Research Article

Evaluation of Pre-Mix Etoxazole 6% + Abamectin 1.5% SC against Red Spider Mite, *Tetranychus Urticae* Koch Infesting Brinjal

R. K. Kalyan[1], S. Ramesh Babu[2] and Deepika Kalyan*[2]

[1]Agricultural Research Station- Banswara Rajasthan, 327 001
[2]Department of Entomology, RCA, MPUAT-Udaipur, 3130 001

Abstract

The experiment was conducted to evaluate the bio-efficacy of ready-mix formulation of Etoxazole 6% + Abamectin 1.5% SC against red spider mite, *Tetranychus urticae* Koch on brinjal at ARS- Banswara (Rajasthan) during Rabi-2019-20 and 2020-21. The trial was laid out in randomized block design (RBD) with three replications and eight treatments (including phytotoxicity test). The results revealed that Etoxazole 6% + Abamectin 1.5% SC @ 600 mlha^{-1} gave highest per cent (82.43 to 90.11%) control of red spider mite, followed by Etoxazole 6% + Abamectin 1.5% SC @ 450 ml ha^{-1} and Etoxazole 10% EC @ 400 ml ha^{-1}. In case of fruit yield, the highest fruit yield of 16.58 and 17.61 t ha^{-1} was recorded in Etoxazole 6% + Abamectin 1.5% SC @ 600 ml ha^{-1} during the year 2019-20 and 2020-21, respectively. It was statistically at par with its lower doses i.e. Etoxazole 6% + Abamectin 1.5% SC @ 450 ml ha-1 during both the years. The pre-mix formulation of Etoxazole 6% + Abamectin 1.5% spray even @ 900 ml ha-1 did not cause any phytotoxicity symptoms on crop.

Keywords: Efficacy, ready mix molecule, Etoxazole 6% + Abamectin 1.5% SC, red spider mite and brinjal

***Correspondence**
Author: Deepika Kalyan
Email: deepikakalyan20@gmail.com

Introduction

Eggplant also known as brinjal, is a very common vegetable in India, and an easily cultivable crop throughout the year in all parts of the country. Among the various limiting factors of successful cultivation of brinjal, the insect pests and mites play a very significant role. Among the non-insect pests, mites are without a doubt the most notorious and gaining tremendous importance in the recent years due to their devastating nature. Out of the 37 mite species, known to feed on vegetable crops, six species are serious pests of the vegetable crops including brinjal in the different parts of the country [1]. In vegetable crops, damage due to spider mites accounts for 10-15 per cent yield loss [2], among which red spider mite, *Tetranychus urticae* is ranked as a major threat next to fruit and shoot borer [3]. Singh [4] also reported losses in vegetable production from 2 to 35% in eastern part of the India due to mite's infestation. Red spider mite is a highly polyphagous pest attacking many field and horticultural crops, distributed throughout the world and can cause potential damage to more than 1100 plant species, including different eggplant species [5, 6]. Okra and brinjal crops suffer more due to the damage caused by red spider mites [7].

Red spider mite imposes heavy damage to brinjal plant by sucking sap from underside of leaves resulting in white spots which coalesce producing large patches. As the population increases, mites web profusely covering the entire foliage on all sides resulting in poor growth of the crop. A yield reduction of 13.64 and 31.09 % in brinjal due to the red spider mite was estimated at Bangalore and Varanasi, respectively [8] and 46 per cent in okra [9]. To tackle this pest, a number of chemical insecticides and acaricides are freely sprayed on vegetable crops, which led to several problems like toxic residues, elimination of natural enemies, environmental disharmony and development of resistance. To overcome these problems, various new ready-mix molecules (insecticides and acaricides) have come in the scene, therefore periodical evaluation of their comparative efficacy, specificity, selectivity and economics of control operations is essential.

Material and Methods

The field experiments were conducted at Agricultural Research Station-Borwat Farm, Banswara (Rajasthan) during *Rabi*-2019-20 and 2020-21 to evaluate the efficacy of different doses of Etoxazole 6% + Abamectin 1.5% SC @ 300, 450, 600 ml ha^{-1} along with Etoxazole 10% EC @ 400 ml ha^{-1}, Abamectin 1.9% EC @ 375 ml ha^{-1}, Propargite 57% EC @ 1000 ml ha^{-1} and Etoxazole 6% + Abamectin 1.5% SC @ 900 ml ha^{-1} (only for phytotoxicity test) against red spider mite in brinjal. The trial was laid out in randomized block design (RBD) with eight treatments replicated thrice (including phytotoxicity test). The brinjal variety, *Kavya* was sown in the nursery and after one month, the brinjal

seedlings were transplanted into the main field. All recommended package and practices were followed to raise the crop except plant protection measures. Two sprays were given when red spider mite population or damage reached to economic threshold level (ETL) and subsequent spray was given 15 days after first spray.

The observations were recorded from 5 randomly selected plants from each plot. For this, three leaves (one each from top, middle and bottom portion) of selected plants [10] were plucked randomly, collected in separate labelled polythene bags and brought to the laboratory without disturbing mites to count the mite population under stereo binocular microscope. Both upper and lower portions of the leaves were examined. The number of mites was recorded before spray and 1, 3 and 7 days after spray (DAS). The data so obtained were subjected to statistical analysis. The brinjal fruit was harvested at weekly interval and hence a cumulative yield data per plot was recorded and calculated as ton ha^{-1}.

The visual observations on the phytotoxicity symptoms *viz.* leaf injury, wilting, stunting, vein clearing, necrosis, chlorosis, epinasty and hyponasty *etc.* if any, on the crop due to application of test molecules (Etoxazole 6% + Abamectin 1.5% SC @ 900ml ha^{-1}) were recorded using the scores shown in (**Table 1**).

Table 1 Phytotoxicity rating on brinjal plant

Score	Percent crop affected	Score	Percent crop affected
0	No adverse effect	**6**	51-60
1	1-10	**7**	61-70
2	11-20	**8**	71-80
3	21-30	**9**	81-90
4	31-40	**10**	91-100
5	41-50		

Results and Discussion

The efficacy of different doses of pre-mix Etoxazole 6% + Abamectin 1.5% SC *i.e.* 300, 450, 600 ml ha^{-1} along with Etoxazole 10% EC @ 400 ml ha^{-1}, Abamectin 1.9% EC @ 375 ml ha^{-1} and Propargite 57% EC @ 1000 ml ha^{-1} were evaluated against red spider mite in brinjal under field conditions, the results of which are summarized in (**Tables 2** and **3**).

Table 2 Bio-efficacy of different insecticides against red spider mite on brinjal during *Rabi*-2019-20

Treatments	Formulation dose (ml ha^{-1})	PTC	% Red spider mite control					
			After First Spray			After Second Spray		
			1 DAS	3 DAS	7 DAS	1 DAS	3 DAS	7 DAS
T_1= Etoxazole 6% + Abamectin 1.5% SC	300	31.00 (5.57)	34.15 (31.52)	44.42 (48.98)	56.37 (69.32)	52.55 (63.02)	57.86 (71.70)	59.11 (73.65)
T_2= Etoxazole 6% + Abamectin 1.5% SC	450	32.67 (5.71)	35.07 (33.02)	46.93 (53.37)	64.15 (80.99)	61.56 (77.32)	64.61 (81.61)	69.85 (88.13)
T_3= Etoxazole 6% + Abamectin 1.5% SC	600	32.00 (5.66)	35.44 (33.62)	48.03 (55.27)	65.22 (82.43)	62.43 (78.57)	65.82 (83.22)	71.67 (90.11)
T_4= Etoxazole 10% EC	400	30.33 (5.51)	34.60 (32.24)	46.71 (52.98)	59.43 (74.13)	55.24 (67.50)	59.52 (74.28)	60.76 (76.13)
T_5= Abamectin 1.9% EC	375	30.33 (5.51)	34.28 (31.72)	43.41 (47.22)	55.68 (68.22)	51.84 (61.82)	57.83 (71.64)	59.10 (73.62)
T_6= Propargite 57% EC	1000	33.00 (5.74)	34.69 (32.40)	45.92 (51.61)	59.02 (73.51)	54.50 (66.28)	59.24 (73.85)	60.45 (75.68)
T_7= Untreated control	-	31.33 (5.60)	-	-	-	-	-	-
S. EM (±)		-	-	0.66	1.02	0.89	1.03	1.02
CD at 5%		NS	NS	1.96	3.04	2.66	3.07	3.04

PTC – Pre-Treatment Count; Figures in parenthesis are retransformed per cent values; DAS= Day/days after spray; NS=Non-significant

During the year 2019-20, the pre-treatment population of red spider mite was uniform and no significant difference was observed among the treatments/plots (31.00 to 33.33 per three leaves) before first spray. The significant maximum reduction in the red spider mite population with a mean of 82.43 and 90.11 per cent was recorded in Etoxazole 6% + Abamectin 1.5% SC @ 600 ml ha^{-1} at 7 days after of 1st and 2nd spray, respectively and it

was statistically at par with its lower dose *i.e.* Etoxazole 6% + Abamectin 1.5% SC @ 450 ml ha^{-1}. Etoxazole 10% EC @ 400 ml ha^{-1} was found to be the next best treatment (Table 2).

During the year 2020-21, the population of red spider mite did not vary significantly in all the plots before first spray (25.33 to 26.67 per three leaves). The significant maximum reduction in the red spider mite population with a mean of 82.64 and 89.50 per cent was recorded in Etoxazole 6% + Abamectin 1.5% SC @ 600 ml ha^{-1} at 7 days after of 1st and 2nd spray, respectively and was statistically at par with its lower dose *i.e.* Etoxazole 6% + Abamectin 1.5% SC @ 450 ml ha^{-1}. Etoxazole 10% EC @ 400 ml ha^{-1} was found as the next best treatment (Table 3).

There were no visual symptoms of phytotoxicity (rating) on brinjal at any given stage, *i.e.*, before spray or 1, 3, 7 and 15 days after spraying in test doses of Etoxazole 6% + Abamectin 1.5% SC @ 900 ml ha^{-1}.

Table 3 Bio-efficacy of different insecticides against red spider mite on brinjal during *Rabi*-2020-21

Treatments	Formulation dose (ml ha^{-1})	PTC	% Red spider mite control					
			After First Spray			After Second Spray		
			1 DAS	3 DAS	7 DAS	1 DAS	3 DAS	7 DAS
T_1= Etoxazole 6% + Abamectin 1.5% SC	300	25.67 (5.06)	34.00 (31.28)	46.35 (52.36)	57.11 (70.51)	53.05 (63.87)	55.60 (68.08)	58.27 (72.33)
T_2= Etoxazole 6% + Abamectin 1.5% SC	450	26.00 (5.10)	36.62 (35.58)	48.84 (56.69)	62.77 (79.07)	57.97 (71.87)	60.55 (75.83)	68.02 (85.99)
T_3= Etoxazole 6% + Abamectin 1.5% SC	600	25.33 (5.03)	37.49 (37.05)	51.27 (60.85)	65.38 (82.64)	59.95 (74.92)	62.88 (79.21)	71.09 (89.50)
T_4= Etoxazole 10% EC	400	26.33 (5.13)	36.27 (35.00)	47.68 (54.66)	59.58 (74.36)	56.01 (68.75)	58.52 (72.74)	61.85 (77.74)
T_5= Abamectin 1.9% EC	375	26.67 (5.16)	33.67 (30.74)	45.66 (51.15)	56.64 (69.76)	52.80 (63.44)	55.28 (67.55)	58.55 (72.77)
T_6= Propargite 57% EC	1000	25.33 (5.03)	35.62 (33.92)	47.54 (54.43)	58.26 (72.33)	54.63 (66.50)	57.22 (70.68)	59.28 (73.91)
T_7= Untreated control	-	26.00 (5.10)		-	-	-	-	-
S. EM (±)		-	-	1.85	1.49	1.37	1.33	1.54
CD at 5%		NS	NS	5.51	4.43	4.08	3.95	4.58

PTC – Pre-Treatment Count; Figures in parenthesis are retransformed per cent values; DAS= Day/days after spray; NS=Non-significant

Effect on fruit yield (t ha^{-1})

The maximum fruit yield of 16.58 and 17.61 t ha^{-1} was recorded in Etoxazole 6% + Abamectin 1.5% SC @ 600 ml ha^{-1} during the year 2019-20 and 2020-21, respectively. It was statistically at par with its lower doses *i.e.* Etoxazole 6% + Abamectin 1.5% SC @ 450 ml ha^{-1}, during both the years. Whereas, minimum fruit yield of 9.32 and 10.12 t ha^{-1} was recorded in untreated check during 2019-20 and 2020-21, respectively (**Table 4**).

In the present investigation, Etoxazole 6% + Abamectin 1.5% SC @ 600 and 450 ml ha^{-1} provide good protection against red spider in brinjal with higher fruit yield. The effectiveness of the pre mixture formulation may be attributed due to its unique and novel mode of action. The specific information regarding to efficacy of this pre-mix molecule against the red spider mite of brinjal is not available. However, efficacy of various acaricides and insecticides of different groups are evaluated time to time by researchers and are available. Rahman *et al.* [11] recorded that propargite was less effective than etoxazole against red spider mite in tea. However, Varghese and Mathew [12] reported that propargite 57 EC at 570 g a.i. ha^{-1} was found to be effective in reducing chilli mite population. Among various treatments, etoxazole 10 SC gave comparatively better protection and followed by hexythiazox [13]. Etoxazole 10 SC @ 25-80g a.i. ha^{-1}, gave very effective results, specifically in controlling eggs and immature stages of red spider mites and resulted in higher fruit yield of brinjal than rest of the treatments [14]. Chakrabarti and Sarkar [15] tested different molecules to manage *Polyphagotarsonemus latus (*Banks) and diafenthiuron 50 WP@ 300 g a.i.ha^{-1} showed the maximum efficiency against motile stages followed by milbemectin and propargite. New acaricides hexythiazox 5.45 EC (1.5 ml/l), abamectin 1.9 EC (0.5 ml/l) and propargite 57 EC (2.0 ml/l) appeared to be highly effective against grape mites [16]. Propargite 57 EC @ 1500 ml a.i. ha^{-1} proved to be the best treatment followed by fenazaquin which were also highly effective against mites on okra [17]. Pal and Karmakar [18] observed that the application of diafenthiuron 50 WP @ 800g a.i. ha^{-1} was very promising followed by fenazaquin 10 EC@ 100 g a.i. ha^{-1}, while ethion 50 EC @ 1 ml/lit recorded the least mortality (47.72 %). Shukla and Radadia [19] reported that fenazaquin 10 EC was very effective over rest of the treatments and also gave highest yield of brinjal.

Table 4 Effect of Etoxazole 6% + Abamectin 1.5% SC on Fruit Yield (t ha-^{1}) of brinjal during *Rabi*-2019-20 and 2020-21

S. No.	Treatments	Formulation dose (ml ha-^{1})	Fruit yield (t ha-^{1})		
			2019	2020	Mean
1.	T_1= Etoxazole 6% + Abamectin 1.5% SC	300	12.28	13.02	12.65
2.	T_2= Etoxazole 6% + Abamectin 1.5% SC	450	15.69	16.64	16.16
3.	T_3= Etoxazole 6% + Abamectin 1.5% SC	600	16.58	17.61	17.09
4.	T_4= Etoxazole 10% EC	400	13.53	14.42	13.97
5.	T_5= Abamectin 1.9% EC	375	12.02	12.70	12.36
6.	T_6= Propargite 57% EC	1000	12.73	13.53	13.13
7.	T_7= Untreated control	-	9.32	10.12	9.72
	S. EM (±)	-	10.27	10.84	
	CD at 5%		2.80	2.96	

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