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Value of Safer Management Methods against Key Insect Pests of Tomato and Garden Pea in Kumoun Himalayas

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ABSTRACT

Safer management tools against major insect pests of tomato and garden pea have been evaluated for the first time in Kumaon hills of North West Himalayas. In tomato, four releases of *Trichogramma chilonis* @ 50,000 insects/ha/release at an interval of 10 days from flowering initiation stage against fruit borer, *Helicoverpa armigera* and in garden pea, BSKE (*Batain* (Chinaberry, *Melia azedarach*) Seed Kernel Extract) (10%) against pod borers, *H. armigera* and *Lampides boeticus* were found most promising. Planting a row of marigold after 10 rows of tomato, application of BSKE, azadirachtin (0.03%), HaNPV@250 LE/ha, *Bacillus thuringiensis* @ 1 kg/ha, endosulfan (0.07%) have also significantly reduced the major insect pests of tomato and garden pea over control.

INTRODUCTION

Hill agriculture is comparatively more vulnerable to insect pest infestation due to the occurrence of varied climatic conditions. Intensive vegetable farming, especially in valley areas of hills, has witnessed terrific pest build-up during recent past. Among vegetables, tomato, and garden pea are the major crops of North West Himalayan region of India (Anonymous, 2002). The over reliance on chemicals to manage these, resulted in several ill effects. Organic farming is being advocated by the Government is also challenged with the need for management of insect pests and diseases. Hence, for higher productivity and production of the crops, without ecological hazards, it is vital to adopt the safer management tools with more emphasis on biological control. Against major insect pests of tomato and garden pea, trichogrammatids (Yadav *et al.,* 1985, Yadav, 2001), NPV (Mohan *et al*., 1996), *Bacillus thuringiensis* (Battu *et al.*, 1993,), one row of marigold after 16 rows of tomato (Srinivasan, 1994), azadirachtin (Singh *et al.*, 2004), *Batain* (Chinaberry, *Melia azedarach*) Seed Kernel Extract (Anonymous, 2003-04) and endosulfan (Kumar and Ameta, 2003, Srivastava *et al*., 2003) have been found effective. The present study was therefore, undertaken to evaluate the efficacy of above safer management tools in order to manage the major insect pests of tomato and garden pea for the first time in Kumaon hills.

MATERIALS AND METHODS

Data on percent damage at farmer's field as well as crops are grown nearby experimental farm were taken into consideration for the calculation of overall damage of the crops by the major pests in the region. No treatment was used by the farmers in their fields. Randomly ten fields (sites) were selected and twenty plants in each field were tagged for observation of damage caused by fruit borer and leaf miners in case of tomato and pod borer and leaf miner in case of a garden pea.

All the experiments were conducted at the Project period of IPM at the farm of Vivekananda Institute of Hill Agriculture located at Hawalbagh ($29^0$36' N, $79^0$40' E, and 1250 msl), Almora, India during 2006 to 2008. Tomato (Variety: Marglobe) was grown during rainy season (June to September) while garden pea (Variety: VL-7) was grown during winter season (November to April). Details of the treatments in tomato are mentioned in Table1. In case of garden pea, except treatment of marigold, all other treatments were same. No treatment was applied in control. Both

the experiments were conducted in 5 x 2 m^2 plots in a randomized block design with three replications.

In case of tomato, percent fruit borer damage was recorded from the fruits obtained from random 10 plants in each replication. Leaf miner damage was not considered for analysis as damage was very low. In case of garden pea, percent pod borer was recorded by counting the number of damaged pods obtained from random 10 plants in each replication. Leaf miner damage was recorded by counting a total number of damaged leaves out of total number of leaves obtained from random 10 plants in each replication. The data on percent infestation was converted to arcsine transformation before subjected to analysis of variance.

RESULTS AND DISCUSSION

Damage by major insect pests of tomato and garden pea in Kumaon hills

Regular field observations were made at the farmer's field as well as in the nearby localities of the experimental area. Pooled data of 2006 and 2007 revealed that fruit borers, *Helicoverpa armigera* was the major insect pest of tomato while pod borers, *H. armigera* and *Lampides boeticus* and leaf miner, *Phytomyza horticola* were the major pests of garden pea. *H. armigera* was also reported as a regular pest of tomato and garden pea in Himachal Pradesh (Verma and Kakar, 1996). In tomato, fruit borer damage was 24.1 per cent (range 18.5 -29.0%) during 2006 while it was 23.3 percent (range 12.6-29.4 %) during 2007. The occurrence of leaf miner was comparatively low (3.83%) during two years of experimentation. In garden pea, pod borer damage was recorded to the tune of 7.4 per cent (range 4.5-10.5%) during 2006 while it was 7.95 percent (range 3.8-12.2%) during 2007. The occurrence of leaf miner was severe and it was 43.1 per cent (range 32.5-52.2%) during 2006, while it was 41.2 percent (range 35.1-50.2%) during 2007.

Efficacy of safer management tools against fruit borer in tomato

Out of seven treatments, four releases of *T. chilonis* @ 50,000 insects/ha/release at an interval of 10 days from the pre-flowering stage was found to reduce fruit borer, *H. armigera* damage to the extent of 81.99% over control. Treatments such as azadirachtin @ 0.03%, one row of marigold after 10 rows of tomato, BSKE @10%, HaNPV @ 250 LE/ha, *B. thuringiensis* @ 1 kg/ha,

endosulfan @ 0.07% were recorded to suppress fruit borer damage to the tune of 71.85, 67.13, 62.96, 56.15, 41.33 and 82.55 percent respectively over control. Treatments of HaNPV and *B. thuringiensis* were not that effective as they were found effective in plain areas of the country (Battu *et al.*, 1993; Mohan *et al.*, 1996; Satpathy and Rai, 2000) probably because of more intensity of UV radiations at higher altitudes. Reduction in percentage damage over control due to releases of *T. chilonis* (81.99%) was on par with endosulfan (82.55%). Planting a row of marigold was more effective than HaNPV, BSKE and *B. thuringiensis* treatments. It is therefore concluded that planting of marigold and release of *T. chilonis* would effectively suppress fruit borer in tomato. Significant increase in yield was recorded in the treated plots (64.17–70.74 q/ha) as compared to control (47.31 q/ha). However, the difference in yield among the different treatments was non-significant. (Table 2). When economics of the application of different treatments was compared, the treatment of four releases of *T. chilonis* @ 50,000 insects/ha/release was found most economical followed by marigold as trap crop despite the fact that the yields were higher in case of applications of azadirachtin, endosulfan, HaNPV and *B. thuringiensis* (Table 4).

Efficacy of safer management tools against pod borer and leaf miner of garden pea:

Among various treatments, BSKE (10%) was found to be the best as it gave 79.51 percent reduction in pod borer damage, 39.85 per cent reduction in leaf miner damage with a significant increase in yield (82.11 q/ha). Although reduction (56.27%) in leaf miner damage was highest in case of treatment of endosulfan, the impact on yield was low due to the fact that the economical damage caused by leaf miners was meager. Other treatments such as azadirachtin @ 0.03 (74.29%), *T. chilonis* @ 50,000 insects/ha/release at an interval of 10 days from pre-flowering stage (71.68%), HaNPV @ 250 LE/ha (59.87%), *B. thuringiensis* @ 1 kg/ha (43.78%), endosulfan @ 0.07% (70.95%) have also significantly reduced the pod borer and leaf miner damage over control. Both of the botanicals, BSKE (10%) and azadirachtin (0.03%) proved to be effective in reducing pest population and gave higher yield. Significant increase in yield was recorded in all the treated plots (67.41 – 82.11 q/ha) as compared to control (62.13%) (Table 3). The economics of different treatments revealed that the treatment of *batain* (Chinaberry, *M. azedarach*) seed kernel extract was most economical followed by that was the release of *T.*

chilonis and application of azadirachtin. In case of garden pea, botanicals were found most effective compared to microbial and chemical pesticides (Table 5).

The study has revealed that the application of microbial pesticides such as *B. thuringiensis* and NPV were not that cost effective at higher altitudes as compared to plains. The use of botanicals especially locally available *M. azedarach* was found economical, as it is available in plenty in North West Himalayan hills. The most economical treatments in case of tomato were four releases of *T. chilonis* @ 50,000 insects/ha/ release and plantation of marigold as a trap crop and that of garden pea were the application of BSKE and four releases of *T.chilonis* @ 50,000 insects/ha/ release. These treatments would be utilized easily in IPM as well as organic farming programs.

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Table 1. Details of treatments for the management of insect pests of tomato.

Treatment/application	Dosage/ conc.	Time of application
HaNPV (Two applications)	250 LE/ha	One pre-flowering + one post-flowering
Bacillus thuringiensis (Two applications)	1 kg/ ha	One pre-flowering + one post-flowering
BSKE (*Batain* (*Melia azadirech*) Seed Kernel Extract) (Three applications)	10 %	One pre-flowering + two post-flowering
Azadirachtin (Three applications)	0.03%	One pre-flowering + two post-flowering
Endosulfan (Two applications)	0.07%	One pre-flowering + one post-flowering
Trichogramma chilonis (Four applications)	50,000 insects/ ha/ release	Four releases at an interval of 10 days commencing from initiation of flowering
One row of marigold on sides of experimental plot	One row of marigold after every 10 rows of tomato	Twenty five days old seedlings of tomato and 40 days old seedlings of marigold were planted together.
Untreated control	-	-

Table 2. Effectiveness of safer management Techniques against fruit borer of tomato in Kumaon hills (Pooled data of 2006 and 2007).

Sr. No.	Treatment	Fruit borer damage* (%)	Damage reduction over control (%)	Yield (q/ha)
1.	HaNPV @250 LE/ha	12.37^{bc} (18.86)	56.15	67.81^{a}
2.	*Bacillus thuringiensis* @ 1 kg/ha	16.55^{b} (21.11)	41.33	67.70^{a}
3.	BSKE @ 10%	10.41^{bcd} (18.50)	62.96	64.17^{a}
4.	Azadirachtin @ 0.03%	7.94^{cde} (16.16)	71.85	70.74^{a}
5.	Endosulfan @ 0.07%	4.92^{e} (12.36)	82.55	70.12^{a}
6.	*Trichogramma chilonis* @ 50,000 insects/ha/release (Four releases)	5.08^{cde} (14.61)	81.99	66.94^{a}
7.	One row of marigold	9.27^{bcd} (18.06)	67.13	66.30^{a}
8.	Control	28.21^{a} (31.11)	-	47.31^{b}
CD at 5% CV (%)		4.75 14.0	-	13.32 11.7

* Figures in parentheses are angular transformed values.

The values in individual columns superscripted by similar letter(s) do not differ significantly.

Table 3. Effectiveness of safer management techniques against major insect pests of garden pea in Kumaon hills (Pooled data of 2006-07 and 2007-08).

Sl. No.	Treatment	Pod borer		Leaf miner		
		Damage* (%)	Damage reduction over control (%)	Damage* (%)	Damage reduction over control (%)	Yield (q/ha)
1.	HaNPV @250 LE/ha	3.84^{c} (11.23)	59.87	31.15^{b} (33.91)	17.46	72.17^{bc}
2.	*Bacillus thuringiensis* @ 1 kg/ha	4.19^{b} (11.81)	43.78	29.74^{bc} (33.02)	21.19	67.41^{cd}
3.	BSKE @ 10%	1.96^{e} (8.06)	79.51	24.12^{de} (29.41)	36.08	82.11^{a}
4.	Azadirachtin @ 0.03%	2.46^{d} (9.03)	74.29	22.70^{e} (28.42)	39.85	81.58^{a}
5.	Endosulfan @ 0.07%	2.78^{d} (9.57)	70.95	16.50^{f} (23.93)	56.27	72.62^{bc}
6.	*Trichogramma chilonis* @ 50,000 insects/ha/ release (four releases)	2.71^{d} (9.46)	71.68	26.42^{cd} (30.91)	29.99	76.52^{ab}
7.	Control	9.57^{a} (17.98)	-	37.74^{a} (37.87)	-	62.13^{d}
CD (P=0.05) CV (%)		0.54 2.7	-	2.27 4.1	-	8.10 6.2

* Figures in parentheses are angular transformed values.

The values in individual columns superscripted by similar letter(s) do not differ significantly.

Table 4. Economics of different treatments against major pest of tomato.

Treatment	Yield (q/ha)	Increase in yield over control (q/ha)	Gross* income (Rs.)	Cost of ** application	Net gain (Rs.)	Cost: Benefit ratio
HaNPV @250 LE/ha (Two applications)	67.81	20.50	14,350	5,908	8,442	1:1.43
Bacillus thuringiensis @ 1 kg/ha (Two applications)	67.70	20.39	14,273	3,128	11,145	1:3.56
BSKE @ 10% (Three applications)	64.17	16.86	11,802	1,287	10,515	1:8.17
Azadirachtin @ 0.03% (Three applications)	70.74	23.43	16,401	1,662	14,739	1:8.86
Endosulfan @ 0.07% (Two applications)	70.12	22.81	15,967	1,248	14,719	1:11.79
Trichogramma chilonis @ 50,000 insects/ha/release (Four releases)	66.94	19.63	13,741	977	12,764	1:13.06
One row of marigold after 10 row plot of tomato	66.30	18.99	13,293	1,010	12,283	1:12.16
Untreated Control	47.31	-	-	-	-	-

* Price of produce= Rs 700/q

** HaNPV-@ Rs 2750 per litre; *B. thuringiensis*- @ Rs 1350 per kg, *Batain* seed-@ Rs 3 per kg (locally available in hills in plenty), Azadirachtin @ Rs 350 per litre; Endosulfan @ Rs 280 per litre,; *Trichogramma chilonis* @ Rs 218 per ha/ release, Planting of marigold with five additional labour. Labour charges @ Rs 102 per day per man days.

Labour charges are added in all the applications separately.

Table 5. Economics of different treatments against major pests of garden pea.

Treatment	Yield (q/ha)	Increase in yield over control (q/ha)	Gross* income (Rs.)	Cost of** application	Net gain (Rs.)	Cost: Benefit ratio
HaNPV @250 LE/ha (Two applications)	72.17	10.04	9,036	5,908	3,128	1:0.52
Bacillus thuringiensis @ 1 kg/ha (Two applications)	67.41	5.28	4,752	3,128	1,624	1:0.51
BSKE @ 10% (Three applications)	82.11	19.98	17,982	1,287	16,695	1:12.97
Azadirechtin @ 0.03% (Three applications)	81.58	19.45	17,505	1,662	15,843	1:9.53
Endosulfan @ 0.07% (Two applications)	72.62	10.49	9,441	1,248	8,193	1:6.56
Trichogramma chilonis @ 50,000 insects/ha/release (Four releases)	76.52	14.39	12,951	977	11,974	1:12.25
Untreated Control	62.13	-	-	-	-	-

* Price of produce= Rs 900/q

** HaNPV-@ Rs 2750 per litre; *B. thuringiensis*- @ Rs 1350 per kg; *Batain* seed-@ Rs 3 per kg (locally available in hills in plenty); Azadirachtin @ Rs 350 per litre; Endosulfan @ Rs 280

per litre; *Trichogramma chilonis* @ Rs 218 per ha/ release; Labour charges @ Rs 102 per day per man days.

Labour charges are added in all the applications separately.