Short communication

Bioefficacy and safety evaluation of newer insecticides and acaricides against chilli thrips and mites

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Abstract

The bioefficacy of newer insecticides against the sucking pests of chilli and safety of these insecticides to natural enemy population in chilli ecosystem were evaluated at College of Agriculture, Vellayani, Thiruvananthapuram, Kerala. Spiromesifen 45 SC at 100 g a.i. ha^{-1} and propargite 57 EC at 570 g a.i. ha^{-1} were found to be effective in reducing chilli mite population whereas acetamiprid 20 SP at 20 g a.i. ha^{-1} along with spiromesifen were found to be effective against chilli thrips. The leaf curling symptom due to the feeding of mites and thrips was least in spiromesifen, propargite and acetamiprid sprayed plants. Spiromesifen was found to be the safest insecticide against natural enemies *viz.* predatory mites, coccinellid beetles, spiders and neutral insects whereas the organophosphate insecticide dimethoate 30 EC 300 g a.i. ha^{-1} was found to be unsafe to natural enemies.

Key words: Chilli, Mite, Thrips, Spiromesifen, Propargite, Natural enemy, Predatory mite

India's share in global chilli production is high but the productivity of chilli is only 1500 kg ha^{-1} which has to be increased to a bench mark level of 5000 kg ha^{-1} to compete in the international market (Reddy, 2010). Among the different constraints that lower chilli productivity, the pest complex that attacks chilli at different crop stages is the most important. The major sucking insects that attack chilli are mites (*Polyphagotarsonemus latus* Banks), thrips (*Scirtothrips dorsalis* Hood) and aphids (*Myzus persicae* Sulzer and *Aphis gossypii* Glover). The yield loss due to chilli thrips and mites is estimated to be to the tune of 50 per cent (Ahmed et al., 1987; Kandasamy et al., 1990). Due to monoculture of chilli in major growing areas, the pest build up is so much that farmers have to resort to a minimum of 5 to 6 chemical sprays. The number of insecticidal sprays has increased over the years, making the cultivation of chilli highly risky and non-profitable.

In view of this indiscriminate use of chemical pesticides and public concerns, the rise of new generation insecticides provides and alternative to reduce the ill effects of conventional insecticides. The new insecticides are more tissue-specific, activated in unique ways inside the target cells of insects resulting in reduced threat to other organisms. Selective toxicity to insects and safety to natural enemies have made the new class of insecticides more user and eco-friendly. The present field experiment was carried out to study the bioefficacy of these newer insecticides and acaricides against the sucking pests of chilli and their safety to natural enemies of chilli.

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A field experiment was laid out in randomized block design with three replications. One month old seedlings of chilli *cv*. Anugraha were transplanted during the last week of February 2009 in plots of 4m^2 area at a spacing of 45cm x 45cm. Each plot had a density of 20 plants with one plant per hill. All the management practices except plant protection against sucking pests were adopted as per the recommended package of practices of Kerala Agricultural University (KAU, 2007).

Mites and thrips counts were taken 1, 3, 5, 7, and 14 days after spraying. For counting the population of mites and thrips, six plants were selected at random in each plot and tagged. Six leaves were collected at random from the top canopy of each selected plant and brought to the laboratory in zip lock bags and observed under stereo binocular microscope. Ten plants were selected randomly in each plot and scored for leaf curling visually following the standard scoring procedure as described by Niles (1980) at one week and two weeks after spraying. The selected plants were also observed for recording the population density of predatory mites, coccinellid beetles, spiders, neutrals and pollinators.

The data on population of mites and thrips, and leaf curl index are given on Table 1. One day after spraying (1 DAS), significantly lower population of chilli mites was observed in propargite (0.56 / leaf) followed by spiromesifen (0.76/leaf) and acetamiprid (1.00/leaf) treated plants. All the other treatments recorded mite population ranging from 1 to 1.4 per leaf and were significantly superior to the untreated control (3.33/leaf). At seven and fourteen days after spraying, significantly lower population of chilli mites was recorded in propargite, spiromesifen and acetamiprid treated plants. Propargite, a new generation acaricide,

Table 1. Mean population of chilli mites, thrips and leaf curl index (LCI) in insecticide treated plants at different intervals after spraying.

Treatment	Dosage g a.i.ha^{-1}	Mean population of mite per leaf			Mean population of thrips per leaf			Leaf Curl Index (LCI)	
		1 DAS	7 DAS	14 DAS	1 DAS	7 DAS	14 DAS	1 WAS	2 WAS
Spiromesifen	100	0.76 (1.326)	0.04 (1.021)	0.44 (1.201)	0.05 (1.023)	0.05 (1.023)	0.13 (1.064)	0.97	0.57
Imidacloprid	20	1.24 (1.497)	0.31 (1.145)	0.87 (1.365)	0.09 (1.044)	0.11 (1.052)	0.22 (1.103)	1.43	1.47
Thiamethoxam	40	1.31 (1.519)	0.36 (1.164)	1.00 (1.414)	0.16 (1.074)	0.09 (1.043)	0.18 (1.086)	2.0	2.2
Acetamiprid	20	1.00 (1.414)	0.09 (1.042)	0.58 (1.255)	0.11 (1.054)	0.07 (1.034)	0.11 (1.052)	1.23	1.03
Propargite	570	0.56 (1.249)	0.13 (1.063)	0.40 (1.183)	0.22 (1.104)	0.29 (1.134)	0.42 (1.192)	1.07	0.83
Dimethoate	300	1.4 (1.549)	0.44 (1.200)	0.93 (1.39)	0.07 (1.032)	0.11 (1.053)	0.26 (1.123)	1.76	1.73
Ethion	375	1.33 (1.527)	0.33 (1.153)	0.85 (1.358)	0.13 (1.062)	0.24 (1.114)	0.31 (1.178)	2.23	2.1
Oxy demeton methyl	500	1.29 (1.512)	0.31 (1.143)	0.81 (1.346)	0.07 (1.034)	0.04 (1.021)	0.27 (1.118)	1.8	1.6
Untreated Control	Water spray	3.33 (2.080)	3.95 (2.220)	4.17 (2.272)	0.82 (1.349)	1.11 (1.452)	1.15 (1.466)	3.70	4.9
CD (0.05)		(0.1023)	(0.0717)	(0.0606)	(0.0618)	(0.0963)	(0.1302)	0.331	0.463

Figures in the parentheses are $\sqrt{x+1}$ transformed values, DAS - days after spraying, WAS – weeks after spraying.

which was found effective aginst chilli mite in the present investigation, acts on mites by disrupting the ATP (adenosine tri phosphate) formation by inhibiting ATP synthetase enzyme (Fishel, 2005). The efficacy of acaricides like propargite and fenpyroximate in reducing the population of chilli mite up to 21 days was reported by Smitha and Giraddi (2006).

Spiromesifen, a spirocyclic phenyl substituted tetronic acid derivative, belongs to a new class of insecticide possessing a new mode of action. The biological activity of tetronic acids correlates with inhibition of lipogenesis, especially that of triglycerides and free fatty acids, and they are found effective against white flies and numerous mite species (Bretschneider et al., 2003). The efficacy of spiromesifen in reducing chilli mite in India was reported by Kavitha et al. (2006) and Nagaraj et al. (2007).

Significantly lower population of chilli thrips were recorded in spiromesifen (0.05/leaf), dimethoate (0.07/leaf), oxy demeton methyl (0.07/leaf) imidacloprid (0.09 / leaf) and acetamiprid (0.11/leaf) treated plants one day after spraying and all these treatments were at par with each other (Table 1). At two weeks after spraying, acetamiprid (0.11/leaf) and spiromesifen (0.13/leaf) application recorded lowest thrips population and were at par. Seal and Klassen (2006) had reported the effectiveness of spiromesifen in reducing the incidence of chilli thrips in Scotch Bonnet variety of chilli pepper. In another study, acetamiprid 20 SP @ 40 g and 80 g a.i. ha^{-1} were effective in reducing the sucking pests of chilli, followed by acetamiprid 20 SP @ 20 g a.i. ha^{-1} which also recorded maximum green chilli yield (Jayewar et al., 2003). The leaf curling symptom due to the feeding of mites and thrips was lowest in spiromesifen followed by propargite and acetamiprid treated plants at one and two weeks after insecticidal spraying.

In evaluation of safety of newer class of insecticides against natural enemies, significantly more number of predatory mites was recorded from spiromesifen (0.19/leaf) treated plots as compared to plots treated with other insecticides. A week after spraying, all the insecticide treated plots except spiromesifen (0.1/leaf) were devoid of predatory mites. Spiromesifen treated plot recorded the highest population of predatory mites after two weeks of spraying and the lowest population of predatory mites was recorded on application of ethion (0.01/leaf) (Table 2).

Even though the coccinellid population was affected by insecticidal spraying after one day, it increased at one and two weeks after spraying. Spiromesifen (1.67/5 plants) and thiamethoxam (1.67/5 plants) treated plots recorded significantly higher number of coccinellid beetles 14 DAS than other insecticidal treatments. Beetle population was not recorded in dimethoate sprayed plots at 1 DAS and 14 DAS indicating the toxicity of the chemical (Table 2).

All the insecticide treated plots except spiromesifen (0.33/5 plants) were devoid of spiders one day after spraying (Table 3). On the 14^{th} day after spraying, the spider population in spiromesifen (1.67/5 plants) treated plots was on par with those in untreated plots. Dimethoate sprayed plots were devoid of spiders till 14 DAS. The neutral insects' and pollinators' population in chilli ecosystem were comparatively higher when compared to natural enemies like predatory mites, coccinellid beetles and spiders. The mean population of neutral insects was significantly higher in spiromesifen treatment at one week (1.33/5 plants) and two weeks (2.33/5 plants) after spraying and dimethoate harbored least number of neutral insects. The safety of spiromesifen (Oberon-240 SC) in the present study is in agreement with the findings of Sekh et al. (2007) that the chemical was very safe to natural enemies (*Stethorus* sp, *Chrysoperla* sp, *Amblyseius* spp). Spiromesifen was also found to be safer to *Apis cerana cerana* Fab and *Apis mellifera* L. on mustard (Choudhary et al., 2009).

The present study revealed that the use of newer

Table 2: Mean population of predatory mite *Amblyseius* sp and coccinellid beetles at different intervals after spraying.

Treatment	Dosage (g a.i. ha^{-1})	Mean population of predatory mite *Amblyseius* sp per leaf.			Mean population of Coccinellid beetles / five plants		
		1 DAS	7 DAS	14 DAS	1 DAS	7 DAS	14 DAS
Spiromesifen	100	0.19	0.10	0.24	0.33	1.00	1.67
		(1.091)	(1.048)	(1.114)	(1.154)	(1.414)	(1.634)
Imidacloprid	20	0.00	0.00	0.02	0.00	0.33	0.33
		(1.000)	(1.000)	(1.010)	(1.000)	(1.154)	(1.292)
Thiamethoxam	40	0.02	0.00	0.10	0.00	0.67	1.67
		(1.010)	(1.000)	(1.048)	(1.000)	(1.292)	(1.634)
Acetamiprid	20	0.06	0.00	0.02	0.00	0.67	1.00
		(1.029)	(1.000)	(1.010)	(1.000)	(1.292)	(1.414)
Propargite	850	0.04	0.00	0.09	0.33	0.33	1.00
		(1.021)	(1.000)	(1.044)	(1.154)	(1.154)	(1.414)
Dimethoate	300	0.02	0.00	0.02	0.00	0.33	0.00
		(1.010)	(1.000)	(1.010)	(1.000)	(1.154)	(1.00)
Ethion	375	0.00	0.00	0.01	0.00	0.33	0.67
		(1.000)	(1.000)	(1.005)	(1.000)	(1.154)	(1.292)
Oxy demeton methyl	500	0.04	0.00	0.10	0.00	0.67	1.000
		(1.021)	(1.000)	(1.048)	(1.000)	(1.292)	(1.414)
Untreated Control		0.41	0.56	0.8	2.33	3.00	3.33
		(1.187)	(1.249)	(1.341)	(1.826)	(2.00)	(2.082)
CD (0.05)		(0.0467)	(0.0286)	(0.0277)	(0.2269)	(0.4876)	(0.4895)

Figures in the parentheses are √x+1 transformed values, DAS - days after spraying.

Table 3. Mean population of spiders, pollinators and neutrals in chilli ecosystem at different intervals after insecticidal spraying.

Treatment	Dosage (g a.i. ha^{-1})	Mean population of spiders/ five plants			Mean population of pollinators and neutrals / five plants		
		1 DAS	7 DAS	14 DAS	1 DAS	7 DAS	14 DAS
Spiromesifen	100	0.33	1.00	1.67	0.33	1.33	2.33
		(1.154)	(1.414)	(1.634)	(1.154)	(1.526)	(1.825)
Imidacloprid	20	0.00	0.33	0.67	0.00	0.67	1.33
		(1.000)	(1.154)	(1.292)	(1.000)	(1.292)	(1.526)
Thiamethoxam	40	0.00	0.33	0.67	0.33	0.33	1.00
		(1.000)	(1.154)	(1.292)	(1.154)	(1.154)	(1.414)
Acetamiprid	20	0.00	0.67	1.00	0.33	1.00	2.00
		(1.000)	(1.292)	(1.414)	(1.154)	(1.414)	(1.732)
Propargite	850	0.00	0.00	0.67	0.33	0.67	1.67
		(1.000)	(1.00)	(1.292)	(1.154)	(1.292)	(1.634)
Dimethoate	300	0.00	0.00	0.00	0.0	0.00	0.67
		(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.154)
Ethion	375	0.00	0.33	0.33	0.0	0.67	1.33
		(1.000)	(1.154)	(1.154)	(1.000)	(1.292)	(1.526)
Oxy demeton methyl	500	0.00	0.33	0.33	0.00	0.67	1.00
		(1.000)	(1.154)	(1.154)	(1.000)	(1.292)	(1.414)
Untreated Control		1.67	2.33	1.67	8.0	7.00	7.00
		(1.634)	(1.824)	(1.634)	(3.000)	(2.828)	(2.828)
CD(0.05)		(0.1380)	(0.2948)	(0.3800)	(0.2760)	(0.4105)	(0.4583)

Figures in the parentheses are √x+1 transformed values, DAS - days after spraying.

insecticides like spiromesifen and acetamiprid were effective in reducing the sucking pests of chilli viz. mites and thrips, without significantly affecting the natural enemies in the chilli ecosystem. In view of the safety and efficacy of these insecticide molecules against sucking pest of chilli, they can be incorporated as the chemical component in the integrated pest management of chilli.

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