Indian Journal of Entomology 84(1): 152-155 (2022) DoI.: 10.55446/IJE.2021.293

EFFICACY OF ACARICIDES AGAINST PHYTOPHAGOUS MITES IN APPLE

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ABSTRACT

Efficacy studies were conducted during June-July in 2017 in Kullu Valley of Himachal Pradesh against the phytophagous mites *Panonychus ulmi* (Koch) and *Tetranychus urticae* Koch in apple orchards. Four acaricides were evaluated at different doses. After seven days of spray, maximum efficacy was obtained from fenazaquin @ 0.20 ml/ l (0.50 mites/ leaf) which was at par with other test concentrations of fenazaquin @ 0.15, 0.25ml/ l, hexythiazox @ 0.5, 1.0 ml/ l, etoxazole @ 0.25, 0.4, 0.55 ml/ l and abamectin @ 0.5, 0.6 ml/ l. In 14 and 21days post-treatment observations, though the mite incidence increased gradually in all the treatments, all concentrations of hexythiazox, fenazaquin and etoxazole were found significantly superior. After 28 days of spray, maximum efficacy was again with fenazaquin @ 0.25 ml/ l which was at par with hexythiazox (0.5, 1.0 ml/ l), etoxazole (0.25, 0.4, 0.55 ml/ l) and these were significantly superior. Fenazaquin was found extremely toxic to the natural enemies.

Key words: Apple, *Panonychus ulmi*, *Tetranychus urticae*, abamectin, etoxazole, fenazaquin, hexythiazox, propargite, efficacy, predators, safety

Apple is the main cash crop of temperate regions in the Himalayan states. This crop is attacked by many insects and non-insect pests, of which the mites are the most serious causing substantial loss. Mites attack a diverse group of crops including various fruit, vegetable, ornamental and field crops. The two major mite pests of apple in north western Himalayas are the European red mite *Panonychus ulmi* (Koch) and two spotted spider mite *Tetranychus urticae* (Koch). In nature, phytophagous mites are kept under check by different predators such as predatory mites, *Chrysoperla* larvae, *Stethorus* beetles and predatory thrips etc. Khajuria and Sharma (1996) reported the phytoseiid mite *Amblyseius fallacis* (Garman) to suppress mites in apple. Phytoseiid mites are an important component of IPM by virtue of their ability to feed on alternate prey and survive at low prey mite densities (Overmeer, 1985). Indiscriminate use of pesticides has often been attributed for mite outbreaks. Although, many acaricides are being recommended for their effective management (Marshall and Pree, 1991; Khajuria and Sharma, 2001; Khajuria et al., 2006), with the passage of time many of these acaricides become obsolete either due to ban on their use or their non-production. Also, there are reports of resistance development (Croft et al., 1987). Besides, predator activity is also adversely affected to a larger extent due to their regular exposure to chemicals being applied to manage phytophagous mites. Therefore, newer molecules against phytophagous mites should be evaluated regularly under field conditions. Keeping this in view, efficacy of some acaricides were tested during 2017 along with their safety to natural enemies in apple orchards.

MATERIALS AND METHODS

Field trials were laid out in apple orchards at the Horticultural Research Station, Seobagh in Kullu. The trials were laid out in completely randomized block design on 15-20 years old trees CV. Red Chief. There were 15 treatments each replicated four times with single tree serving as a replication. Four acaricides viz., abamectin, etoxazole, fenazaquin and hexythiazox at different concentrations were evaluated and compared with standard propargite and the untreated control (Table 1). Spraying was done with a high-volume sprayer in the third or last week of June. The pretreatment counts of mites were taken a day before spray and post-treatment counts at 7, 14, 21 and 28 days after the spray (DAS). A sample of 20 mature leaves each from outer and middle part of the canopy was taken randomly from each replication in a treatment. These leaf samples were then passed through a mite-brushing machine and number of live mites/ leaves was counted under a stereozoom microscope. Only motile stages of mites were taken into consideration. Data on number of natural enemies viz., *Chrysoperla* larvae, phytoseiid mites, *Stethorus* beetles and predatory thrips were also observed to evaluate the

Table 1. Efficacy of acaricides against phytophagous mites and the natural enemies in apple

Treatments	Dose (ml/ l)	No. of mites/ leaf					No. of natural enemies/ leaf				
		Pre count	7 DAT	14 DAT	21 DAT	28 DAT	Pre count	7 DAT	14 DAT	21 DAT	28 DAT
Abamectin	0.3	20.03	10.43	14.28	26.40	34.73	3.78	2.53	2.83	4.13	3.25
1.9EC		(4.55)	(3.37)^{c}	(3.89)^{e}	(5.20)^{f}	(5.94)^{c}	(2.18)	(1.87)^{h}	(1.96)^{d}	(2.26)^{f}	(2.05)^{de}
Abamectin	0.4	27.55	10.13	14.53	20.88	25.03	3.15	1.30	1.75	2.78	2.20
1.9EC		(5.27)	(3.15)^{c}	(3.75)^{e}	(4.49)^{ef}	(5.04)^{bc}	(2.04)	(1.51)^{def}	(1.66)^{bc}	(1.94)^{e}	(1.78)^{bcd}
Abamectin	0.5	28.40	4.33	6.00	14.60	21.48	3.38	0.85	1.15	2.23	1.15
1.9EC		(5.32)	(2.16)^{ab}	(2.64)^{cd}	(3.67)^{cde}	(4.58)^{b}	(2.09)	(1.36)^{bcde}	(1.46)^{ab}	(1.80)^{de}	(1.46)^{a}
Abamectin	0.6	27.85	3.23	4.30	11.15	16.60	2.93	0.35	0.55	1.80	1.00
1.9EC		(5.26)	(1.97)^{ab}	(2.21)^{abcd}	(3.31)^{bcde}	(4.10)^{b}	(1.98)	(1.16)^{a}	(1.24)^{a}	(1.67)^{cd}	(1.41)^{a}
Etoxazole	0.1	27.38	7.78	8.83	8.25	16.80	3.63	2.40	2.28	2.33	2.63
10SC		(5.30)	(2.89)^{bc}	(3.04)^{de}	(2.92)^{abcd}	(4.18)^{b}	(2.15)	(1.84)^{gh}	(1.81)^{cd}	(1.82)^{de}	(1.90)^{cd}
Etoxazole	0.25	24.20	2.30	3.60	5.60	8.20	3.45	1.78	2.05	2.10	2.15
10SC		(5.00)	(1.77)^{a}	(2.12)^{abcd}	(2.52)^{abc}	(2.99)^{a}	(2.11)	(1.66)^{fg}	(1.75)^{cd}	(1.76)^{de}	(1.77)^{bcd}
Etoxazole	0.4	27.80	1.60	2.28	3.25	6.15	3.55	1.33	1.68	1.75	1.88
10SC		(5.25)	(1.59)^{a}	(1.78)^{abc}	(2.03)^{ab}	(2.66)^{a}	(2.13)	(1.52)^{ef}	(1.63)^{bc}	(1.65)^{bcd}	(1.69)^{abc}
Etoxazole	0.55	24.88	1.33	1.78	2.88	4.55	3.68	0.75	0.88	1.00	1.20
10SC		(5.07)	(1.51)^{a}	(1.65)^{abc}	(1.94)^{a}	(2.34)^{a}	(2.14)	(1.32)^{abc}	(1.37)^{a}	(1.41)^{a}	(1.48)^{a}
Fenazaquin	0.15	20.73	0.90	4.63	12.23	20.18	2.53	0.58	0.80	1.20	1.63
20SC		(4.64)	(1.37)^{a}	(2.32)^{bcd}	(3.58)^{cde}	(4.58)^{b}	(1.87)	(1.25)^{ab}	(1.33)^{a}	(1.48)^{abc}	(1.61)^{ab}
Fenazaquin	0.20	20.53	0.50	2.33	7.73	16.33	2.68	0.40	1.00	1.15	1.08
20SC		(4.63)	(1.20)^{a}	(1.82)^{abc}	(2.91)^{abcd}	(4.14)^{b}	(1.91)	(1.18)^{ab}	(1.40)^{a}	(1.45)^{abc}	(1.43)^{a}
Fenazaquin	0.25	25.03	0.60	1.55	2.30	3.70	2.33	0.45	0.85	1.10	1.13
20SC		(5.09)	(1.24)^{a}	(1.55)^{abc}	(1.79)^{a}	(2.13)^{a}	(1.81)	(1.20)^{ab}	(1.34)^{a}	(1.44)^{ab}	(1.44)^{a}
Hexythiazox	0.5	36.35	1.10	0.35	2.58	7.00	3.25	0.78	0.55	1.15	1.50
5.45EC		(5.95)	(1.44)^{a}	(1.16)^{a}	(1.88)^{a}	(2.82)^{a}	(2.06)	(1.33)^{abcd}	(1.24)^{a}	(1.46)^{abc}	(1.58)^{ab}
Hexythiazox	1.0	34.43	0.80	0.55	2.03	6.23	3.50	0.60	0.68	0.90	1.20
5.45EC		(5.84)	(1.31)^{a}	(1.23)^{ab}	(1.72)^{a}	(2.63)^{a}	(2.11)	(1.26)^{ab}	(1.29)^{a}	(1.38)^{a}	(1.48)^{a}
Propargite	1.0	41.38	8.25	11.70	13.55	25.68	3.25	1.13	1.90	1.73	3.00
57EC		(6.40)	(2.93)^{bc}	(3.48)^{e}	(3.76)^{cde}	(5.12)^{bc}	(2.05)	(1.46)^{cde}	(1.70)^{c}	(1.65)^{bcd}	(1.99)^{de}
Control	water spray	28.73	51.18	88.75	93.13	116.15	3.93	3.63	3.95	4.00	4.13
	only	(5.39)	(7.12)^{d}	(9.34)^{f}	(9.61)^{g}	(10.80)^{d}	(2.21)	(2.15)^{i}	(2.21)^{e}	(2.22)^{f}	(2.24)^{e}
CD ($p = 0.05$)		NS	0.96	1.14	1.33	1.07	NS	0.18	0.23	0.22	0.28

*Figures in parentheses $\sqrt{(n+1)}$ transformed values *Each replicate consisted of 20 leaves; *Means followed by the common letter do not differ significantly at $p = 0.05$; *DAT = Days After Treatment safety/ toxicity of acaricides. The data was analyzed statistically after √ (n+1) transformation.

RESULTS AND DISCUSSION

The data revealed significant reduction in mite incidence after 7 DAS in all the treatments (Table 1). Fenazaquin (all concentrations), hexythiazox (both concentrations) and etoxazole (0.25, 0.4 and 0.55 ml/ l) were more effective followed by abamectin (0.6 and 0.5ml/ l), while etoxazole (0.1ml/ l), propargite (1.0ml/ l) and abamectin (0.3 and 0.4ml/ l) were less effective; the least mite count of 0.50 mites/ leaf was observed in fenazaquin @ 0.20 ml/ l, however, it was found at par with fenazaquin @ 0.15, 0.25 ml/ l (0.90, 0.60 mites/ leaf), hexythiazox @ 0.5, 1.0 ml/ l (1.10, 0.80 mites/ leaf), etoxazole @ 0.25, 0.4, 0.55 ml/ l (2.30, 1.60, 1.33 mites/ leaf) and abamectin @ 0.5, 0.6 ml/ l (4.33, 3.23 mites/ leaf). Fourteen DAS, both the concentrations of hexythiazox (0.35, 0.55 mites/ leaf), fenazaquin @ 0.20, 0.25ml/ l (2.33, 1.55 mites/ leaf), etoxazole @ 0.4, 0.55ml/ l (2.28, 1.78 mites/ leaf) retained their efficacy, whereas fenazaquin @ 0.15ml/ l (4.63 mites/ leaf), etoxazole @ 0.1, 0.25 ml/ l (8.83, 3.60 mites/ leaf) and all the concentrations of abamectin (4.30 to 14.28 mites/ leaf) were less effective; after 21 DAS, hexythiazox (both concentrations), fenazaquin (0.25ml/ l), etoxazole (0.4 and 0.55 ml/ l) retained effectiveness (2.03 to 3.25 mites/ leaf); and after 28 DAS, although all the acaricides showed an increase in incidence still higher doses of fenazaquin and etoxazole (3.70, 4.55 mites/ leaf) were superior.

These results are in confirmation with Rana and Bhardwaj (2004) on fenazaquin who reported it as highly effective and persistent against European red mite *Panonychus ulmi* on apple. Reddy et al. (2014) found abamectin and fenazaquin as superior against two spotted spider mite infesting cucumber under laboratory and green house conditions. Alfred and Ramaraju (2018) reported hexythiazox 5.45EC as very effective against *Oligonychus coffeae* in tea. Wang et al. (2018) ranked eight acaricides, from highest average efficacy at the recommended dosage to lowest as etoxazole > bifenazate > fenpyroximate > propargite > spirodiclofen > pyridaben > hexythiazox > chlorfenapyr against two spotted spider mites on greenhouse strawberries. Propargite was found moderately toxic against phytophagous mites of fruit trees (Laffi and Raboni, 1995; Khajuria and Sharma, 2010). Different natural enemies viz., *Chrysoperla* larvae, phytoseiid mites, *Stethorus* beetles and predatory thrips were observed during the study. Data on the toxicity at different concentrations against the natural enemies indicated their significant higher mortality in all the acaricidal treatments (Table 1); fenazaquin and hexythiazox recorded higher toxicity, while most others were found to be moderately toxic. High toxicity of fenazaquin observed in this study, receives support from Kim and Seo (2001) who reported it to be very toxic to adult females and immatures of *Amblyseius womersleyi*. They also found that etoxazole did not seriously affect the survival and reproduction of adult female predators but caused high mortality rates in eggs and larvae of *A.womersleyi*. Moderate toxicity of hexythiazox observed now receive support from Hoy and Ouyang (1986) who reported it to be safer against phytoseiid predator *Metaseiulus occidentalis* (Nesbitt), whereas moderate toxicity of propargite corroborate the earlier reports of Croft (1975) and Khajuria and Sharma (2010).

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(Manuscript Received: September, 2020; Revised: January, 2021;
Accepted: January, 2021; Online Published: August, 2021)
Online published (Preview) in www.entosocindia.org Ref. No. e20339