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Resistance evaluation in *Chilo partellus* against synthetic pyrethroid in maize cropping system

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Abstract
Maize is one of the high yielding and most grown cereal crop in the world. Maize stem borer *Chilo partellus* is most destructive pest of maize in fields of Pakistan. Cypermethrin from pyrethroids group of insecticides is used to control *Chilo partellus*. Experiment was conducted to observe the percent damage of *Chilo partellus* using cypermethrin (synthetic pyrethroid). Percent damage of *Chilo partellus* was observed at low, standard and high concentrations. Replications used in this experiment were ten for each treatment. Observations were recorded after time interval on different dates to observe if resistance was found in stem borers and to observe the percent damage. Results found that low damage percentage was observed on high sprayed concentration fields, while medium percent damage was observed on medium sprayed concentration fields. And highest percent damage was observed on high sprayed concentration fields as compared to control. So these results explicitly reveal that *Chilo partellus* in Pakistan does not pose any risk in sprayed maize fields. As a conclusion we can assert that there was no resistance developed in *Chilo partellus* against cypermethrin.

Keywords: Resistance evaluation, *Chilo partellus*, cypermethrin, pyrethroid efficacy

1. Introduction

Maize is cultivated on 967 thousand hectares area in Pakistan. The annual output of maize is 1731 thousand tons with average production of 1970 kg per hectare [1]. In Pakistan, maize production is about 6.4% of total grains yield of the country [1]. "Queen of cereals" is the name that is given to the maize because of its high productivity [2].

In Americas, maize is most widely grown crop, while in Asian countries maize is grown less compared to rice and wheat [3]. The countries which are important in production of maize are USA, Mexico, France, Argentina, Romania, India, China, Brazil, Italy, Indonesia and South Africa [4]. Due to high demand for industries maize production is increasing day by day [5].

The introduction of modern varieties is increasing day by day instead of increasing per hectare production. The major reason in this context is attack of maize insect pests, among them *Chilo partellus*is more significant. The other prominent insect pest of maize are stem borer (*Chilo partellus* Swin), shoot fly (*Atherigona soccata*), armyworm (*Mythimna separata*) and many species of aphids. They all attack the plants and are major cause of the destruction of the maize crop [6, 7].

Chilo partellus adults start ovipositing on maize leaves [8].They lay eggs in between the leaf sheath and stem of the plant. First instar goes into main whorl of leaves, during feeding they start moving to base of the plant. After transforming to further instars, they move to stem. The severe attack of *Chilo partellus* on stem gives the symptoms, the dead hearts. After that when the leaves are dry, the whole plant becomes affected. If stem borer attacks on flowering stage, the pollination is severely affected in maize [9].

The loss from the maize stem borer, *Chilo partellus* is about 90-95 per cent of the total destruction in Kharif season [10]. Maize is most susceptible to *Chilo partellus* (Lepidoptera: Crambidae) which causes large damage to it [11]. Because the pest is feeding internally on the plant so application of pesticides for the management of this insect is suitable. The different kinds of pesticides can be used in different concentrations for managing of this insect pest. The insecticides which are using for the management should be economical for the farmers as well [12]. The insects are not only killed by use of the insecticides, but biological mechanism may also disturbed by the use of these insecticides [13].

Not more work has been carried out to sort out the exact biochemical changes occurring in the plants after the application of the insecticides. Still some work was conducted to find the phenomena [14].

2. Materials and Methods

2.1. Area

The experiment was conducted in the entomological research area, Young Wala, at the campus of university of agriculture, Faisalabad, Pakistan, during (October to November) 2017 using hybrid maize varieties upto two months. The area of plot was 100 x 174 sqft and row to row distance 3 ft and plant to plant distance of 30 cm.

2.2. Crop sowing and field preparation

Following the recommendations for the field preparation, Cross-wise disc plough was used for plouhghing the experimental land. When the land was prepared then seedbed was prepared by using cross-wise cultivator or by using rotavator. The clods that were formed in the prepared land, that were crushed by the clod crusher. Manual method was used for the sowing of the seeds. All the four varieties were sown in three replicates and to facilitate the irrigation process channels were made. The Randomized Complete Block Design (RCBD) with three replications was followed. After 20 days of seed emergence two irrigations were given and thinning was carried out to maintain the required plant to plant spacing and normal agronomic practices were carried out.

The total area of plot was of 1 acre and area covered by 1 replication was of 40 sq ft. The space between replications was 4 feet and plant to plant distance was 20 cm. The first two irrigations were given frequently after 20 days of seed emergence and thinning was carried out to maintain the required plant to plant spacing. Normal agronomic practices were carried out throughout the growing season of the crop.

2.3. Treatment

Treatment was carried out by making three concentration i.e low, medium and high against *Chilo partellus.* The prepared insecticide were sprayed on 10 plants in each variety. The plants which were sprayed were randomly selected and tagged from each variety.

2.4. Concentrations

There were three concentrations of insecticides were made. The low concentration of insecticide was made of 1ml of cypermethrin and water was used to make final volume of 1000ml. The standard concentration was contained 2ml of cypermethrin and water was used to make final volume of 1000ml.The high concentration of insecticide was made of 3ml of cypermethrin and water was used to make final volume of 1000ml.

2.5. Field Sampling

The population dynamics of stem borer was recorded on all maize varieties. Ten plants were selected randomly, which were tagged already. Population of *Chilo partellus* was recorded from damaging signs of stem, by observing the exit hole made by stem borer. The data was recorded after the spray of different concentrations to check the population dynamics of the stem borer.

2.6. Data Analysis

Analysis of variance of all the collected data was calculated by using the appropriate statistical software. Means of significant treatments were compared using multiple ANOVA with replications. However, the mean of two varieties in comparison were analyzed using two way ANOVA.

3. Results

It is evident (Fig. 1) that, percentage damage was 72, 55, 33, and 77% in low, standard, high concentrations and control field areas respectively. There was no significant difference of concentrations as compared to control (df =3, F=24.083, P=8.58). It is clear from figure 2, that percent damage was 64, 43, 30, and 80% in low, standard, high concentrations and control field areas respectively. There was no significant difference in values of concentrations as compared to control (df =3 F=23.173 P=1.3). From figure 3 it is clear that percent damage was 63, 51, 49, and 75% in low, standard, high concentrations and control field areas respectively. There was no significant difference in values of concentrations as compared to control (df =23.35 F=3 P=0.0377).

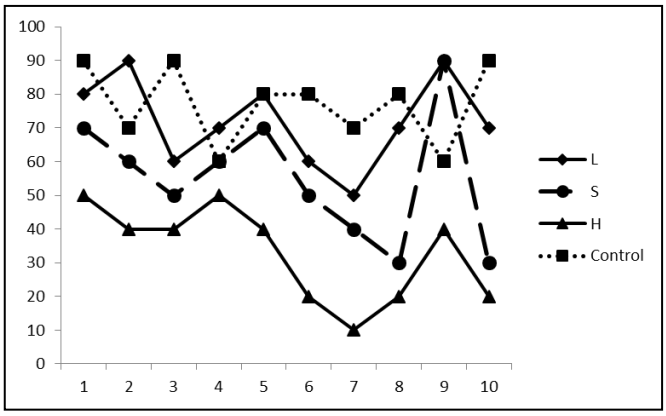

Fig 1: First time data of cypermethrin sprayed at low, standard and high concentrations on maize variety.

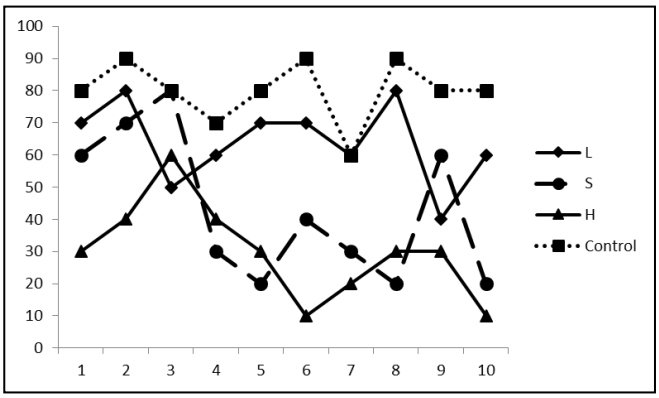

Fig 2: Second time data of cypermethrin sprayed at low, standard and high concentrations on maize variety.

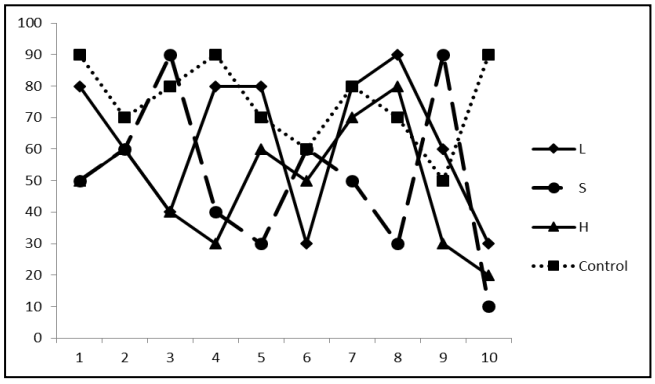

Fig 3: Third time data of cypermethrin sprayed at low, standard and high concentrations on maize variety.

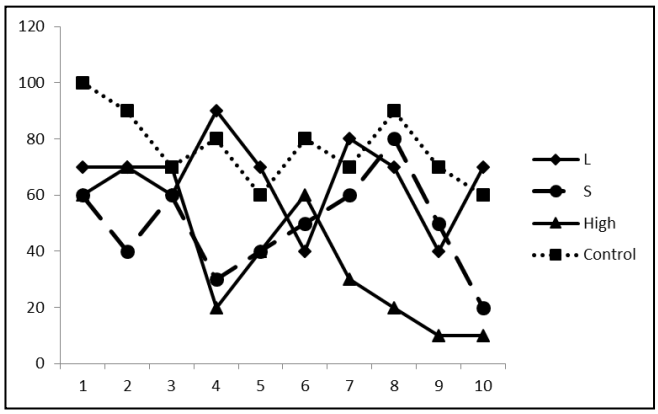

Fig 4: Fourth time data of cypermethrin sprayed at low, standard and high concentrations on maize variety.

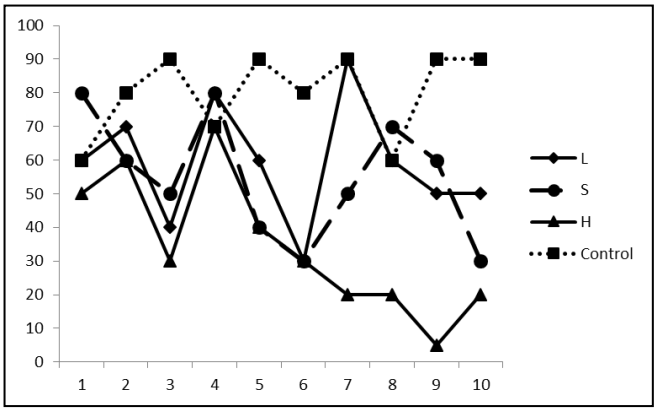

Fig 5: Fifth time data of cypermethrin sprayed at low, standard and high concentrations on maize variety.

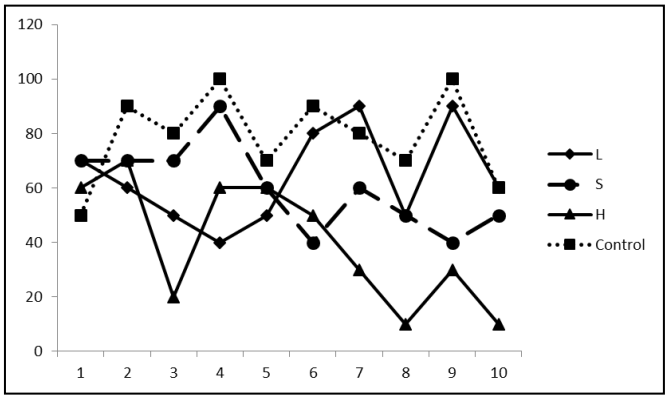

Fig 6: Sixth time data of cypermethrin sprayed at low, standard and high concentrations on maize variety.

From figure 4 it is clear that, percent damage was 66, 49, 39, and 77% in low, standard, high concentrations and control field areas respectively. There was significant difference of concentrations as compared to control (df=3 F=9.991 P=0.001). The figure 5 showed that percent damage was 59, 55, 34.5, and 80% in low, standard, high concentrations and control field areas respectively. There was no significant difference of concentrations as compared to control (df=3 F=12.374 P=2.82). From figure 6 it is clear that, percent damage was 64, 60, 40, and 79% in low, standard, high concentrations and control field areas respectively. There was significant difference of concentrations as compared to control (df=3 F=8.0354 P=0.0005).

4. Discussion

Chilo partellus is the most destructive insect pest of the maize crop. A field study was conducted to check the efficacy of different concentration of insecticide (cypermethrin) against Stem borer (*Chilo partellus*) in maize crop. Experiment was performed to evaluate the best concentration of the insecticide for the control of Stem borer. According to our findings the infestation of the Stem borer was observed less, when high concentration is applied, as compared to the medium and control (variety where none of the treatment was applied). On the other hand the infestation of *Chilo partellus* was also found less when standard dose was applied. More infestation was recorded on the control variety.

Our results show that the application of insecticides to control the population of the *Chilo partellus* have the significant result, that was statistically analyzed. According to our result the cypermethrin showed the significance outcomes in control of the *Chilo partellus*. Our results were not similar to other studies in which cypermethrin did not show any significant result of infestation level of the *Chilo partellus* as compared to control [14]. Our findings are not agreed with other studies, in which cypermethrin was not showing any effectiveness against *Chilo partellus* infestation [15]. The contrast in our results were might be due to different weather condtions i.e. rain fall, temperature, humidity, or soil type. Our results are in agreement to studies, in which different concentrations of the cypermethrin were effective against the *Chilo partellus* [16]. Chemicals spray of cypermethrin resulted in significant high productivity. Our results were in agreement with studies, in which significant results were found when cypermethrin was sprayed against stem borer of rice [17].

Our results were in agreement with other studies in which different pesticides showed better control of stem borer as compared to control [18]. In the same research among different treatments of insecticides, the cypermethrin was effective to give the high productivity of maize and also worked well against the different insect pests including the *Chilo partellus* insect.

5. Conclusion

So our results suggested that we if use cypermethrin and spray twice on crop, it can result in better control of maize stem borer. However better production can only be resulted in better combination of dose with pesticides to control major pest of maize.

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