JOURNAL OF LIAONING TECHNICAL UNIVERSITY (NATURAL SCIENCE EDITION)
ISSN: 1008-0562

EFFECT OF DIFFERENT SYNTHETIC INSECTICIDES AGAINST TOMATO FRUIT WORM (*HELICOVERPA ARMIGERA)*

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ABSTRACT

The major pest of tomato is the tomato fruit worm (*Helicoverpa armigera),* which causes significant damage to tomato crops by feeding on the fruit. The study was carried out Randomized complete block design with five treatments. Different chemical insecticides were used in the experiment i.e Cyantraniliprole 10.26 OD, Volium Flexci Sc, Coragen, Quinalphos 25 % EC and Phosalone 35 % EC were used for the treatment of tomato fruit borer *Helicoverpa armigera* at Swat during 2021. Chemical insecticides gave significant results in control of tomato fruit borer. However, the lowest number of larval populations per plant of tomato fruit worm was noted in plot treated with Coragin. Maximum marketable yield was recorded in plot treated with Coragen (24302kgha^{-1}) followed by Volium flexci sc (22172kgha^{-1}), while minimum marketable yield was observed in control (18333^{-1}). Minimum percent fruit damage was recorded in Coragin (7.7%), followed by Volium flexci sc (11.5). While maximum fruit damage was recorded in untreated plot. (33.217%) Maximum CBR was also recorded in Coragin (1:9.60) treated plot, followed by Volium Flexci Sc (1:6.12) was recorded, while minimum was recorded in Quinalphos (1:2.29). Based on the high-cost benefit ratio for yield and less percent fruit damage, Coragin is the most effective management of tomato fruit worms at the rest of other treatments.

Key words: Tomato, Synthetic insecticides, Fruit worm and Farmer field.

INTRODUCTION

Tomato originated from the Andean region and was brought to Europe during renaissance; it is now a widespread cultivated crop. It stands at 7^{th} most important crop; its cultivated area has also doubled during the last 20 years while China is leading its production worldwide. Tomato has been used in fresh condition as well as in processed form in the food industry. It contains certain secondary metabolites which possess antioxidant activity as well as positive impact on human health. These include and not limited to lycopene, beta carotene, vitamin C etc. (Bergougnoux, 2014).

Vegetables are consumed widely over the world. They have a short span of growth and yield a frequent harvest due to it. Most of the times, vegetables are sent out to the market without any residual analysis of pesticides. Due to this practice, the accumulation of toxic pesticides in both our food chain and body poses a great threat to biodiversity and human life. Bio-pesticides not only reduce the population of pests in an appreciable amount, they also don't get accumulated in our food chain, thus posing no threat to direct consumers. (Ali *et al.,* 2016)

Tomato crops often get attacked by various pests. These pests include *Helicoverpa armigera* (Hubner) and sucking insect pests viz. whitefly, *Bemesia tabaci* Genn., Jassids, *Amrasca biguttulla* (Ishida), thrips, *Thrips tabaci* Lind., Serpentine leaf miner, *Liriomyza trifolii* (Burgess). All of these pests are a serious threat to the overall yield and quality of tomato (Sharma *et al.,* 2013). Morevoer, Pest management of tomatoes, especially for lepidopteran pests is both unsuccessful and expensive because both pests have developed resistance against insecticides. These pests could be controlled using integrated pest management approach as well as new studies related to development of new insecticides and bio-pesticides. (Bhonwong *et al.,* 2009).

There are several advantages of using bio pesticides. They reduce the threats caused using chemical pesticides. The nutritional value of vegetables remains intact, and, in some cases, it increases. It also promotes soil fertility, ecological health. They are preventive in their action rather being curative and have little effect on flowers. (Kumar *et al.,* 2019)

The yield of tomato in Pakistan is low as compared to other countries. One of the major causes is the attack of insect pests on this crop in which Tomato fruit worm is notorious for its destruction of tomato crop. Insecticides can control this pest, but it leaves toxic residues on vegetables as well as increasing the resistance of pests against insecticides. To control pest damage in tomato crop, organic amendments and bio-pesticides should be used and promoted. (Shah *et al.,* 2013)

Chemical pesticides are widely used against many insect pests, but botanical extract is alternative of chemical pesticides (Sithisut *et al.,* 2011). Chemical pesticides showed resistance to many insect pests due to major losses in food is the failure of pesticides. Annually billions of dollars losses in the world due to insect pests attack (Pereira *et al.,* 2006). Keeping in view the above facts, the present study was conducted to know the effect of different chemical insecticides against tomato fruit worm.

MATERIALS AND METHODS

Current experiment "Effect of different synthetic pesticides on tomato worm (*Helicoverpa armigera)* at distract Swat 2023" was carried out at farmer field in Swat during Kharif season 2023 by using Shimla Varity.

Experimental design

The trial was carried out by using Randomized Complete Block design (RCBD) with 5 treatments and all treatment was repeated 3 times. Plant-plant distance was 0.60 cm and row to row distance was 1 m.

Chemical Insecticides

Cyantraniliprole 10.26 OD, Volium Flexci Sc, Coragen, Quinalphos 25 % EC and Phosalone 35 % EC were purchased from local market of Swat.

The following parameters were investigated during the present study.

No of larvae of fruit worm.

For recording the population levels of fruits borer larvae in five plant was selected randomly. A total of five plants per plot were determined for each replication. The pretreatment counts of the number of larvae present in each plant were recorded on a weekly basis. Quality of the fruit. The fruit quality was categorized as damaged and sound fruit.

POD BORER (*Helicoverpa armigera*)

The first data of fruits borer (*Helicoverpa armigera* Hub.), was recorded before 24hrs of pesticides applied and then after 1st, 2nd, 3rd, 4th, 5th ,6th ,7^{th,} and 8th weeks of spray. Then Larval population of fruits borer complex was recorded at weekly interval on five randomly selected plants per plots. Starting with 50% flowering till harvest.

Percent fruit damage = $\frac{\text{Total number of damaged fruits by pod borer /plot}}{\text{Total number of fruits in plants}} \times 100$

Yield kg/ha

After each picking of fruits weight (kg) in each treatment was noted. Each treatment yield was than transformed into kg per hectare with formula:

Yield kg per ha = $\frac{\text{fruits weight (kg) x 10000}}{\text{Area harvested (m}^2\text{)}}$

Statistical Analysis

Data observed and noted on various parameters was analyzed through statistical software (Statistix 8.1) by Analysis of Variance (ANOVA) and through LSD Test at 5% Probability Level means for check their significance level and differences.

IV. RESULTS

The effect of different synthetic insecticides against tomato fruit worm *Helicoverpa armigera* was evaluated under field condition at The experiment was conducted in local Farm from first week of May to July last week. The recorded was noted on different weeks are given in Table 1.

Number of larvae *(H. armigera)*

The number of *H. armigera* larvae were recorded by randomly selected five plants/ plot on different week interval and the results are given below.

Number of larvae *(H. armigera)* recorded in the first week after spray application.

The result showed that the mean number of larvae (*H. armigera*) / plant in plots treated with Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos, Phosalone and Control were 0.94, 0.89, 0.56, 0.93, 0.76 and 2.46 respectively, which were significantly different from one another. Result indicated that the lowest number of larvae of *H. armigera* was noted in plot treated with Coragen was significantly minimum than other of all treatments and followed by plot treated with Phosalone while in control plot highest number of larvae was observed.

Number of larvae *(H. armigera)* recorded on second week after spray application.

The result indicated that the mean number of larvae (*H. armigera*) / plant in plots treated with Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos and Control were 1.24b, 0.99, 0.66, 0.99, 1.02 and 2.53, respectively, which were significantly different from one another. Result indicated that the lowest number of larvae of *H. armigera* was noted in plot treated with Coragen was significantly minimum than other of all treatments and followed by plot treated Phosalone, Volium flexci sc and Quinalphos, while in control plot maximam number of larvae was noted.

Number of larvae *(H. armigera)* recorded on third week after spray application.

Result showed that the mean number of larvae (*H. armigera*) / plant plot treated with Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos, Phosalone and Control were 1.55, 1.15, 0.68, 1.02, 1.67 and 2.56 respectively, which were significantly different from one another. Result indicated that the lowest number of larvae of *H. armigera* was noted in plot treated with Coragen was significantly minimum than other of all treatments and followed by plot treated Phosalone and Volium flexci sc, while in control plot highest number of larvae was noted.

Number of larvae *(H. armigera)* recorded on fourth week after spray application.

Result revealed that the mean number of larvae (*H. armigera*) / plant plot treated with Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos, Phosalone and Control were 1.63, 1.22, 0.96, 1.17, 1.74 and 2.64 respectively, which were significantly different from one another. Result indicated that the lowest number of larvae of *H. armigera* was noted in plot treated with Coragen was significantly minimum than other of all treatments and followed by plot treated Volium flexci sc, while highest number of larvae was noted in control plot.

Number of larvae *(H. armigera)* recorded on fiveth week after spray application.

The mean number of larvae (*H. armigera*) / plant plot treated with Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos, Phosalone and Control were 1.27, 1.09, 1.12, 1.02, 1.26 and 2.64 respectively, which were significantly similar to one another. The result indicated that the same number of larvae of *H. armigera* was noted in all treated plots, while the highest number of larvae was recorded in control plot.

Number of larvae *(H. armigera)* recorded on sixth week after spray application.

The data revealed that the mean number of larvae (*H. armigera*) / plant plot treated with Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos, Phosalone and Control were 1.05, 0.88, 0.76, 0.92, 0.98 and 2.69 respectively, which were significantly different from one another. Result showed that minimum number of larvae of *H. armigera* was noted in Coragen treated plot, followed by Volium flexci sc, while highest number of larvae was observed in control plot.

Number of larvae *(H. armigera)* recorded on seventh week after spray application.

The data showed that the mean number of larvae (*H. armigera*) / plant plot treated with Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos, Phosalone and Control were 0.68, 0.63, 0.44, 0.84, 0.93and 2.74 respectively, which were significantly different from one another. Result showed that minimum number of larvae of *H. armigera* was noted in Coragen treated plot, followed by Volium flexci sc, while highest number of larvae was observed in control plot.

Number of larvae *(H. armigera)* recorded on eighth week after spray application.

The data showed that the mean number of larvae (*H. armigera*) / plant plot treated with Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos, Phosalone and Control were 0.54, 0.52, 0.31, 0.56, 0.83 and 2.78 respectively, which were significantly different from one another. Result showed that minimum number of larvae of *H. armigera* was noted in Coragen treated plot, followed by Volium flexci sc, Tobacco extract and Phosalone, while control plot was observed highest number of larvae.

Means of all weeks of number of larvae *(H. armigera)/plant.*

The result indicates that the means number of larvae (*H. armigera*) / plant plot treated with Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos, Phosalone and Control were 1.11, 0.92, 0.69, 0.93, 1.15 and 2.63 respectively, which were significantly different from one another. Result showed that a smaller number of larvae of *H. armigera* was noted in Coragen treated plot, followed by Volium flexci sc, while control plot was noted highest number of larvae.

Table 1. Mean number of infestation *H. armigera* larvae per plant in tomato field.

Treatment	**1st week**	**2nd week**	**3rd week**	**4th week**	**5th week**	**6th week**	**7th week**	**8th week**	**means**
Cyantraniliprole	0.94b	1.24b	1.55b	1.63b	1.27b	1.05b	0.68cd	0.54c	1.11b
Volium flexci sc	0.89b	0.99c	1.15c	1.22c	1.09b	0.88cd	0.63de	0.52c	0.92c
Coragen	0.56d	0.66d	0.68d	0.96c	1.12b	0.76d	0.44e	0.31d	0.69d
Quinalphos	0.93b	0.99c	1.02c	1.17c	1.02b	0.92bc	0.84bc	0.56c	0.93c
Phosalone	0.76c	1.02c	1.67b	1.74b	1.26b	0.98bc	0.93b	0.83b	1.15b
Controll	2.46a	2.53a	2.56a	2.64a	2.64a	2.69a	2.74a	2.78a	2.63a
LSD	0.0597	0.0694	0.1182	0.1242	0.1189	0.0584	0.0924	0.0872	0.0718

Means followed by the different letter in each column are statistically significant from each other at 5% level of significance ANOVA followed by LSD Test.

Yield Kg/ha.

The yield obtained from different treated plots of synthetic insecticides (Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos, Phosalone and Control were 21700, 22172, 24302, 20000, 21667 and 18333 respectively were significantly different result from each other. However maximum marketable yield was recorded in plot treated with Coragen (24302kgha^{-1}) followed by Volium flexci sc (22172kgha^{-1}), while minimum marketable yield was observed in control (18333^{-1}).

Percent Fruit Damage

The percent fruit damage indicates that infestation was significantly affected the yield on different treated with (Cyantraniliprole, Volium flexci sc, Coragen, Quinalphos, Phosalone and Control were 16.860, 11.547,7.783, 13.093, 17.710 and 33.217 respectively which were significantly different from one another. Result revealed that minimum percent fruit damage was noted in plot treated with Coragen (7.783), followed by, Volium flexci sc(11.547) and Quinalphos (13.093), while maximum percent damage was recorded in control plot (33.217).

Table.3. Yield and Percent damage of *H. armigera larvae.*

Treatments	**Yield kg/ha**	**weight loss**
Cyantraniliprole	21700b	16.860b
Volium flexci sc	22172b	11.547c
Coragen	24302a	7.783d
Quinalphos	20000bc	13.093c
Phosalone	21667b	17.710b
Control	18333c	33.217a

Means followed by the different letter in each column are statistically significant from each other at 5% level of significance ANOVA followed by LSD Test.

Cost benefit ratio

It is evident from the study that highest CBR value was recorded in plot treated with coragen (1:9.60) followed by Volium flexci sc (1:6.12) while lowest was recorded in Cyantraniliprole (1:5.24).

Table. 3. Economic analysis of different management practices used against fruit borer on tomato crops during 20223

treatments	Marketable yield kg/ha A	Gross income Rs.B	Cost of control /ha C	Return over control Rs. per ha D	Estimated net benefit Rs. per ha E=(D-C)	C: B F=(D/C)
Cyantraniliprole	21700	520800	12945	80808	67863	5.24
Volium flexci sc	22172	532128	12943	92136	79193	6.12
Coragen	24302	583248	13520	143256	129736	9.60
Quinalphos	20000	480000	12150	40008	27858	2.29
Phosalone	21667	520008	12650	80016	67366	5.33
Control	18333	439992	-	-	-	-

V. DISCUSSION

Most serious insect pest of tomato is fruit borer all over the world. It causes significant losses in the quality and quantity of the product. The fruit borer larvae damage the crop and to control this pest the grower apply chemical insecticides.

Larval population of tomato fruit borer (*H. armigera*).

All the synthetic insecticides reduce the larval population of *Helicoverpa armigera* as compared to untreated plot. The plots treated with Phosalone, Cyantraniliprole indicate comparatively poor performance as the rest of chemical insecticides. Due to poor performance of botanical extracts the grower go back to synthetic insecticides because synthetic insecticides give quick result as compared to botanicals extracts result agree with (Sunitha *et al.,* 2006) who study the efficacy of insecticides against gram pod borer. Result shows that different experimental block shows different efficacy which gives a significant reducing the larval population of tomato fruit borer.as compared to control plot.

Generally chemical insecticides i.e Coragen and Volium flexci sc gave significant result to minimizing the larval population of *Helicoverpa armigera* Khorsheduzzaman *et al.,* (1998) reported a remarkable decrease in tomato fruit infestation. when chemical insecticides with other bio pesticides approaches for the control of tomato fruit borer. The chemical insecticides Coragen revealed better results than other applied insecticides. This result is agreed with the result of Wakil *et al.,* (2012).

Yield of tomato fruit

In all the treatments the yield of tomato was significantly different from untreated plots. Maximum yield of tomato crop was observed in plot treated with Coragen (24302 kg/hac) because Coragen did best result against the control of *Helicoverpa armigera* larvae and less attack was observed therefore maximum yield was obtained. This result is like Sujayanand *et al.,* (2020). The larval infestation gives a significant decrease the yield to tomato crop. The chemical insecticides show quick result and significant increase in the yield of tomato. These results are in line with Sunitha *et al.,* (2006) observed that chemical insecticides have significantly higher yield.

Percent fruit damage

Person fruit damage results clearly revealed that fruit borer of tomato was significantly decreased by all the treatment as compared to untreated plot. The effect of chemical insecticides Coragin show significance result as compared to all other treatments. Less percentage losses were recorded in Coragin treated because of quick action of insecticides on tomato fruit borer (7.783%) *H. armigera* population was less and therefore less percent damage was noted. These results are in line with Sujayanand *et al* (2021) while the highest percentage infestation was recorded in untreated plot. Therefore, the highest percentage loss was observed in untreated plots.

Cost benefit ratio

In all treatments CBR is very important because it show real image of the treatment that how much is gain by applying different control practices. However, application of Coragin was found best and highest value of CBR was noted **(**9.60**)** followed by Volium flexci sc while minimum value of CBR (6.12) was expensive than other treatment but better result in performance and maximum yield with maximum net returned.

CONCLUSION AND RECOMMENDATIONS

1. All the chemicals insecticide has potential to manage tomato fruit borer as compared to untreated plot.
2. All chemicals' insecticides perform better results against tomato fruit borer.
3. Coragin and Volium flexci sc are the most effective in reducing the larval population of tomato fruit borer.
4. Chemical insecticides show positive outcomes bearing CBR values.

Acknowledgement

Special thanks Dr. Misbahullah and Dr. Farman Ullah of Entomology Department, The University of Agriculture Swat, for their advice and support through our research.

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