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BIO-EFFICACY OF BOTANICALS, MICROBIAL AND CONVENTIONAL INSECTICIDE AGAINST TOMATO LEAFMINER

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ABSTRACT

The field experiment was conducted to evaluate the bio-safety of botanicals, microbial and conventional insecticide against leafminer. The minimum infestation due to leafminer was found in the treatment with neem seed extract 5% which recorded the infestation to the tune of 0.45 and 0.99% on 3 and 7 DAS, respectively and appeared to be the most effective treatment against leafminer. The other neem based treatments i.e. neem leaf extract 5% and neem oil1 % were almost found to have similar impact as that of insecticidal treatment with endosulfan 0.05%, whereas, the treatment schedule of NSE 5% alternated with either Btk@1000 ml/ha or HaNPV@250 LE/ha and the treatment with microbial i.e. *Photorhabdus luminescens*@2.5 ml/lit water showed diminishing results against leafminer as that of untreated control. It might be due to the effectiveness of Btk or HaNPV against *lepidopterous* pest specifically. The treatments with other botanicals had shown desirable effect against leafminer. As regard to the effect of different treatments on number of mines per leaf inflicted due to leafminer indicated that the treatment with neem seed extract 5% had recorded least number of mines (1.41 and 1.40%) on 3 and 7 DAS, respectively followed by endosulfan 0.05%, neem leaf extract 5% and neem oil 1%. The other botanicals also performed well against this pest. Whereas, the treatment with microbial and the treatment schedule of NSE 5% alternated with either HaNPV@250 LE/ha or Btk @1000 ml/ha shown comparatively poor impact. As regard to the yield of tomato fruit the highest fruit yield of 86.48 q/ha than control was obtained from endosulfan 0.05% followed by other neem based treatments. The other botanicals also showed good performance in producing better yield. The highest ICBR of 1 : 30.39 was obtained in endosulfan 0.05% followed by with neem leaf extract 5% (1:25.75) and neem seed extract 5%(1:16.41) while, the treatment with neem oil 1% had gained less ICBR (1:6.80) as that of other neem based treatments due to increased cost of treatments. The treatments with microbial also get the less ICBR due to marginal yield potentiality and reduced cost of treatments.

Keywords:
Botanicals
Microbial
Conventional insecticide
Leafminer
Endosulfan

INTRODUCTION

Tomato (*Lycopersicon esculentum*) is one of the most important and favorite vegetable crops of the globe due to its immense commercial and nutritive value. Productivity of tomato in India is 19 t/ha (Anonymous, 2006). Whereas its productivity potential is considered up to 30 t/ha (Singhal, 1996). An array of arthropod pests attacks the crop during its different growth stages attributing low productivity in India. Among them, leafminer (*Liriomyza trifolii*) is a serious pest of tomato. The genus *Liriomyza* contains more than 300 species out of which 23 species are economically important. The larva of leafminer begins feeding immediately after eclosion and feeds incessantly till it is ready to emerge from the leaves. The maggots mine the mesophyll portion of the leaves between the upper and lower leaf surfaces creating serpentine mines and white blotches visible on the upper surface (Trumble, 1981). This type of damage adversely affects the photosynthetic activity of plant, the growth of young shoots and ultimately the fruit formation (Parella, 1987). In tomato, the damage caused by this pest has been reported to the extent of 30 to 40% (Anonymous, 1995). For control of this pest various chemical insecticides have been used. Regular application of chlorinated hydrocarbons, organo phosphorus and parathyroid insecticides have created problems viz., resurgence of non target pest, development of resistance and environmental pollution. By observing all the above facts, the present investigations were therefore, undertaken to suggest the safer and compatible alternative method of pest control in order to save crop from disastrous pest and to ensure eco safety to the environment by an integrated approaches utilizing botanicals, microbial and conventional insecticide.

MATERIALS AND METHODS

Present study was conducted at the Experimental Farm of Department of Agricultural Entomology, Dr. PDKV, Akola during the *kharif* season of the two consequent years i.e. 2005-06 and 2006-07. Thirteen treatments (Table 1) including an

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untreated control were laid out in Randomized Block Design (RBD) with three replications. The healthy *Pusa Ruby* Seedlings of about 30 days old having uniform size were used for transplanting on hills marked at 60 × 60 cm in each plot having the size of 3.6 × 6.0 m. All the agronomic practices as per recommendations were timely followed. Five plants were randomly selected in each treatment plot. The number of total leaves and the infested leaves were counted on each of the randomly selected plants in each treatment plot and the percentage of infested leaves due to leafminer was worked out at three and seven days after each spraying.

The percent leafminer infestation was calculated by using the following formula.

Leafminer Infestation % = (Number of mined leaves)/ (Total number of leaves) × 100

However, the numbers of mines or galleries/leaf were counted on each of the available infested leaves restricted to maximum of 25 in each treatment plot at 3 and 7 days after each spraying.

Average number of mines/leaf = (Total number of mines present on leaves examined)/ (Total number of infested leaves examined)

The yield obtained in net plot of each treatment was also recorded. The money received from the sale of tomato fruits, cost of insecticides for its application and labour cost were used for calculating incremental cost benefit ratio (ICBR) in order to know the economic viability of each treatment. The cumulative data were statistically analysed after appropriate transformation (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Experimental data of both year pooled data presented in Table 1 on the effect of different treatments against leafminer infestation revealed that the spray application of neem seed extract 5% recorded the minimum infestation due to leafminer to the tune of 0.45 and 0.99% on 3 and 7 DAS, respectively and it appeared to be the most effective treatment against leafminer. It was followed by the treatment with neem leaf extract 5% and the treatment with neem oil 1% which accounted 1.17 and 1.29 and 1.21 and 1.70% leafminer infestations on 3 and 7 DAS, respectively. These treatments of neem based material were found to be quite effective against this pest (Ramesh and Ukey, 2006; Dimetry *et al.*, 1995).

The treatment with insecticide endosulfan 0.05% had exerted promising impact against leafminer noting the infestation to the extent of 1.21 and 1.25% on 3 and 7 DAS, respectively as against the maximum infestation of leafminer in untreated control. The effectiveness of endosulfan against leafminer as observed in the present investigation is in conformity with the results (Pawar *et al.*, 1998; Ukey *et al.*, 2003; Wankhede *et al.*, 2007) on tomato crop.

The treatments with other botanicals viz., giripushpa leaf extract 5%, nirgudi leaf extract 5%, garadi leaf extract 2.5%, mahua oil 1% and karanj oil 1% had shown desirable effect against this pest. The findings of the present investigations as regard to the desirable impact of these botanicals against leafminer could not be corroborated with earlier worker for want of information in published literature.

Whereas, the treatment with NSE 5% alternated with Btk@1000 ml/ha, treatment schedule of NSE 5% alternated with HaNPV@250 LE/ha showed increased incidence of leafminer to the extent of 3.41 and 3.69 and 3.42 and 3.93% on 3 and 7 DAS, respectively. This decreasing effect of these treatment is due to the reduced frequency and prolonged interval of spray application of NSE 5% and also due to the fact that Btk is effective against lepidopterist pests and HaNPV being specifically effective against *H. amigeraonly* (Lange and Bronson, 1981; Ramesh and Ukey, 2006; Jesmi Vijayan, 2006). The treatment with microbial i.e. *Photorhabdus luminescens*@2.5 ml/lit water registered 3.23 and 3.29% leafminer infestation and this treatment also did not perform well against this pests. These observations of present investigations are not comparable with previous workers for non availability of published literature.

Number of Mines/ Galleries per Leaf

The cumulative data of the present investigations as regard to the number of mines inflicted due to leafminer revealed that the minimum number of mines to the tune of 1.41 and 1.40% was found in the treatment with neem seed extract 5% on 3 and 7 DAS, respectively and it emerged to be the most effective treatment against leafminer in keeping the minimum number of mines per leaf. Similarly, the treatment with spray application of neem leaf extract 5% and the treatment with neem oil 1% accounted the number of mines to the extent of 1.73 and 2.09 and 1.96 and 2.01% on 3 and 7 DAS, respectively. These findings on the effectiveness of neem based material against tomato leafminer are well authenticated with the reports (Urusula and Parrella, 1985; Kondel *et al.*, 1986).

The treatment schedule with spray application of NSE 5% alternated with either Btk@1000 ml/ha or HaNPV@250 LE/ha had shown diminishing effect against leafminer noting the increased number of mines to the extent of 4.49 and 4.33 and 2.65 and 3.40% on 3 and 7 DAS, respectively. The treatment of NSE 5% when alternated with either Btk or HaNPV did not perform well against leafminer which might be due to the reduced frequency and prolong interval of application of NSE 5% and non effectiveness of Btk or HaNPV against this pest.

The treatment with endosulfan 0.05% exhibited good performance against this pest noting 1.81 and 2.01 mines/leaf at 3 and 7 DAS, respectively. These findings on the positive influence of endosulfan against leafminer in restricting to inflict mines/leaf on tomato crops is supported with the reports of Ramesh and Ukey (2006), who claimed reduced number of mines/leaf in the treatment with endosulfan.

Table 1: Effect of treatments on population of leafminer infestation and number of mines/galleries/leaf at 3 and 7 DAS

Treatment	Leaf miner infestation (%) at 3 DAS			Leafminer infestation (%) at 7 DAS			No. of mines/ leaf at 3 DAS			No. of mines/ leaf at 7 DAS		
	05-06	06-07	Pooled	05-06	06-07	Pooled	05-06	06-07	Pooled	05-06	06-07	Pooled
Neem oil 1%	031 (0.56)	2.11 (1.45)	1.21 (1.01)	2.65 (1.63)	0.75 (0.87)	1.70 (1.25)	1.60 (1.26)	2.58 (1.61)	2.09 (0.44)	1.74 (1.32)	2.28 (1.51)	20.1 (1.42)
Karanj oil 1%	0.96 (0.98)	3.56 (1.88)	2.26 (1.43)	3.14 (1.77)	2.84 (1.69)	2.99 (1.73)\	0.65 (1.28)	3.13 (1.77)	2.39 (1.53)	1.58 (1.26)	4.90 (2.21)	3.24 (1.74)
Mahua oil 1%	2.12 (1.45)	3.16 (1.78)	2.64 (1.62)	3.85 (1.96)	2.05 (1.43)	2.95 (1.70)	1.93 (1.39)	3.03 (1.74)	2.48 (1.57)	2.10 (1.45)	3.82 (1.95)	2.96 (1.70)
Neem leaf extracts 5%	0.44 (0.66)	1.34 (1.16)	0.45 (0.91)	0.79 (0.89)	1.19 (1.09)	0.99 (0.99)	1.59 (1.26)	1.23 (1.11)	1.41 (1.19)	1.98 (1.41)	0.82 (0.91)	1.40 (1.16)
Neem seed extract 5%	0.29 (0.54)	2.05 (1.43)	1.17 (0.99)	1.83 (1.35)	0.79 (0.87)	1.29 (1.11)	2.06 (1.44)	1.40 (1.18)	1.73 (1.31)	2.25 (1.50)	1.6 (1.29)	1.96 (1.40)
Garadi leaf extract 2.5%	1.00 (1.00)	4.46 (2.11)	2.73 (1.56)	3.98 (1.99)	1.78 (1.33)	2.88 (1.66)	1.65 (1.28)	3.53 (1.88)	2.59 (1.58)	1.76 (1.33)	3.18 (1.78)	2.47 (1.56)
Giripushpa leaf extract 5%	1.38 (1.32)	2.66 (1.63)	2.02 (1.40)	3.02 (1.74)	1.14 (1.07)	2.08 (1.41)	1.92 (1.39)	2.32 (1.52)	2.12 (1.46)	2.64 (1.62)	1.76 (1.33)	2.20 (1.48)
Nirgudi leaf extract 5%	1.73 (1.32)	2.45 (1.57)	2.09 (1.45)	2.99 (1.73)	1.21 (1.10)	2.10 (1.42)	1.87 (1.36)	2.39 (1.54)	2.13 (1.45)	2.54 (1.59)	2.06 (1.44)	2.30 (1.52)
NSE 5% alternated with Btk @1000 ml/ha	3.02 (1.74)	3.82 (1.95)	3.42 (1.85)	4.17 (2.04)	3.69 (1.92)	3.93 (1.98)	2.60 (1.16)	6.11 (2.47)	4.36 (2.04)	2.33 (1.53)	5.73 (2.39)	4.03 (1.96)
NSE 5% alternated with HaNPV @250 LE/ha	2.72 (1.65)	4.10 (2.02)	3.41 (1.84)	4.41 (2.10)	2.97 (1.72)	3.69 (1.97)	3.78 (1.94)	1.52 (1.23)	2.65 (1.59)	2.87 (1.69)	3.93 (1.9)	3.40 (1.84)
Photorhabdus luminescens @ 2.5 ml/lit water	2.83 (1.68)	3.63 (1.91)	3.23 (1.80)	4.04 (2.01)	2.54 (1.59)	3.29 (1.80)	2.61 (1.62)	2.63 (1.62)	2.62 (1.62)	3.07 (1.75)	3.53 (1.88)	3.30 (1.82)
Endosulfan 35 EC 0.05%	0.79 (0.89)	1.63 (1.28)	1.21 (1.09)	1.77 (1.33)	0.73 (0.85)	1.25 (1.09)	3.08 (1.75)	0.50 (0.73)	1.81 (1.24)	4.16 (2.04)	0.14 (0.37)	2.01 (1.21)
Untreated (control)	4.07 (2.01)	5.05 (2.25)	4.56 (2.13)	5.92 (2.43)	4.12 (2.03)	5.02 (2.23)	3.91 (1.98)	6.38 (2.52)	5.15 (2.25)	4.29 (2.07)	6.33 (2.52)	5.31 (2.30)
CD (*P*=0.05)	0.46	0.47	0.33	0.50	0.49	0.28	0.28	0.30	0.42	0.21	0.24	0.31

Figures in parenthesis are √x transformed value; DAS = Days after spraying

Table 2: Yield of tomato fruits and ICBR for different treatment

Treatment	Yield (q/ha)	Total Cost (₹)	Yield over control	Yield over control (B)	(C) B-A	ICBR (C/A)	Rank
Neem oil 1%	67.31	3474	22.59	27108	23634	1:6.80	6
Karanj oil 1%	59.21	2574	14.53	17436	14862	1:5.77	9
Mahua oil 1%	61.21	4374	16.49	19788	15414	1:3.52	10
Neem leaf extracts 5%	68.67	1650	23.95	28740	27090	1:16.41	3
Neem seed extract 5%	72.61	1251	27.89	33468	32217	1:25.75	2
Garadi leaf extract 2.5%	61.28	1824	16.56	19872	18048	1:9.89	5
Giripushpa leaf extract 5%	62.35	1824	17.63	21156	19332	1:10.60	4
Nirgudi leaf extract 5%	62.56	2274	17.84	21408	19134	1:8.41	7
NSE 5% alternated with Btk @1000 ml/ha	58.85	2632	14.13	16956	14323	1:5.44	8
NSE 5% alternated with HaNPV @250 LE/ha	57.89	6736	13.17	15804	9067	1:1.34	12
Photorhabdus luminescens @ 2.5 ml/lit water	56.59	5589	11.87	14244	8655	1:1.55	11
Endosulfan 35 EC 0.05%	86.48	1596	41.76	50112	48515	1:30.39	1
Untreated (control)	44.72	--					

NB-Sale price of tomato ₹ 1200 /q; Spray pump charge ` 30/day; Labour charges ₹ 47/day; Detergent ` 20 kg

Whereas, the treatment with other botanicles viz., the treatment with nirgudi leaf extract 5%, mahua oil 1%, giripushpa leaf extract 5%, garadi leaf extract 2.5% exerted marginal impact against pest. These results on the marginal performance of these botanicals could not be compared with other workers for want of published literature. The treatment with *Photorhabdus luminecsens*@2.5 ml/lit water observed the number of mines to the extent of 2.62 and 3.30/leaf on 3 and 7 DAS, respectively and indicated comparatively poor impact against this pest.

Yield

The pooled data presented in (Table 2) of the present investigation revealed that the treatment with spray of endosulfan 0.05% had recorded the highest yield of tomato fruits to the tune of 86.48 q/ha as against the minimum yield of 44.42 q/ha in untreated control and it was found to be significantly superior over all the treatments. The high yield potentiality of endosulfan might have attributed to the positive impact of this treatment against major sucking pest as well as leafminer and fruit borer the similar results regarding the high yield potentiality of insecticides endosulfan treated plots were reported by Patel *et al.* (1998) confirming the present findings.

The other neem based treatments viz., the treatment with spray application of neem leaf extract 5% , neem seed extract 5% and neem oil 1% registered the yield of tomato fruits to the tune of 72.61, 68.67 and 67.31 q/ha, respectively and they were found to be statically equal effective among themselves. This promising yield performance in neem based material is certainly due to positive impact of these treatments against sucking pests, leaf miner and tomato fruit borer. The findings of the present investigations on the positive influence of these neem based material on the yield of tomato fruits are in conformity with the reports of Marcado and Guerrero (1992); Mahadevan (1998), who observed the similar impact of neem based material in getting increased yield of tomato fruits.

Among the other botanicals, the treatment with spray of nirgudi leaf extract 5%, giripushpa leaf extract 5%, garadi leaf extract 2.5%, mahua oil 1% and karanj oil 1% had shown the good performance in producing 62.56, 62.35, 61.28, 61.21, and 59.25 q/ha yield of tomato fruits which attributed due to its positive efficacy of these treatment over leafminer and sucking pest. These findings of the present investigations could not be compared with other workers as no information on the yield potentiality of this treatment is available in published literature. However, the treatment schedule consisting spray application of neem seed extract 5% alternated with Btk, or HaNPV@250 LE/ha and the treatment with spray of *Photorhabuds luminescens*@2.5 ml/lit water had obtained the yield of tomato fruits to the tune of 58.85, 57.89, and 56.59 q/ha, respectively. This poor yield potentiality is certainly attributed due to the lower efficacy of these microbial against sucking pests and leaf miner. The findings of the present investigation on low yield potentiality of Btk (Ramesh and Ukey, 2006).

ICBR

The pooled data (Table 2) on ICBR as influenced by the various treatments revealed that the insecticidal treatment of endosulfan 0.05%, fetched maximum cost benefit ratio (1:30.39) and appeared to be the most economically viable treatment owing to their efficiency in controlling insect pests, moderately higher yield and low cost of insecticides incurred on its application. Similarly highest ICBR of insecticidal treatment of endosulfan was reported by (Patel *et al.,* 1991; Pawar *et al*., 1996).

The treatments with neem based materials viz., spray of neem leaf extract 5% and spray of neem seed extract 5% found to be next profitable treatment getting the ICBR of 1:25.75 and 1:16.41, while, the another neem based treatment with spray application of neem oil 1% received comparatively less ICBR of 1:6.80 which attributed due to the fact that although it had good yield potentiality, but due to increased cost of treatment. In context of the other botanicals, i.e. giripushapa leaf extract 5%, garadi leaf extract 2.5% and nirgudi leaf extract 5% also obtain desirable ICBR to the extent of 1:10.60, 1:9.89 and 1:8.41 respectively. This could be due to better yield of tomato fruits and reduced cost of treatments. These results of the present investigations could not be corroborated with earlier workers for non availability of published literature. While, the spray application of remaining botanicals i.e. karanj oil and mahua oil each at 1% was found comparatively less economically viable treatment getting ICBR of 1:5.77 and 1:3.52 due to relatively higher cost of treatment.

The treatment schedule with NSE 5% alternated with Btk@1000 ml/ha obtained ICBR (1: 5.44) which attributed to the marginal yield level and higher cost of treatment. The another treatment schedule with NSE 5% alternated with HaNPV@250 LE/ha received ICBR to the tune of 1 : 1.34 this was due to marginal yield potentiality and relatively more cost of treatment which is due to the higher rate of HaNPV. The treatment with microbial application of *Photorhabdus luminescens* provided the marginal ICBR of 1:1.55. The findings of the present investigation on less economical viability of the microbial could not be compared with previous workers for want of information on this aspect in the published literature.

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