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Topic 1 - Ecological approaches to systems' health

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SUSTAINABLE CONTROL OF YELLOW MITE (POLYPHAGOTARSONEMUS LATUS BANKS) INFESTING CHILLI (CAPSICUM ANNUM L.) BY USING BIOPESTICIDES

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Abstract: *Chilli (Capsicum annum L.) plant is highly susceptible to Polyphagotarsonemus latus (Banks). The incidence of this mite population always remained higher on upper canopy of the plant. Among the seven treatments evaluated microbial toxin- avermectin resulted in the best suppression of mite population (86.32% suppression), closely followed by chemical insecticide, fenazaquin (73.07%) and mixed formulation of botanical pesticide, azadirachtin with botanical extract, Spilenthes (70.99%). Microbial toxin and botanicals are bio-pesticides having less or no hazardous effects on human health and environment, and therefore, they can be incorporated in Integrated Pest Management (IPM) and organic farming.*

Introduction: Chilli (*Capsicum annum* L.) is an important spice and vegetable crop, commercially grown in India. The plant is susceptible to insect and mite pests of which yellow mite, *Polyphagotarsonemus latus* is most predominant. The mites attack young apical leaves, flower buds and cause damage of flower buds, flowers and developing fruits.The incidence of mite population always higher on the upper canopy of the plant (Ghosh, 2013). Mixed formulation of botanical pesticide, azadirachtin with pesticide, dicofol provide best suppression of mite (71.41 %) (Ghosh and Chakraborty, 2014). The mite mortality percent on chilli crop was found high in Fenazaquin 10 EC treatment (Bala and Ghosh, 2016). Ten days after spraying against mite *Aceris tulipae* it is found very low population (1.40 mites per sq. cm) in fenazaquin treatment (Bala *et.al*. 2015). The objective of this study is to determine the efficacy of microbial toxin, the plant extracts against mite and to formulate suitable control measure.

Material and methods: The experiment was conducted at the Farm and Laboratory of BCKV at Kalyani, India during 2016-2017. The geographical details of the site are 23° N latitude, 89° E longitude. The soil of the field was sandy loam with pH value 6.9.

Distribution of mites within plants

Chilli variety 'Bullet' was grown during 2016-2017 crop seasons in both years under recommended cultural practices in 4.0 m x 5.0 m plots. The total mite population per leaf from top, middle and bottom leaves from five randomly selected plants per replication was recorded at seven days interval. Data obtained over two years were presented graphically.

Control of mite

Chilli variety 'Bullet' was grown during 2016-2017 crop season in both years under recommended fertilizer levels (50:50:80 kg NPK/ha) and cultural practices in3 m x 3m plots at a spacing of 30 cm x 30 cm. The treatments were replicated three times in a Randomized Block Design (RBD). One microbial toxin avermectin (Vertimec 1.9 EC) @ 1ml/L, one botanical insecticide azadirachtin i.e. neem (neemactin 0.15 EC) @ 2.5 ml/L, two botanical extracts viz. *Spilanthes paniculata* floral parts extract @ 7.0%, and garlic (*Allium sativum*) extract@ 7.0%, two treatments containing mixture of azadirachtin and *Spilanthes* @ 2.5 ml + 70 ml/L and mixture of azadirachtin and garlic @ 2.5 ml + 70 ml/L were evaluated and compared with the ability of Fenazaquin (Magister 10EC), a chemical insecticide @ 2ml/ L to control the mite pest.

Preparation of extracts

The botanicals, *Spilanthes paniculata* floral parts and garlic were extracted in methanol as follows. After washing with water, the plant parts were powdered. The powder (50 g) samples of each tested plant were transferred separately to a conical flask (500 ml) and dipped in 250 ml methanol. The material was allowed to stand for 72 hours at room temperature with occasional stirring. After 72 hours the extract was filtered through Whatman 42 filter paper and residues were washed twice with methanol.

Data recording

Four sprays at 10 day intervals were made. Mite population was recorded 3, 6 and 9 days after each spraying. The total mite population per leaf from top, middle and bottom leaves from five randomly selected plants per replication was recorded. The results were expressed as mite population suppression (%) compared to densities recorded on the control treatment. Per cent reduction of mite population over control was calculated by the following formula (Abbott, 1925):

$$Pt = \frac{Po - Pc}{100 - Pc} \times 100$$

Where, Pt = Corrected mortality, Po = Observed mortality and Pc = Control mortality. Data were analyzed by using INDO-STAT- software

Results: *Distribution of mite within plants*

It was revealed that the mites of chilli plants were most densely populated in the upper canopy (58.35% population) followed by middle (31.23%) and lower canopy (10.42%).

Dutta *et.al.*, (2011) reported that mites were most densely populated in the upper canopy (44.24%) followed by middle (30.57%) and lower canopy (25.19%).

Control of mite

Among the seven treatments evaluated (table 1) microbial toxin- avermectin treatment resulted best suppression of mite population (86.32 % suppression), closely followed by chemical insecticide, fenazaquin and mixed formulation of botanical pesticide, azadirachtin with botanical extract, *Spilenthes* (73.07 % and 70.99% suppression respectively). However among the bio-pesticides including plant extracts avermectin was the most effective for mite control followed by mixed formulation of botanical pesticide, azadirachtin with botanical extract, *Spilenthes* and another mixed formulation azadirachtin with botanical extract, garlic (70.99% and 64.02% suppression respectively).

Three days after spraying, avermectin treatment was found most effective (83.25% suppression) followed by fenazaquin (80.10 %) and mixed formulation of botanical pesticide, azadirachtin with botanical extract *Spilanthes* (73.42 %) against

mite. The avermectin treatment is significantly different from all other treatments. Six and nine days after spraying the results of the different treatments evaluated followed the findings of three days after spraying.

Table 1 Overall efficacy of pesticides against yellow mite (*Polyphagotarsonemus latus* on chilli

Treatments	Dose ml or g/L(%)	Pretreatment observation (mites/Leaf)	Overall efficacy (% reduction) Days after treatment				
			3	6	9	Mean	
T_1=Avermectin (Vertimec 1.9 EC)	1 ml/L	8.77	83.25 (66.23)	86.35 (68.40)	89.36 (71.42)	86.32 (68.68)	
T_2= *Spilanthes* flower extract (7%)	70 ml/L	9.01	43.65 (40.85)	37.55 (37.77)	35.18 (36.32)	38.79 (38.31)	
T_3= Neem (Nemactin 0.15 EC)	2.5 ml/L	8.69	37.85 (38.27)	41.49 (40.39)	43.29 (41.13)	40.88 (39.93)	
T_4= *Garlic 7%*	70 ml/L	9.13	34.23 (36.11)	35.18 (36.32)	43.65 (40.85)	37.69 (37.76)	
T_5= Neem+*Spilanthes* extract (7%)	2.5 ml/L+ 70 ml/L	9.05	73.42 (57.95)	70.10 (56.79)	69.45 (56.86)	70.99 (57.20)	
T_6= Neem+*Garlic* extract (7%)	2.5 ml/L+ 70 ml/L	8.82	64.59 (53.50)	59.01 (51.49)	68.47 (55.89)	64.02 (53.63)	
T_7= Fenazaquin(10EC)	2ml/L	8.88	80.10 (63.87)	70.64 (57.51)	68.47 (55.89)	73.07 (59.09)	
T_8=Untreated check(control)	-	9.21	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	
SEm(±)	-	---	1.70	1.70	1.63	-	
CD(p=0.05)	-	NS	5.11	5.09	4.87	-	

Figures in parentheses are angular transformed values, NS = Not significant

Discussion: Mites were most densely populated in the young and new leaves of chilli plant on upper canopy. So sprays should be carefully taken on the upper canopy. Avermectin and mixture of azadirachtin with botanical extracts gave moderate to higher mite suppression (more than 64% suppression). Considering moderate to higher efficacy as well as its low toxicity to natural enemies and minimum impact on human health microbial toxin, botanical insecticides, botanical extracts can be incorporated in future IPM and organic farming. Azadirachtin individually did not produce higher results

but when mixed with botanical extracts gave higher results of mite control recording more than 64 % suppression. This treatment also is recommended for general farmers use.

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Image:

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