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### EFFICACY OF DIFFERENT INSECTICIDES AGAINST *CYDIA POMONELLA* INFESTATION FROM APPLE ORCHARDS IN GILGIT-BALTISTAN, PAKISTAN

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#### ABSTRACT

Codling moth (*Cydia pomonella* Linn.) is a serious pest of apple and other stone fruits and causes serious economic damage. Present study was conducted to evaluate the efficacy of different insecticides against *C. pomonella* infestation in Gilgit-Baltistan. In case of cypermethrin, maximum infestation (7.3, 6.3 and 6) was recorded after ten days of first, second and third spray. After this, infestation started decreasing to reach to the minimum (2.3, 1.6 and 1.3) after 30 days of first, second and third spray. Lambda showed the minimum infestation (3.3, 2.6 and 1.6) after 30 days of first, second and third spray. In case of neem seed oil, maximum infestation (8.0, 7.0 and 6.3) was estimated after 10 days of first, second and third spray. Minimum infestation (3.0, 2.6 and 2.3) was recorded after 30 days of first, second and third spray. Before spray, maximum fruit infestation rate was observed and it started decreasing after first spray and minimum infestation was recorded after the third spray and same trend was seen in case of days. This trend was observed with all insecticides i.e. cypermethrin, lambda and neem seed oil. Infestation was recorded as decreasing with the passage of time and maximum was after ten days while minimum was recorded after 30 days with all treatments. There was significant difference of fruit infestation among the first, second and third spray and among the results after 10, 20 and 30 days of sprays. Present results showed that before spray all fields had maximum fruit infestation caused by codling moth and infestation rate decreased after the treatments. It is concluded that cypermethrin is the most favorable insecticides for local apple former of this region to control codling moth infestation.

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#### INTRODUCTION

Apple (*Malus domestica*) is one of most common fruit crop of Gilgit-Baltistan and is grown in all most all parts of the region. It contains different essential nutrients. Different varieties are grown in the region e.g. Golden

Delicious, Super Delicious, Red Delicious, Ultra red, Five Star, Saspolo and Desi etc. Its production from Gilgit-Baltistan is almost 24 thousand metric tons according to local market. About four thousand metric tons apple production loss was observed during the past years in

this region and insect pests are one of the major causes for this loss which reduce yield up to 30 percent. Codling moth is one of common insect pests which attack apple severely in this region.

The codling moth (*Cydia pomonella* Linn.) is a polyphagous pest of global agricultural importance (Neven and Hansen, 2010). It infests apple, but also attacks pears, quinces, and occasionally walnuts and stone fruits causing economic losses in the production (Chidawanyika and Terblanche, 2011). *C. pomonella* was originally from Eurasia, most likely from Kazakhstan. Over the last two centuries, it dispersed globally with the cultivation of apples and pears. Currently, *C. pomonella* is present in South America, South Africa, Australia and New Zealand (Franck et al., 2007). *C. pomonella* occurs in almost every country where apples are grown and has achieved a nearly cosmopolitan distribution, being one of the most successful insect pest species known today (Thaler et al., 2008). In Pakistan, it is the major pest in apple growing regions of Baluchistan province with two complete and partial third generations per year. It causes significant crop losses if not managed with adequate measures (Ashraf et al., 2007; Asmatullah-Kakar et al., 2015; Asmatullah-Kakar and Hazara, 2002; Asmatullah-Kakar and Hazara, 2009).

Larvae attack fruits and pollute them with frass. Fruits damaged early in the season drop off trees soon after damage occurs. Fruits damaged later in the season remain on trees but lose their market value (Maceljski, 2002). On apples and pears, larvae penetrate fruit and bore into the core, leaving brown-colored holes in the fruit that are filled with larval droppings (Bouvier et al., 2001). Depending on the cultivation area and climatic conditions, the pest develops one to four generations in a year (Neven, 2012). If chemical treatment is not used, it can cause a decrease in apple harvest from 30% up to 50% (Neven, 2013).

Chemical control of codling moth is still the main method used in fruit production because number of these compounds are capable of killing the larvae in a very early stage of tunneling and many are effective against moths and the eggs as well (Hepdurgun et al., 2001; Ioriatti et al., 2009; Sauer, 2017). There are 11 modes of action (MoA) available on the market depending on the country for the control of this pest; some insecticides affect the nervous system, or pest growth and development (Boivin et al., 2001; Bouvier et al., 2001; Sauphanor et al., 2000).

In apple orchards, about 70% of codling moth control

achieved by the use of insecticides (Thaler et al., 2008) and use of various neuroactive products such as organophosphates, carbamates, synthetic pyrethroids, neonicotinoids, and insect growth regulators (IGR) are most common against this pest. During the 1980s and 1990s the pest control in Europe was achieved using broad spectrum insecticides (pyrethroids and organophosphates), however, due to the evolution of pesticide resistance, efficacy of these insecticides diminished quickly (Bouvier et al., 2001; Stara et al., 2006). Moreover, Codling moth is becoming now resistant to neonicotinoids and other traditional insecticides (Reyes et al., 2007) and different population strains of codling moth showed different types of resistance against insecticides and growth regulators (Thaler et al., 2008).

Keeping in view the importance of apple crop in Gilgit-Baltistan and the economic importance of codling moth which is a major insect pest of apple in this region, the present study was conducted. Results of this experiment will be helpful in control program of codling moth for this region and will also be very helpful to local apple growers for selection of effective insecticide for the management of codling moth.

#### **MATERIAL AND METHODS**

The study was designed to observe the susceptibility level of codling moth against different commercial insecticides available to local farmers in Gilgit-Baltistan, Pakistan. Study was conducted in apple field areas of Directorate of Agriculture Research in Danyore, Gilgit-Baltistan, Pakistan during 2019. Golden delicious variety of local apple was selected for this study because it is the most common growing variety of this area. In the present study, four different commercially available insecticides Cypermethrin, Lambda Cyhalothrin and Neem seed oil were selected (Table 1). Knapsack sprayer was used for insecticides spray in apple fields. Three field sprays were applied during the experiment with ten days' interval. To assess the infestation rate of apple fruit caused by codling moth, recording of codling moth damage on fruits was the first step to carry out study of infestations. To estimate the infestation, 20 fruits from sample trees were randomly observed for damage. Each fruit sample was examined in suitable light conditions and recorded how many of these showed infestation. The percentage of codling moth infestation (%) was calculated by recording total number of fruits showing infestation divided by total number of fruits collected and multiplying by 100. The

observations on fruit infestation in different treatments were recorded before the application of the first spray and thereafter the data were recorded 10, 20 and 30 days after each spray application. Randomized Complete

Block Design was laid down for this field experiment with three replications. Collected data were analyzed with the help of Statistics 8.1 and Microcal Origin was used for graphical presentation of data.

Table 1. Insecticides treatment details for spray.

S. No	Treatment	Active Chemical	Doses (Field Dose)
1	T 1	Cypermethrin (Commercial grade)	250 ml/ 100Liter
2	T 2	Lambda Cyhalothrin (Commercial grade)	250 ml/ 100Liter
3	T 3	Neem seed oil	500 ml/ 100Liter
4	T 4	Control	Water Spray

## RESULTS AND DISCUSSION

Results of present study showed that cypermethrin had the maximum effect on codling moth infestation and least infestation was recorded with neem oil followed by lambda Cyhalothrin. Maximum infestation was observed with neem seed oil after control (Figure 1).

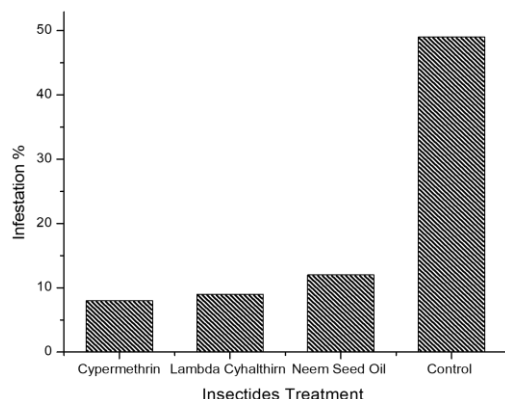


Figure 1. Comparison of different insecticides towards

infestation rate.

In case of cypermethrin, maximum infestation (7.3, 6.3 and 6) was recorded after ten days of first, second and third spray. After this, infestation started decreasing to reach to the minimum (2.3, 1.6 and 1.3) after 30 days of first, second and third spray. Results of lambda showed that minimum infestation (3.3, 2.6 and 1.6) was recorded after 30 days of first, second and third spray. On the other hand, maximum infestation (8.3, 7.3 and 7.0) was observed after 10 days of first, second and third spray. In case of neem seed oil, maximum infestation (8.0, 7.0 and 6.3) was estimated after 10 days of first, second and third spray. Minimum infestation (3.0, 2.6 and 2.3) was recorded after 30 days of first, second and third spray. Present results showed that before spray all fields had with maximum fruit infestation caused by codling moth and infestation rate decreased after the treatments (Table 2).

Table 2. Effect of different treatments on mean fruit infestation.

Treatments	Mean Fruit Infestation				
	Before Spray	After 10 days	After 20 days	After 30 days	
Cypermethrin	Spray 1	10.6	7.3	4.6	2.3
	Spray 2	9.3	6.3	3.3	1.6
	Spray 3	10	6.0	2.6	1.3
Lambda Cyhalothrin	Spray 1	10.6	8.3	5.6	3.3
	Spray 2	9.3	7.3	5.0	2.6
	Spray 3	10.0	7.0	3.6	1.6
Neem Seed Oil	Spray 1	10.6	8.0	5.3	3.0
	Spray 2	9.3	7.0	4.3	2.6
	Spray 3	10.0	6.3	3.6	2.3
Control		10.6	11	10	10.6

Before spray, maximum fruit infestation rate was observed and it started decreasing after first spray

and minimum infestation was recorded after the third spray and same trend was seen in case of days. This

trend was observed with all insecticides i.e. cypermethrin, lambda and neem seed oil. Infestation was recorded as decreasing with the passage of time

and maximum was after ten days while minimum was recorded after 30 days with all treatments (Figures 2, 3, 4).

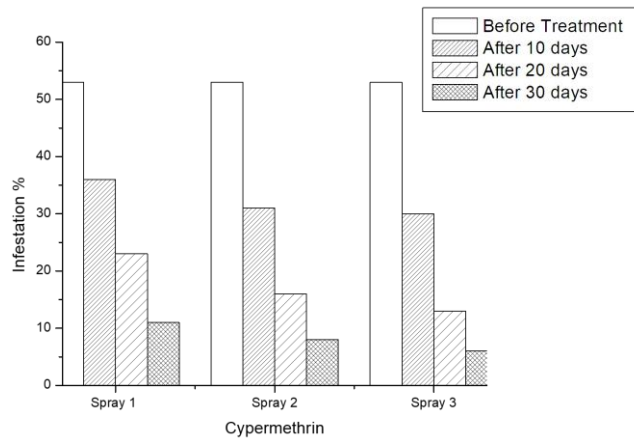


Figure 2. Effect of Cypermethrin on fruit infestation caused by *C. pomonella*.

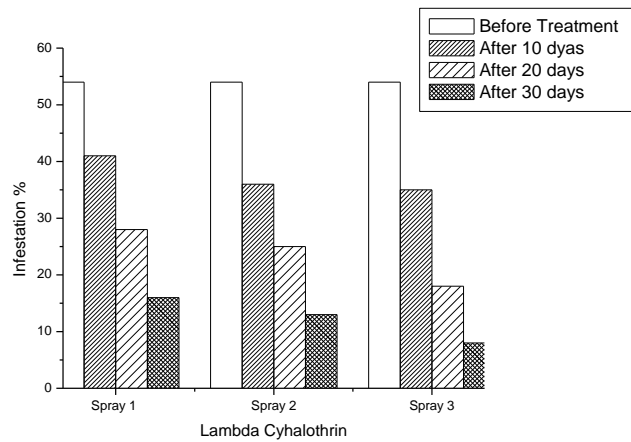


Figure 3. Effect of Lambda Cyhalothrin on fruit infestation caused by *C. pomonella*.

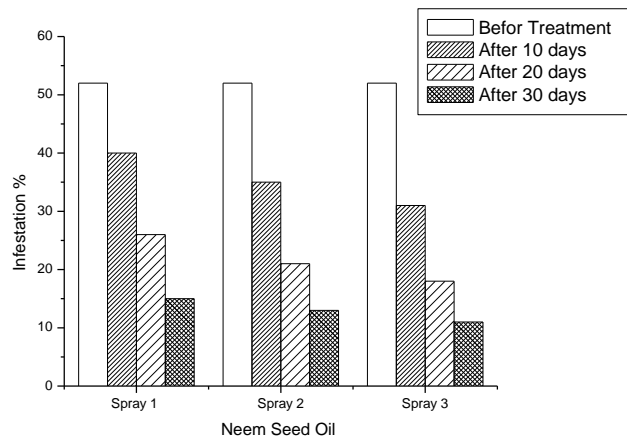


Figure 4. Effect of Neem Seed Oil on fruit infestation caused by *C. pomonella*.

Results showed that there was significant difference of fruit infestation among the first, second and third spray and there was also significant difference among the results after 10, 20 and 30 days of sprays (Table 3).

Results of present study showed that cypermethrin was the most effective against codling moth infestation and similar results about cypermethrin were reported for pomegranate fruit borer (Kumar. and Gupta, 2017). Results

about sprays shows minimum infestation after 30 days of first, second and third spray and same results were reported in case of pomegranate fruit borer (Khan et al., 2017). Present study was designed for the estimation of fruit infestation caused by codling moth in apple orchards of Gilgit, Pakistan because apple is the most common fruit crop of this area and codling moth infestation is most severe problem of apple orchards in this region.

Table 3. Analysis of variance regarding effectiveness of insecticides treatments.

Treatment	Mean Infestation			
	Before Treatment	After 10 days	After 20 days	After 30 days
Cypermethrin	10.0 A	6.5 B	3.5 C	1.7 C
Lambda Cyhalothrin	9.8 A	7.5 B	4.7 B	2.5 BC
Neem Seed Oil	10.0 A	7.1 B	4.4 B	2.6 B
Control	10.6 A	11 A	10.0 A	10.6 A
P	1.000	0.0001	0.0000	0.0000
CV	17.64	17.57	17.65	24.78

This study showed that cypermethrin is the most favorable insecticides for local apple former of this region to control codling moth infestation. This study also recommends the use of botanical insecticides neem seed oil which showed good results against codling moth infestation. Use of neem seed oil may be less environmental hazardous for this region and will be helpful to reduce much use of insecticides. Present study will be helpful in IPM program for codling moth control program in future for this region.

#### Author Contribution

MI designed the study and executed the experiment, SK collected field data, FR designed the study and wrote the manuscript, MA collected field data, S maintained the apple orchard, MM analyzed the data, UAAS wrote and edited the manuscript.

#### Conflict of Interest

The authors declare no conflict of interest.

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