EFFICACY OF BOTANICAL EXTRACTS AND A CHEMICAL PESTICIDE AGAINST TOMATO FRUIT WORM, *HELICOVERPA ARMIGERA*

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ABSTRACT

Investigations on the effect of extracts of different botanicals i.e. neem seed extract (2.5%), turmeric extract (5%), henge extract (1.25%), garlic extract (5%) and insecticide (emamectin benzoate) (0.07%) on tomato fruit worm, Helicoverpa armigera, were carried out at New Developmental Farm of the The University of Agriculture, Peshawar, Pakistan during, 2011. Minimum number of larvae plant^{-1} of H. armigera (0.40 and 0.46) was recorded in neem seed extract and emamectin benzoate and maximum number of 1.00 larvae plant^{-1} was recorded in control. Number of fruit damage was minimum (10.2%) in emamectin benzoate (0.07%) but it was highest (19.5%) in control. Maximum yield (7540 kg ha^{-1}) was recorded in neem seed extract (2.5%) and percent infestation of larvae of tomato fruit worm was minimum (0.40) in emamectin benzoate whereas maximum (1.00) in control plot. Based on total yield and lower toxicity to the environment as well as human being neem seed extract is the most promising insecticide for the effective management of tomato fruit worm larvae. Garlic, turmeric and henge extracts proved ineffective in control of H. Armigera.

Key Words: **Botanical Extracts, Insecticide, Tomato, *H. Armigera***

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INTRODUCTION

Tomato, *Lycopersicon esculentum* Mill, has become a major world food crop in less than a century. Tomato is considered a vegetable instead of fruit (Anonymous, 2000). Like other crops tomato is also damaged by a number of pests including fruit worm, *Helicoverpa armigera*. The polyphgous larvae of this insect feed on corn, tobacco, cotton and other vegetables. In tomato, the larva damages the fruit at any stage of growth rendering it non-marketable (Gajete *et al*., 2004).

In Pakistan the yield of tomato is low as compared to developed countries. Among many factors of its low yield insect pests are serious constraints. Tomato crop is attacked by a number of pests but the most damaging one is the tomato fruit worm. Although insecticidal control is one of the common means against the fruit borer, many of the insecticides applied are not effective for the satisfactory control of this pest. Also chemical insecticides will leave considerable toxic residues on the fruits. Beside this, sole dependence on insecticides for the control of this pest has led to insecticidal resistance by the pest (Natekar *et al*., 1987). Hence, use of organic amendments, plant products and microbial origin insecticides can be the novel approaches to manage the pest.

Natural pesticides are good alternative to synthetic pesticides because they are safe to environment, natural enemies, humans and other animals, e.g. most botanical pesticides have low to moderate mammalian toxicity (Hassan, 1992). Keeping in view the importance of *H. armigera* the present investigations were conducted to determine the effect of botanical insecticides and chemicals on yield and quality of tomato crop.

MATERIALS AND METHODS

Experiments were conducted at the New Developmental Farm of the Khyber Pakhtunkhwa Agricultural University, Peshawar during 2011. The experiment was laid in randomized complete block design with 6 treatments and three replications. Plant to plant distance was 0.60 m and row to row distance was 1 m. The total field size was 360 m^2. Each plot size was 5 x 1 m. Number of plants in each plot was 16. Shimla variety of tomato was planted on 2nd March, 2011. Recommended agronomic practices were applied.

Treatments

T_1 Neem seed crude extracts (2.5%)
T_2 Turmeric crude extracts (3.5%)
T_3 Garlic crude extracts (5%)
T_4 Heng crude extracts (2.5%)
T_5 Thiodan (0.07%)
T_6 Control

Preparation of Treatments

Insecticide (emamectin benzoate 1.9 E.C) was purchased from local market. Neem seed crude extract (2.5%), turmeric, asafetida (henge) and garlic crude extract was prepared by the procedure adopted by Munir (2006).

Data Collection

Data was recorded at weekly interval. All treatments were applied soon after first fruit setting and were repeated after 15 days interval, till fruiting. The mature tomato fruit were collected separately from each plot. Weight and number of damaged tomato fruit were recorded for each plot separately. The total yield of tomato was determined by adding the yields of tomato per picking of each plot.

Yield = Total weight of tomato collected from each plot

$$\text{Percent fruit damage} = \frac{\text{Number of damage fruit} \times 100}{\text{Total Number of fruits}}$$

Data Analysis

Statistical package MSTAT-C was used to analyze the data. Statistical significance was assessed by DMRT at 5% significant level (Steel and Torrie, 1980).

RESULTS AND DISSCUSION

Effect on Larval Population of H. armigera

The results on the larval populations of after application of different spray concentrations *i.e.* neem seed extract (2.5%), turmeric extract (2.5%), henge extract (1.25%), garlic extract (5%) and emamectin benzoate (0.07%) recorded at weekly intervals are presented in Table 1. The data show that on 1st week after the treatment indicated the lowest number (0.08) of *H. armigera* larvae plant^{-1} in treatments T_5. The treatments T_1, T_2 and T_3 on par with T_4 which recorded 1.16 mean number of. In T_6 the mean number of *H. armigera* larvae plant^{-1} recorded was 1.30. Data in Table1 recorded on 2nd week revealed the lowest number (0.66) of *H. armigera* larvae plant^{-1} was recorded in T_5. The number of *H. armigera* larvae plant^{-1} recorded on T_6 (1.33 larvae plant^{-1}) was at par with T_1, T_2, T_3 and T_4.

The number of *H. armigera* larvae plant^{-1} recorded on 3rd week was highest in T_6 *i.e.* recorded 1.26 larvae plant^{-1} followed by 1.16, 1.06 and 1.00 at T_3, T_4 and T_2 where as the lowest number of 0.76 and 0.83 larvae plant^{-1} was recorded in T_5 and T_1. All the treatments were significantly not different with the T_6. Results in Table1 on 4th week indicated that the lowest number of *H. armigera* larvae was recorded in T_5 *i.e*. 0.46 larvae plant^{-1}. The number of larvae recorded on T_1, T_2, T_3, T_4 and T_6 was 0.60, 1.03, 1.10, 1.00 and 1.13 respectively, was non-significant. Data recorded on 5th week after the application showed the highest (1.06) number of *H. armigera* larvae plant^{-1} in T_3 followed by 1.00, 0.93 and 0.40 larvae plant^{-1} in T_2, T_4, T_1 as compared to T_5 where the number of *H. armigera* larvae was recorded lowest (0.33 larvae plant^{-1}). In T_6 the number of *H. armigera* larvae was 1.10 larvae plant^{-1}.

Data collected on 6th week revealed that the lowest number of *H. armigera* larvae plant^{-1} was recorded in T_5 *i.e*. 0.16 larvae plant^{-1} followed by 0.23 larvae plant^{-1} at T_1. The number of larvae recorded in T_2, T_3, T_4 and T_6 were 0.86, 1.00, 0.93 and 1.00, respectively. On 7th week the data show a different trend than the previous one, here T_6 and T_3 are the same. Rest of the treatments is significantly better than these two treatments. Highest number of *H. armigera* larvae (0.90) was recorded in T_6, while lowest number of *H. armigera* larvae was recorded in T_1 and T5 which was recorded 0.00. No larvae were recorded in any treatment on 8th week. Results concluded from overall mean of the data indicated that the lowest number of *H. armigera* larvae was recorded in T_5 *i.e*. recorded 0.40 larvae plant^{-1} followed by 0.46 larvae plant^{-1} in T_1. In control the number of larvae recorded was 1.00 larvae plant^{-1}. The treatments T_5 and T_1 were significantly different from T_2, T_3, T_4 and T_6. It is clear from Table 1 that neem seed extract and emamectin benzoate significantly reduced the mean larval population as compared to control and other treatments. Though some reduction was done by these treatments but the difference was not significant. The present findings are in accordance with Prasad *et al*. (2006) who reported that application of emamectin benzoate 5 SG was found to be effective in reducing dead hearts and also fruit damage in brinjal. Udikeri *et al*. (2004) also reported that emamectin benzoate and spinosad were most effective treatments by recording less number of bad opened bolls in cotton ecosystem which agrees with the present findings.

These results are also supported by Ganeshan *et al*. (1995) who recorded percent mortality of *H. armigera* larvae by application of neem 1% as well with neem + annona + mahua 1% under laboratory condition. Hegde (2004) registered minimum number of larvae per plant by application of NSKE 5% in okra, while Sarode *et al*. (1995) recorded 63.39 and 53.48 percent reduction in *H. armigera* larvae at 7 and 14 days after spray by two application of NSKE 5%. Similarly, neem oil (3000 ppm) and solvent based NSKE, EC (1500 ppm) further proved to be superior by registering significantly less number of *Helicoverpa* larvae per 10 plants as reported by Rao *et al*.

(1991). In the present studies garlic did not show any significant effect on *H. armigera* larvae. This could be the reason that garlic alone is not effective against *H. armigera* in tomato ecosystem for *H. armigera* control.

Considering the mean larval number emamectin treatment had lowest larval infestation followed by neem seed extract. There are many reasons for it probably because of rapid action of synthetic pesticide or the botanical insecticide may be degraded rapidly as compared synthetic insecticide. Barnby *et al.* (1989) reported that azadirachtin and its derivatives were photo degraded resulting in a significant decrease in biological activities.

Table 1. ***Mean number of larvae of H. armigera plant^{-1} on different dates during 2011***

Treatments	Time interval (week)								Mean
	2nd May	9th May	16th May	23rd May	30th May	6th June	13th June	20th June	
T_1	0.86ab	0.80ab	0.83a	0.60ab	0.40b	0.23b	0.00c	0.00	0.46b
T_2	1.10ab	1.16ab	1.00a	1.03ab	1.00a	0.86a	0.43b	0.00	0.82a
T_3	1.20ab	1.30ab	1.16a	1.10a	1.06a	1.00a	0.83a	0.00	0.95a
T_4	1.16ab	1.20ab	1.06a	1.00ab	0.93a	0.93a	0.30b	0.00	0.80a
T_5	0.80b	0.66b	0.76a	0.46b	0.33b	0.16b	0.00c	0.00	0.40b
T_6	1.30a	1.33a	1.26a	1.13a	1.10a	1.00a	0.90a	0.00	1.00a
LSD Values	0.45	0.64	0.53	0.57	0.32	0.17	0.21	---	0.24

Means followed by the same letters within in each column are not significantly different at 5 % level of probability (DMRT – Test).

Yield (kg ha^{-1}) and Percent Fruit Damage

The mean yield of tomato fruit recorded in T_1, T_2, T_3, T_4 and T_5 were 7540, 6033, , 4800, 5900 and 7300 kg respectively, as compared to control plot where the yield of tomato fruit was 3640 kg. Table 2 show that highest yield (7540 kg ha^{-1}) was recorded in T_1 which was non-significant from the yield recorded in T_5 (7300 kg ha^{-1}) while significantly higher than T_2, T_3, T_4 and T_6. Percent fruit damage of tomato fruit recorded in T_1, T_2, T_3, T_4, and T_5 were 11.30, 15.40, 17.25, 14.50, and 10.10%, respectively as compared to T_6 plot where the percent fruit damage was 19.65%. Statistical analysis of the data showed that the lowest percent damage (10.10%) recorded in T_5 was non-significant from T_1 (11.30%) and significant with all other treatments.

Table 2. ***Yield (kg ha^{-1}) and percent fruit damage in tomato crop during 2011***

Treatments	Total yield (kg ha^{-1})	% fruit damage
Neem (T_1)	7540a	11.30c
Turmeric (T_2)	6033b	15.40b
Henge (T_3)	4800cd	17.25ab
Garlic (T_4)	5900b	14.50b
Emamectin (T_5)	7300a	10.10c
Control (T_6)	3640d	19.65a
LSD values	992.9	2.76

Means followed by the same letters within in each column are not significantly different at 5 % level of probability (DMRT – Test).

In the present research henge and turmeric was tried for the first time on *H. armigera* in tomato ecosystem. The results are not encouraging and need further work. These results are in agreement with the finding of Sardana and Kumar (1989) in which neem oil at 2% indicated increased yield and was as effective as monocrotophos at 0.05%. Phadke *et al*. (1988) reported that neemark (an herbal extract of neem) at 0.5% gave highest yield in treated plots on cotton. The author attributed the protection due to antifeedant action of neem oil and neem seed extract. Mahadevan (1998) found that 'econeem' at 10 ppm (3.3%) was the best for controlling *H. armigera* on tomato and produced high yield during summer and winter seasons. In the present experiment it was also found that neem treatments were as good as synthetic insecticide (emamectin benzoate) in reducing losses. These finding are in consistent with the findings of Srivastava *et al.* (1984) who reported that on red gram 8% neem seed kernel extract significantly reduced the damage caused by *H. armigera* and gave the highest yield which was comparable to the treatments with Fenvalerate and Quinalphos.

Considering the overall mean all treatments had significant effect in reducing fruit damaged which mean that neem seed extract was as effective as synthetic insecticide (emamectin) in controlling *H. armigera* and prevents the pest from causing major damage to crop. Kumar and Sangappa (1984) reported that neem oil at 3% or 5% permitted lowest pod damage when applied against *H. armigera* on gram as compared to synthetic insecticides. Fruit damage results show that although turmeric extract, garlic extracts and henge treatments did not reduce fruit borer population, there was significant difference between control and treated plots. The reason could be the anti feedant activity of these treatments as reported by Vijayalakshmi *et al*. (1996).

CONCLUSION AND RECOMMENDATIONS

It is concluded from the results that neem seed extract was as effective as synthetic insecticide and the rest of treatments *i.e.* garlic, turmeric, henge were not effective against *H. armigera*. These treatments were effective against aphids and were safe to ladybugs. Highest yield and less percent damage were obtained in neem seed extract and emamectin benzoate treated plot. So it is preferable to use the botanical insecticides instead of synthetic insecticide, because botanicals degrade rapidly in sunlight, air, moisture and rapidly breakdown by detoxification enzymes. The rapid breakdown means less persistence in the environment and reduces risk to non-target organisms. The botanical insecticides may not have or little effect on environment, animals, human being as well as natural enemies when used in combinations.

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