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Bio-efficacy of botanicals, microbials and newer insecticides in the management of tomato leafminer, *Liriomyza trifolii* burgess

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ABSTRACT
Studies on the effect of botanicals, microbials and newer insecticides along with conventional insecticides against tomato leafminer were conducted at Experimental Farm of Department of Entomology, Dr.PDKV, Akola during *Kharif* season of 2002-03. Abamectin 0.002% was found to be the most effective treatment in reducing leafminer infestation (13.61 & 16.50%) at five and seven days after spraying (DAS) followed by cypermethrin 0.01%. But significantly the lowest number of mines per leaf was noticed in cypermethrin 0.01% (1.62) at 5 DAS and in abamectin 0.002% (1.89) at 7 DAS. The NSKE 5%, spinosad 0.0015%, neem oil 1% and endosulfan 0.05% were the next best treatments with minimum infestation and lower number of mines per leaf. The *Btk* @ 1.5ml/lit.and newer molecules, thiamethoxam and imidacloprid each at 0.01% were least effective against this pest. The maximum fruit yield (26.25 t/ha) was recorded in abamectin, which increased yield 115.87 per cent than control and at par with spinosad (24.60 t/ha) and scheduled application of endosulfan 0.05% before flower initiation and HaNPV@250 LE/ha during flowering phase of the crop (24.30 t/ha). The highest Incremental Cost Benefit Ratio (ICBR) of 1:23.71 was obtained from endosulfan 0.05% and closely followed by cypermethrin 0.01% (1:21.03) and NSKE 5% (1:20.30). The lowest ICBR was recorded in abamectin (1:0.78). The higher cost of insecticides reduced its ICBR, though it produced highest yield.

Key words : Tomato, *Liriomyza trifolii,* NSKE, Neem oil, Abamectin, Spinosad, Imidacloprid, Thiamethoxam, Endosulfan

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) in one of the most popular and remunerative vegetable crops grown world over and particularly round the year in India for its fleshy delicious fruits. Among the several problems that created obstacles for tomato productivity and quality fruits are heavy losses caused by insect pests. Among them, American serpentine leafminer, *Liriomyza trifolii* Burgess (Diptera: Agromyzidae), a notorious polyphagous pest has recently attained a serious pest status on tomato. Its severe infestation starting from nursery and continue till fruiting stage resulting into severe yield loss. In tomato, the damage caused by this pest has been reported to 30 to 40 per cent (Anon., 1995). Its extensive leaf mining activity reduces the photosynthetic rate to about 62 per cent within mined tissues as compared with unmined leaves, leads to adverse effects on young shoot growth and fruit formation which ultimately reduce the yield (Johnson *et al*., 1983). Management of this pest becomes very difficult due to internal mining activity of larvae within the leaf. By and large insecticides are used for the control of this problematic pest; however it is necessary to have ecofriendly insecticides of various mode of action to replace the older one. Hence an endeavour has been made to evaluate the efficacy of various ecofriendly insecticides against tomato leafminer.

MATERIALS AND METHODS

The field experiment was conducted at the Experimental Farm of Department of Entomology, Dr. PDKV, Akola during *kharif* 2002-03. This experiment was laid out in Randomized Block Design (RBD) with 12 treatments (Table 1) including untreated control and replicated thrice.

The healthy Pusa Ruby seedlings of about 30 days old having uniform size were transplanted on hills marked at 60x60 cm in each plot having the size of 3.6x6.0 m. All the agronomic practices as per recommendations were timely followed. Totally five rounds of insecticidal sprays were given at fortnight interval commencing from one month after transplantation.

Five plants were randomly selected in each treatment plot and total number of leaves and infested leaves due to leafminer were counted and the percentage of leafminer infestation was worked out at five and seven days after each spraying. The number of mines or galleries per leaf was also counted in each of available infested leaves restricted to maximum of 25 in each treatment plot at five and seven days after spraying (DAS). The marketable ripened tomato fruits were picked periodically and yield obtained in net plot of each treatment was recorded to compare the responses of different treatments on fruit yield. The income received from the sale of tomato fruits, cost of insecticides and labours cost were used to calculate the Incremental Cost Benefit Ratio (ICBR) to know the economic viability of each treatment. All the cumulative data were statistically analyzed after appropriate transformation (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The observation on percentage leafminer infestation and number of mines per leaf (Table 1) indicated that the lowest leaf infestation (13.61 & 16.50%) was recorded in abamectin 0.002% at 5 and 7 DAS, it was closely followed by cypermethrin 0.01% on both days of observation. The other effective treatments in the order of merit were $T_1>T_2>T_4>T_9>T_3$ and were at par with previous treatment at 5 DAS, whereas this order was slightly changed at 7DAS.

It is evident from the data that the lowest number of mines was recorded in cypermethrin 0.01% (1.62) followed

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by abamectin 0.002% (1.77) at 5 DAS, but this case was reverse at 7DAS, where abamectin recorded the lowest (1.89) followed by cypermethrin (1.96). But these two treatments did not differ significantly from the following treatments T_2>T_1>T_4>T_9>T_3 at both 5 and 7DAS. The other treatments like, *Btk* @ 1.5 ml/lit. and newer molecules, thiamethoxam and imidacloprid each at 0.01% were least effective and slightly better than untreated control in both leafminer infestation and number of mines per leaf. The less impact of *Btk* due to the fact that, it is the recommended insecticide for the control of lepidopteran insects (Lange and Bronson, 1981) but it was found ineffective against an internal feeder like leafminer.

The findings on the effectiveness of abamectin against leafminer as observed in the present study are well supported by the reports of Schuster and Taylor (1987), Lima and Machodo (1994) and Logiswaran and Bhuvaneswari (2000) on leafminer infestation and Parrella *et al*., (1996) on number of mines. Pawar *et al*., (1996) observed that cypermethrin was effective in reducing leafminer infestation and Schuster and Everett (1983) who found that least number of mines per leaf in cypermethrin, in line with the results obtained in the present investigations.

The positive influence of NSKE is well authenticated by Pawar *et al.* (1996), who also observed NSKE as the most effective in reducing leaf damage while Jeyakumar and Uthamasamy (1990) found that neem oil was most effective and Ursula and Parrella (1985) who found higher concentration of neem oil had reduced the number of mines.

When considering the yield of tomato fruits, all the treatments enhanced the fruit yield over control. The abamectin 0.002% recorded the highest yield of 26.25 t/ha, an increased yield of 115.87 per cent than control. It was closely followed by T_4 and T_{11} which recorded an increased yield of 102.30 and 99.84 per cent, respectively than untreated control. The latter two treatments were remain at par with T_9>T_1>T_7.

The *Btk* was slightly better than control. Though, *Btk* was most effective against fruit borer but their inability towards sucking pests, which ultimately caused lower yield. Dibyantono and Siswojo(1988) also reported low yield in *Btk* treated plots, are in conformity with present findings.

Among botanicals, NSKE and neem oil exhibited better yield performance, whereas, jatropha oil was least among all. It could be due to reduced concentration was not strong enough to keeping down the pest incidence.

Patel *et al.,* (1988) reported the fruit yield of 23.03 t/ha in endosulfan treated plot as equal to 23.75 t/ha, which

Table 1: Effect of treatments on leafminer infestation, number of mines per leaf and their impact on fruit yield and ICBR

Tr. No.	Treatments	Leafminer infestation (%)		Number of mines per leaf		Yield of Tomato Fruits		Economics			
		5 DAS	7DAS	5 DAS	7 DAS	Mean Yield (t/ha)	Increased (%) over control	Total cost of treatment (Rs./ha) (A)*	Value of increased yield over control (B)**	Net gain over control C = (B-A)	ICBR (C/A)
T_1	NSKE 5%	15.69 (3.96)	19.99 (4.47)	1.89 (1.37)	2.19 (1.48)	23.49	93.17	2127.50	45320	43192.5	1:20.30
T_2	Neem Oil 1 %	16.01 (4.00)	19.17 (4.38)	1.84 (1.36)	2.09 (1.44	19.69	61.92	3440	30120	26680	1:7.76
T_3	Jatropha Oil 1%	17.78 (4.22)	22.18 (4.71)	2.08 (1.44)	2.49 (1.58)	16.90	38.18	3190	18960	15770	1:4.94
T_4	Spinosad 2.5 EC @ 0.0015%	16.59 (4.07)	18.28 (4.28)	2.01 (1.42)	2.24 (1.50)	24.60	102.30	3265	49760	46495	1:14.24
T_5	Abamectin 1.8EC @ 0.002%	13.61 (3.69)	16.50 (4.06)	1.77 (1.33)	1.89 (1.37)	26.25	115.87	31645.23	56360	24714.77	1:0.78
T_6	*Btk* @ 1.5 ml/lit.	19.81 (4.45)	22.22 (4.71)	2.31 (1.52)	2.89 (1.70)	18.85	55.02	3527.50	26760	23232.5	1:6.59
T_7	Imidacloprid 17.8 SL @ 0.01%	21.81 (4.67)	24.67 (4.97)	2.71 (1.65)	3.01 (1.73)	22.59	85.87	6007.50	41720	35712.5	1:5.94
T_8	Thiamethoxam 25 WS @ 0.01%	20.84 (4.56)	23.48 (4.84)	2.66 (1.63)	2.97 (1.72)	21.20	74.34	5090	36160	31070	1:6.10
T_9	Endosulfan 35 EC @ 0.05%	17.63 (4.20)	20.41 (4.52)	2.00 (1.41)	2.31 (1.52)	23.75	95.31	1876.50	46360	44483.5	1:23.71
T_{10}	Cypermethrin 25 EC @ 0.01%	15.44 (3.93)	18.22 (4.27)	1.62 (1.27)	1.96 (1.40)	20.64	69.74	1540	33920	32380	1:21.03
T_{11}	Endosulfan @ 0.05% BFI and Ha NPV @ 250 LE/ha DFP	17.88 (4.23)	22.32 (4.72)	2.25 (1.50)	2.54 (1.59)	24.30	99.84	2754.60	48560	45805.4	1:16.63
T_{12}	Untreated Control	28.75 (5.36)	34.02 (5.83)	3.89 (1.97)	4.10 (2.02)	12.16	-	-	-	-	-
	F test	Sig.	Sig.	Sig.	Sig.	Sig.					
	SE(m) ±	0.23	0.19	0.07	0.07	0.78			-		
	CD at 5%	0.68	0.56	0.20	0.21	2.29					
	CV%	9.45	7.15	7.79	7.90	6.38					

Figures in parentheses are corresponding $\sqrt{x}$ values.

* Cost of insecticides, labour and spray pump charges.

** Sale of tomato fruits at current season was Rs. 4000/t.

DAS – days after spraying, BFI – Before flower initiation, DFP – During flowering phase.

was observed in the present study. The positive impact of abamectin was due to the fact that their strong efficiency against leaf feeding insects and sucking pests leads to higher yield and this is in agreement with the reports of Chaudhary and Senapati (2001).

The economics of different treatments indicated that endosulfan 0.05% (1:23.71) contributed the maximum ICBR followed by cypermethrin (1:21.03) and NSKE (1:20.30). Their efficiency in checking pests, moderately higher yield and very low cost of insecticides incurred on its application attributed their success as the most economically viable treatments. The remaining treatments also registered better ICBR in the range of 1:4.94 to 1:16.63 barring abamectin, which recorded the lowest of 1:0.78. Though it provided better control against all types of pests and highest yield, the higher cost of insecticides has reduced its ICBR and least among all. Patel *et al*.(1991) and Singh and Narang (1990) earlier reported the similar kind of effectiveness of endosulfan and cypermethrin, respectively in getting higher ICBR, all in corroborate with our present findings.

From our result it may be inferred that abamectin 0.002% was most effective against leafminer and in getting higher yield. But looking at the ICBR, it was lacked behind all treatments. Whereas, endosulfan 0.05%, cypermethrin 0.01%, NSKE 5% and spinosad 0.0015% were also exhibited better performance against leafminer and produced comparatively higher yield with more ICBR. Considering all facts, instead of using sole application of insecticides, they could be rotated with each other in order to prevent insecticidal resistance, because they have different mode of action and also reduce the burden of higher cost incurred on its application.

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