.36)	16.24 (23.73)	42.61 (40.74)	49.29 (44.54)	29.27 (32.71)	11.33	17.67
Control (Water Spray)	-	16.57	1.84 (7. 71)	8.92 (17.36)	16.21 (23.73)	19.49 (26.13)	11.61 (19.91)	9.33	-
SEM ±		-	**3.742**	**3.951**	**3.715**	**5.072**	-	**1.662**	
CD (0.05)		-	**1.250**	**8.242**	**7.748**	**10.579**	-	**2.432**	
Significance		**NS**	**S**	**S**	**S**	**S**		**S**	

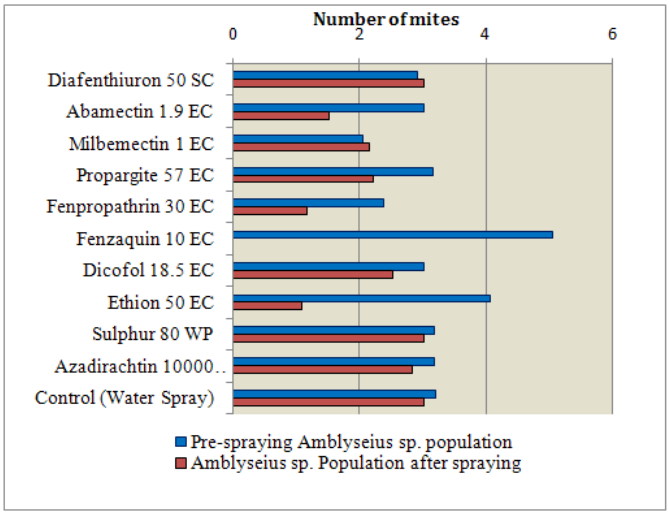
*Mean of three replications, Values in the parenthesis were Acr-sine transformed
DAS- Days after spraying, S- Signifiant, NS- Nonsignifican

Table.2 Effect of pesticides on the population of natural enemy, *Amblyseius* sp. (Pooled data of *Kharif*, 2010- 11 and 2011-12)

Treatments	Dosage (g a.i/ha)	Dose	Pre-spraying mean population per leaf	Population of predatory mite (*Amblyseius sp.*) /30 leaves
Diafenthiuron 50 SC	400	0.75 ml/lit	2.92	3.02
Abamectin 1.9 EC	70	0.70 ml/lit	3.02	1.52
Milbemectin 1 EC	3.5	0.75 ml/lit	2.05	2.15
Propargite 57 EC	1000	2.0 ml/lit	3.16	2.22
Fenpropathrin 30 EC	100	0.5ml/lit	2.38	1.18
Fenzaquin10 EC	1000	2.0ml/lit	5.06	0
Dicofol 18.5 EC	500	2.7 ml/lit	3.02	2.52
Ethion 50 EC	1000	2.00ml/lit	4.06	1.08
Sulphur 80 WP	2500	3.12 gm/Kg	3.18	3.02
Azadirachtin 10000 PPM	0.2%	2.0 ml/lit	3.19	2.83
Control(Water Spray)	-	-	3.20	3.03
CD (0.05)			**0.18**	**0.22**
Significance			**NS**	**NS**

NS- Non significant at 5% level of significance

Figure.1 Effect of various acaricides on the population of natural enemy, *Amblyseius* sp



The pesticides were ranked in the following order based on their overall performance: Sulphur 80 WP <Azadirachtin 10000 PPM <Ethion 50 EC <Fenzaquin 10 EC < Dicofol 18.5 EC <Fenpropathrin 30 EC <Propargite 57 EC < Milbemectin 1 EC <Diafenthiuron 50 SC <Abamectin 1.9 EC.

Effect of pesticides on yield of chilli

The per cent increase in yield over control in the plots treated with of Diafenthiuron was (63.65%) 25.67qt/ha followed by Abamectin (62.30%) 24.75 qt/ha, Propargite (60.71%) 23.75 qt/ha, Dicofol (59.73%)23.17 qt/ha,

Milbemectin (57.26%) 21.83 qt /ha, Fenpropathrin (54.86%) 20.67 qt /ha, Sulphur 80 WP (47.28%) 17.70 qt /ha and Azadirachtin 10000 PPM (31.74%)13.67 qt /ha. The least increase in yield of chilli was found in the plots were treated with of Fenzaquin (2.0ml/lt) gave 11.33 qt/ha (17.67%) (Table1). Gundannavar *et al.,* (2007) studied that Diafenthiuron (0.75 g/lt) gave the highest yield in case of chilli.

Effect on natural enemy (*Amblyseius sp*.)

The data on the population of predatorymite *Amblyseius sp*. was presented in Table 2 which shows that the population of predatory mite in different treatments varied significantly among themselves at 7 days after treatment. Among the different treatments, the maximum number of predatory mite were recorded from untreated control plots (3.03 *Amblyseius sp*./ 30 leaves) followed by Dicofol 18.5 EC and Diafenthiuron 50 SC with 3.02 *Amblyseius sp*./30 leaves remained at par with each other and with Azadirachtin 10000 PPM (2.83 *Amblyseius sp*. /30 leaves/plot) (Table 2 & Fig 1). There was no predatory mite recorded in Fenzaquin10 EC @ 1000 g a.i. /ha (30 leaves/plot). It was revealed from the experiment that though the *Amblyseius* sp. population was affected by application of the pesticides but the population was found to be least affected by application of Abamectin 1.9 EC @ 70 g a.i./ha with 3.02 and 1.52/ 30 leaves).

All the acaracides were effective in reducing the population over control with percent reduction of 71.47 (Abamectin) to 28.04 (Sulphur). The performance of Diafenthiuron, Milbemectin, Propargite and Fenpropathrin showed similar trend with 65.05%, 61.48%, 57.99% and 54.88% respectively. The treatments behaved in similar manner 7 and 14 days after spray with minimum percent reduction of mite population over control recorded by Ethion, Azadirachtin, Sulphur (40.63, 32.71 and 28.04%) and maximum by Abamectin (71.47%) followed by Diafenthiuron (65.05%), Milbemectin (61.48%), Propargite (57.99%), Fenpropathrin (54.88%) and Dicofol (46.09%). The result of the same trend also has been recorded during second and third round of spraying. Present findings regarding efficacy of Abamectin1.9EC @ 70 g a.i. /ha against *Polyphagotarsonemus latus* (Banks) are in conformity with the study of Srinivasulu *et al.,* (2002) and Nayak *et al.,* (2010). Higher mortality of yellow mite was observed in Abamectin 1.9 EC @ 70 g a.i. /ha after 14 days of application during two consecutive years, respectively whereas Diafenthiuron proved to be at par effective was reported by Patel *et al.,* (2010). The toxicity of different treatment against the predatory mite has been presented in Table- 2. The treated dosages Abamectin 1.9 EC, Diafenthiuron 50 SC and Ethion 50 EC have got very low to moderate impact on predatory fauna of *Amblyseius sp*. Only fenazaquin 10EC was unsafe, reducing population of predators up to 100 % (Fig.1). Hence, from this part of study, it can be concluded that, Sulphur 80 WP at 2500 g a.i. /ha, Diafenthiuron 50 SC at 400 and Azadirachtin 10000 PPM at 0.2 % were safe for the predatory mite in chilli eco-system. Conservation and release of native predatory mites if available also can minimize the mite populations from the field. *Amblyseius* sp. Is an efficient predatory mite, which regulates the pest under field conditions. The acaricides viz. Diafenthiuron, Abamectin and Propargite were found to enhance the fruit yield of chilli, in addition to reduction of mite population.

In conclusion, it is evident from this studies that three rounds of sprays of Abamectin 1.9 EC @ 70 g a.i. /ha, Diafenthiuron 50 SC @ 400 ga.i. /ha, Milbemectin 1 EC@ 3.5 g a.i. /ha gave excellent control of Chill Yellow mite, *Polyphagotarsonemus latus* Banks. The pesticide was moderately toxic to natural enemies & did not produce any phytotoxic symptoms on chilli fruits and plants. In addition to this, they also have effect on increasing the fruit yield of chilli in comparison to the untreated plots. Considering the limitations of chemicals in management of chilli mite in large perspective selective control measures are very important aspect for successful chilli cultivation. So, the chemicals like

Diafenthiuron 50 SC @ 400 ga.i. /ha, Milbemectin 1 EC @ 3.5 g a.i. /ha, Abamectin 1.9 EC @ 70 g a.i. /ha could be recommended to farmers for successful management of yellow mite incidence in chilli crop.

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