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Research Article

Eco-friendly management of tomato pests

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ABSTRACT

The experiment was conducted to find out relative efficacy of different integrated pest management modules comprised of alternate spray of chemical pesticides, biopesticides and botanicals against tomato leafhopper and fruit borer. The cumulative effect of all the sprays indicated that the module M_9 composed of chemical pesticides used in four sprays was significantly superior over other modules and recorded lowest number of leafhopper and fruit borer population population (0.78 per leaf and 0.62 per plant, respectively). However, module M_5 composed of alternate spray of 0.005 per cent Lamda cyhalothrin followed by *B. bassiana* @ 1.25 kg ha-1 followed by 0.0009 per cent abamectin followed by azadirachtin @ 2 ml L^{-1} in four sprays, respectively could also record nearly same population of leaf hoppers (0.96 per leaf) and fruit borer (0.71 larvae/plant) and comparable with M_9. Therefore, it can be concluded that the use of integrated approach composed of alternate use of chemical, biopesticides and botanicals can be adopted for control of major pests infesting tomato with minimum damage to environment.

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INTRODUCTION

Tomato is the world's largest vegetable crop, which occupies an outstanding place among the important vegetables of the world and commercially cultivated for its fleshy fruits. In India, productivity of tomato is very low as compared to its production potential of the developed countries. There are many reasons for low production potential and among them pest infestation is major one. Tomato fruit borer (*Helicoverpa armigera* Hubner) is a polyphagous pest. It's outbreak in crops like cotton, cereals, pulses, vegetables etc. are common and highly devastating. It has cosmopolitan distribution and has been recognized as a 'national pest'. In India it is known to cause 18 to 55 per cent losses in tomato crop by boring the fruits, which results into a direct loss by reducing the marketable value (Selvanarayanan and Narayanaswami, 2001). Therefore, the pest has become threat to successful production of tomato.

Presently, chemical pesticides are preferably used by farmers for the protection of tomato fruits against leaf miner and other pests. The over dependence and indiscriminate use of chemical pesticides has resulted in several problems like development of resistance to pesticides, outbreak of secondary pest, reduction of biodiversity and natural enemies. Indiscriminate use of pesticides resulted in failure of control of the tomato fruit borer (Lal and Lal, 1996). These drawbacks of chemical pesticides emphasized the need to identify alternate eco-friendly methods to manage the pests of tomato.

MATERIALS AND METHODS

Field experiment was conducted at ASPEE Agricultural Research and Development foundation Farm, Village Nare Tal Wada, Dist. Thane during *Rabi* season of 2008-2009. The seedlings of tomato variety NS-815 (M/s Namdhari Seeds Private Limited, Bidadi- 562 109, Bangalore) were raised under shed net condition. Transplanting was done in plot with (Gross- 4.8m x 3.0m, Net- 4.8m x 2.25m) R.B.D. (Randomized Block Design) having three replications and eleven treatments. There were eleven predefined IPM modules including control (Table A). Four sprays were given, each at interval of 15 days starting from 15 days after transplanting. The quantity of spray solution

Table A : Details of the IPM modules tested for management of whitefly infesting tomato

Module	I spray/application	II Spray	III Spray	IV Spray
M_1	Imidacloprid 70 WS 10 gm kg^{-1} (Seed treatment)	*Ha*NPV 0.5 L ha^{-1}	Goneem 5 ml L^{-1}	Azadirachtin 1500 ppm 2 ml L^{-1}
M_2	Imidacloprid 17.8 SL 0.04% (seedling root dip)	*Ha*NPV 0.5 L ha^{-1}	Goneem 5 ml L^{-1}	Azadirachtin 1500 ppm 2 ml L^{-1}
M_3	Imidacloprid 17.8 SL 0.0045%	*Ha*NPV 0.5 L ha^{-1}	Diflubenzuron 25 WP 0.015%	Goneem 5 ml L^{-1}
M_4	Imidacloprid 17.8 SL 0.0045%	*B. thuringiensis* 1kg ha^{-1}	Diflubenzuron 25 WP 0.015%	Goneem 5 ml L^{-1}
M_5	Lamda cyhalothrin 5EC 0.005%	*B. bassiana* *1.25 kg* ha^{-1}	Abamectin 1.9 EC 0.0009%	Azadirachtin 1500 ppm 2 ml L^{-1}
M_6	Lamda cyhalothrin 5EC 0.005%	Abamectin 1.9 EC 0.0009%	*Ha*NPV 0.5 L ha^{-1}	Azadirachtin 1500 ppm 2 ml L^{-1}
M_7	Acetamiprid 20 SP 0.004%	Abamectin 1.9 EC 0.0009%	*B. thuringiensis* 1kg ha^{-1}	Goneem 5 ml L^{-1}
M_8	*Ha*NPV 0.5 L ha^{-1}	Goneem 5 ml L^{-1}	*B. thuringiensis* 1kg ha^{-1}	Azadirachtin 1500 ppm 2 ml L^{-1}
M_9	Fipronil 5 SC 0.01%	Acetamiprid 20 SP 0.004%	Carbaryl 50 WP 0.15%	Endosulfan 35 EC 0.05%
M_{10}	Neemazal 1% (seedling root dip)	*V. lecanii* 2.5 kg ha^{-1}	*Ha*NPV 0.5 L ha^{-1}	Azadirachtin 1500 ppm 2 ml L^{-1}
M_{11}	Control (water spray)			

required to treat all plants under each treatment was determined prior to the application of each spray. The spraying was done by using manually operated Knap-Sack sprayer. Seed treatment and seedling root dip treatment were given at the time of sowing and transplanting, respectively.

Goneem is prepared in laboratory having constituents- cow urine 80 per cent, Neemazal-T/S 10 per cent, leaf extract of *Ocimum basilicum* (Tulas) 6 per cent, seed powder of *Terminalia chebula* (Harda) 2 per cent, extract of *Allium sativum* (Lasun) 2 per cent.

The pre-count was recorded 1 day prior to treatment and post treatment observations were recorded 3, 7, and 14 days after each spray. The intensity of tomato fruit borer on vegetative flush was recorded by counting number of larvae present on five randomly selected plants. Whereas the observations on fruit infestation were recorded at every picking and cumulative per cent fruit infestation were worked out from each plot. In case of leaf hopper, observations were recorded on three leaves per plant representing lower, middle and upper portion and mean number of nymphs per leaf were worked out.

The yield obtained from the blocks of various modules was recorded separately after categorizing it into damaged and healthy one. The data thus obtained were converted to yield in tones ha^{-1} for each module and presented in tables accordingly.

RESULTS AND DISCUSSION

Among the various options used, the treatments with chemical insecticides were significantly superior over other treatments including control at each spray. The cumulative effect of all the sprays (Table 1) also indicated that the module M_9 composed of chemical pesticides used in all four sprays was significantly superior over other modules and recorded lowest number of leafhopper population (0.78 per leaf). However, module M_5 composed of alternate spray of Lamda cyhalothrin followed by *B. bassiana,* abamectin, and azadirachtin in four sprays have also recorded nearly same population of leaf hoppers (0.96 per leaf) and as effective as M_9.

Cumulative effect of IPM module against tomato fruit borer indicated that among the various options used, the treatments with chemical insecticides were significantly superior over the other treatments including control at each spray. The pooled mean of all sprays also indicated that the module M9 composed of chemical insecticides alone was significantly superior over other modules and recorded lower number of fruit borer larvae (0.62) per plant. However, the module M5 composed of alternate spray of Lamda cyhalothrin 5EC (0.005%), B. bassiana-1.25 kg ha^{-1}, Abamectin1.9 EC (0.0009%) and Azadirachtin 1500 ppm-2 ml L^{-1} and M6 consisted of alternate spray of Lamda cyhalothrin 5EC (0.005%), abamectin 1.9 EC (0.0009%), HaNPV @ 0.5 L ha^{-1}

Table 1 : Relative efficacy of IPM modules against tomato leafhopper, *A. biguttula biguttula* and tomato fruit borer, *H. armigera*

Sr. No.	Module	Cumulative mean population of leafhopper/leaf*	Cumulative mean number of fruit borer larvae / plant*
1.	M_1	1.51 (1.58)**	1.15 (1.47)**
2.	M_2	1.52 (1.59)	1.11 (1.45)
3.	M_3	1.31 (1.52)	0.98 (1.41)
4.	M_4	1.33 (1.53)	1.01 (1.42)
5.	M_5	0.96 (1.40)	0.71 (1.34)
6.	M_6	1.46 (1.57)	0.83 (1.35)
7.	M_7	1.47 (1.57)	1.08 (1.44)
8.	M_8	1.57 (1.60)	1.00 (1.42)
9.	M_9	0.78 (1.33)	0.62 (1.27)
10.	M_{10}	1.31 (1.52)	0.92 (1.39)
11.	M_{11}	2.35 (1.83)	1.95 (1.72)
S.E. ±		0.02	0.03
C.D. (P=0.05)		0.07	0.09

* Cumulative mean of all four sprays

** Figures in parentheses are $\sqrt{n+1}$ transformations

Table 2 : Effect of different IPM modules on mean per cent fruit infestation by fruit borer and yield of tomato crop

Sr. No.	Module	Mean yield (kg $plot^{-1}$)*	Mean yield (t ha^{-1})	Mean per cent fruit infestation*
1.	M_1	9.36	8.67	22.13 (28.06)**
2.	M_2	9.74	9.02	21.61 (27.70)
3.	M_3	11.77	11.40	17.32 (24.59)
4.	M_4	11.89	11.01	19.42 (26.15)
5.	M_5	13.36	12.37	14.65 (22.50)
6.	M_6	13.47	12.48	14.49 (22.37)
7.	M_7	12.70	11.76	16.17 (23.71)
8.	M_8	12.31	10.90	19.64 (26.31)
9.	M_9	14.22	13.16	12.55 (20.75)
10.	M_{10}	11.61	10.75	19.45 (26.17)
11.	M_{11}	7.68	7.11	30.59 (33.58)
	S.E. ±		0.36	1.03
	C.D. (P=0.05)		1.06	3.03

* Mean of three replications

** Figures in the parentheses are arcsin transformations and azadirachtin 1500 ppm @ 2 ml L^{-1} have also recorded lower larval population (0.71 and 0.83 per plant) and showed statistically no significant difference with Mg.

Studies on effect of different IPM modules on mean per cent fruit infestation and yield of tomato crop (Table 2) indicate that, the module M_9 comprised of chemical insecticides alone recorded minimum fruit infestation (12.55%) and maximum yield (13.16 t ha^{-1}). However, the module M_5 and module M_6 consisted of alternate use of chemical pesticides and biopesticides and found as effective as M_9 in reducing per cent fruit infestation (14.65 and 14.49, respectively) and producing higher yield (12.37 and 12.48 t/ha, respectively) of marketable fruits.

The results of present investigation are in confirmation with various workers Gopal and Senguttuvan (1997) indicated that the treatment with NSKE (3%) followed by endosulfan (0.035%) followed by *Ha*NPV 250 LE ha^{-1} was comparable with three sprays of endosulfan alone. Singh *et al.* (2000) also reported that the module comprised of sequential sprays of *Ha*NPV 250 LE ha^{-1}, *B.t.k.* (1500 ml ha^{-1}) and endosulfan 35 EC (1250 ml ha^{-1}) was effective in providing beat protection and production in chickpea crop affected by pod borer. Effectiveness of carbaryl, endosulfan and lambdacyhalothrin was reported by Naitam and Ukey (1999) against tomato fruit borer. Efficacy of new synthetic insecticide molecules namely, acetamiprid and fipronil was against tomato fruit borer reported by Gaikwad *et al.* (2009).

The module M_5 and M_6 have been found best modules in controlling the pest infestation in tomato and comparable with insecticidal module M_9. Therefore, it can be concluded that the integrated approach comprised of alternate use of chemical pesticides, biopesticides and botanicals can be effectively adopted for control infestation of major pests infesting tomato and production of higher yield of marketable fruits.

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