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Pink boll worm resistance evaluation against organophosphate in Cry1Ac expressing transgenic cotton

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Abstract
An experiment was conducted on pink boll worm larvae reared on sprayed Bt cotton as compared to sprayed non-Bt cotton. Pesticide used was triazophos which was sprayed in bioassay on Bt cotton as compared to non-Bt control. Varieties used for bioassay of pink boll worm wereFH-146 and FH-Lalazar as compared to control MNH-786.Three concentrations including low, standard and high were used for bioassay. Results found that there was less mortality of pink boll worm when sprayed lower concentration of pesticides on FH-146 and FH-Lalazar as compared to control. While there was medium mortality of pink boll worms on standard concentration on FH-146 and FH-Lalazar as compared to control. Higher mortality was observed in higher concentration sprayed Bt cotton as compared to control variety. As conclusion it can be asserted that if spray Bt cotton infested with pink boll worm can result in better control and can result in higher yield.

Keywords: Bt cotton, triazophos, pink boll worm, resistance evaluation

1. Introduction

Cotton (*Gossypium hirsutum* L.) plays an important role in the economy of Pakistan. It plays an essential role in the foreign exchange. It attributes 1.7% in the agriculture and 1.5% in GDP of Pakistan. Cotton are source of natural fiber and edible oil. It is most important and cash crop of Pakistan [1].

Transgenic cotton that have insecticidal protein are used to control bollworms of cotton. Cry1Ac toxin are present in transgenic cotton that helped in reduced the attack of insect pests. It is mostly used to control the larvae of insects than adult [2]. *Bacillus thuringiensis* (Bt) are gram positive bacteria in which contain insecticidal protein Cey1Ac that have effective control on transgenic cotton against lepidopterons insect pest rather than a chemical on conventional cotton [3]. Transgenic cotton showed very effective results in the control of bollworms, increased the yield production and have no adverse effect on the beneficial flora and fauna [4]. The use of different chemicals in conventional and Bt cotton are damaging the target and non-target species and have an adverse effect against the environment while transgenic cotton without spray does not cause damage against non-target species [5]. Insecticidal protein Cry1Ac are found in Bt cotton, it causes direct effect on the biology of lepidopterons insect pest and decreased the development process of bollworms [6]. In Bt cotton contain Cry1Ac toxin, it form the big category of insecticidal crystal protein that are created as a protoxin. It is used to control coleopterans and lepidopteron insects. It is used to develop biopesticidal and genetically modified plants for mulations [7]. Cry1 Toxin are produced by the gram positive bacterium that are used to control insect pest of lepidopterons on chemical sprayed and transgenic cotton [8].

Many factors affect the production of cotton. The main cause of a reduction in the quality and production of cotton is attack of different insect pest, but pink bollworm cause heavy attack on the cotton. The larvae of pink bollworm feed on flower and bolls of cotton but food of adult is pollen and nectar. Temperature plays an important role in the development of pink bollworm, high rate of development at 27±1 and low rate development are observed at 35±1 [9].

There are different chemical are used to decrease the infestation of bollworm on the fruiting bodies, squares, flowers and green boll, cypermethrin and indaxocarb have effective results to control bollworm [10]. Different types and mode of action insecticides are used to control the

lepidopterons insect pest, chlorfenapyr and quinalphos results showed that it is less effective to control lepidopterons insect pest, while spinosad and chlorpyrifos showed very effective results against lepidopterons insect pest [11]. Some chemicals like Triazophos gives effective results against bollworms and increased the yield production of cotton [12]. Adult and larvae of bollworms damage the cotton crops and reduced the yield production, different method are used to decreased the damage of bollworm like pheromone baits, sterile insect released in the field and different insecticide [13]. Some bio-pesticide are used to control the effect of bollworms and increased the production of cotton, these pesticides are not damaging the environment and natural enemies [14].

2. Materials and Methods

2.1 Experimental Design

The experiment was conducted at at Department of Entomology, University of Agriculture, Faisalabad. Completely Randomized Design (CRD) consisting on three treatments. In each treatment fifteen petri-dishes were used. The larvae of pink bollworm were collected from the field and reared under the laboratory conditions temp (35±1) and relative humidity (65±5%) without the exposure of insecticides. Larval population was maintained on cotton bolls. Three varieties of cotton was used i) FH-146 ii) FH-Lalazar iii) MNH-786, first two variety was Bt and 3rd was non-Bt.

2.2 Insecticide preparation and applications

Triazophos @ 2.0%, 2.5% and 3% was tested against larvae of pink bollworm under the laboratory conditions. Different tested pesticides solution prepared at different concentration. In one treatment used water as a control. In each mortality test control treatment was used for comparison between treated and untreated application.

2.3. Mortality tests of pink bollworm

Three mortality tests were conducted by using the Triazophos with three different concentrations viz. 2.0%, 2.5% and 3.0%. These three concentrations were used respectively in variety FH-146, FH-Lalazr and MNH-786. In each petri-dish one larvae of pink bollworm with boll of cotton. The recommended concentration of pesticides was applied on cotton boll by using the atomizer. The same practice was performed for other treatments. The data regarding the mortality % of Larvae of pink bollworm was taken for consecutive 48 hour.

$$\text{Mortality \%} = \text{No of Larvae died} / \text{Total no of Larvae} \times 100$$

3. Results

Mortality test results in (Fig 1) showed that after the application of Triazophos @ 3.0% maximum mortality of pink bollworm larvae was (20%) after 48 hours while the minimum was (6.6%) after 40 hours in FH-146. In FH-Lalazar the maximum mortality of pink bollworm larvae was (20%) after 44 hour while minimum was (6.6%) after 36 hour. While overall results showed that there is a significant difference in mortality % of pink bollworm larvae on 3.0% concentration as compared to FH-146 and FH-Lalazar. As (df) = 2, (F) = 7.234279, (P-value) = 0.003851.

Mortality test results in (Fig 2) showed that the application of Triazophos @ 2.5% maximum mortality of pink bollworm larvae was (20%) after 44 hours while the minimum was (6.6%) after 36 hours in FH-146. In FH-Lalazar the maximum mortality of pink bollworm larvae was (20%) after 48 hours while the minimum was (6.6%) after 36 hours. While overall results showed that there is a significant difference in mortality % of pink bollworm larvae on 2.5% concentration as compared to FH-146 and FH-Lalazar. As (df) = 2, (F) = 8.779765, (P-value) = 0.001574.

From (Fig. 3) mortality test results showed that the application of Triazophos @ 2.0% maximum mortality of pink bollworm was (13.3%) after 48 hours while the minimum was (6.6%) after 40 hour in FH-146. In FH-Lalazar the maximum mortality of pink bollworm larvae was (20%) after 44 hour while minimum mortality was (6.6%) after 36 hours. While overall results showed that there is a significant difference in mortality % of pink bollworm larvae on 2.5% concentration as compared to FH-146 and FH-Lalazar. As (df) = 2, (F) = 7.234279, (P-value) = 0.003851.

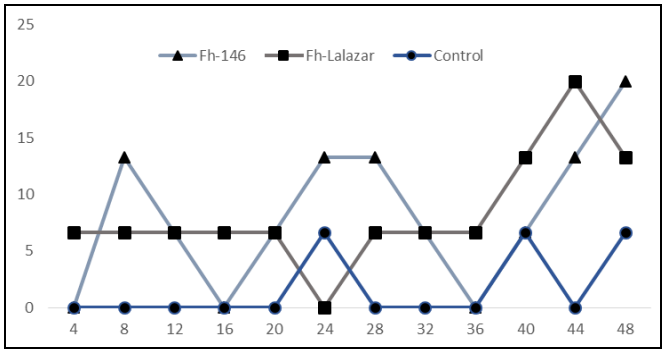

Fig 1: Mortality test of pink bollworm larvae on lower concentration sprayed on FH-146, FH- Lalazar and control varieties

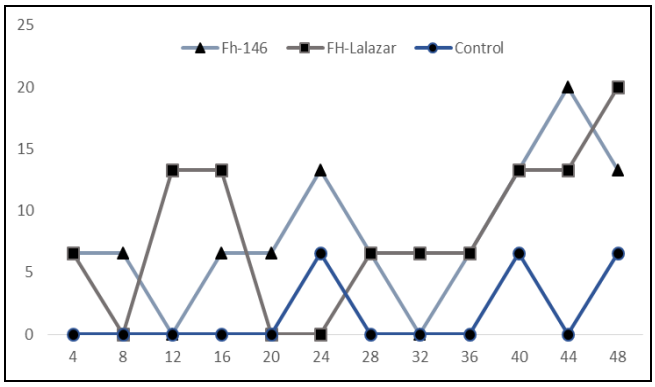

Fig 2: Mortality test of pink bollworm larvae on standard concentration sprayed on FH-146, FH- Lalazar and control varieties

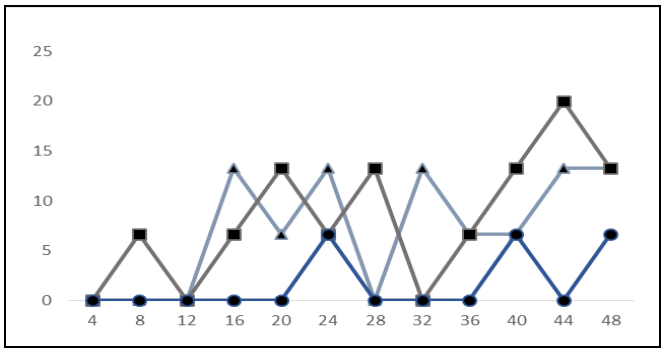

Fig 3: Mortality test of pink bollworm larvae on higher concentration sprayed on FH-146, FH- Lalazar and control varieties

4. Discussion

According to [15], modern insecticides are used to control an attack of Pink bollworm, high concentration of insecticide showed effective results while low concentration showed less

effective, so our results were in agreement because Pink bollworm less infestation/ high mortality rate observed when triazophos was sprayed in cotton field. Our results were also in agreement with [16] because the mortality rate of lepidopterons insect pest was high at high concentration of insecticides and different combination of insecticide, so we also asserted that at high concentration of triazophos was observed high mortality rate of lepidopteron insect pest. It was observed that the effect of triazon was more effective to control larvae of pink bollworm while polytrin C and radiant less effective [17], so our results were in agreement because the high concentration of triazophos showed more effective results than other. It was observed that the high concentration of insecticide gives effective control of lepidopteron insect pest, insecticidal protein is used to decrease the infestation of pink bollworm in Bt and non-Bt cotton, so our results were also in agreement because low infestation was observed when applied high concentration of triazophos on larvae of pink bollworm [18]. In another studies, the attack of pink bollworm was low when used Insecticidal protein cotton [19], so our results were also in agreement because high mortality of pink bollworm was occurred at high concentration of triazophos in Bt cotton. It was observed that high concentration of different insecticides are useful for disturbing the life cycle of Pink bollworm and caused high mortality, when synergistic used with insecticide it play a vital role in the mortality of bollworms [20], so our results were also in agreement because the low infestation/high mortality of pink bollworm was observed at high concentration of triazophos. In another research it was indicated the low infestation percentage of pink bollworm occurred at high concentration of insecticidal protein, cause direct effect on the development of pink bollworm [21], so our results were also in agreement because low infestation was observed when sprayed high concentration of insecticides on Bt cotton. It was described that insecticidal protein cause high mortality of pink bollworm [22], so our results were also in agreement because high concentration of triazophos in Bt cotton caused high mortality. According to research the high concentration of insecticide was effective against bollworms [23], so our results were also in agreement because high concentrations of triazophos showed high mortality rate of bollworm.

5. Conclusion

As a conclusion it can be asserted that organophosphate like triazophos can result in controlling pink boll worms at a standard concentration when sprayed in FH- 146 and FH-lalazar cotton varieties. So spraying organophosphate in the Bt cotton can better control the pink boll worms.

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