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*Review Article*

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# Mechanisms and Effects of Insect Pests Resistance against Bt Crops

**Muhammad Sulaman Saeed[1*], Ayesha Saeed[2] and Muhammad Adnan[3]**

[1]Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan

[2]Department of Botany, University of Education, Dera Ghazi Khan Campus, Sub Campus of University of Education, Lahore, Pakistan

[3]Department of Agronomy, College of Agriculture, University of Sargodha, 40100, Pakistan

*Corresponding Author E-mail: muhammadsulamansaeed2598@gmail.com

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**ABSTRACT**

*Bt crops are basically those crops that are genetically engineered for insect pests resistance. These crops were grown commercially in 1996 for the first time in the world. Then, these crops named Bt crops spread in many countries and their cultivation started. The major advantages of the Bt crops are these that they are environment friendly and other there is big reduction of usage of insecticides. Bt crops produce such toxins or chemicals that kill the insect pests that attack on crop plants. But unluckily, these insects have got resistance against the toxins produced by Bt crops. And the quantity of these species is increasing day by day which is very harmful for the cultivation of these Bt crops. So, there is a great need of time for us that we should understand the resistance system of insect pests at the molecular level and learn how to synthesize Bt crops varieties which are resistant to insect pests.*

***Keywords:*** *Bt crops, Insect pests, Resistance, Toxins, Molecular systems, Schemes of controlling.*

## INTRODUCTION

There are many synthetic insecticides which are used against insect pests in the field crops. DDT is one of them. In 1948, insecticide resistant character was first of all seen in DDT when insect pests got resistance towards them (Atsumi et al., 2012). Then with the passage of time the quantity of such resistant insects got raising up to 500 species. To learn how this resistance comes into insects it is very important to look at their molecular mechanism. Bt crops are being grown commercially since 1996 in which there is a mechanism of transmitting Bacillus thuringiensis toxic chemicals to kill the insect pests that is harmful for the crop plants (Bernardi et al., 2015). So, the genetically engineered crops are called Bt crops. The examples of Bt crops are soybean, brinjals, cotton, maize and many others. In Bt crops, the toxins produced upset the mid guts membranes and bind to the special sites and in the last destroys the insects by killing them.

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Cry1A family can be considered as commonly utilized as Bt toxins like Cry1Ac in the Bt cotton and Cry1Ab in the Bt maize (Brevault et al., 2013). The genetically engineered crops are cultivated in billions of hectares. There is a great increase in the yield and reduction in the utilization of the traditional insecticides but now the good influence of Bt crops is decreased due to a lot of resistance created by insect pests. Now about 13 resistant species are produced against 5 Bt toxin in bioengineered maize and cotton. Many references belong to the Cry1A families. There are many systems by which the insect pests get resistance. So, we have to develop such techniques by analyzing the genetics and molecular study of the insect pest which will produce the well-adopted Bt crops (Brevault et al., 2015).

In this review article, we will discuss the resistance mechanisms and effects of Bt crops.

**Resistance to the Pyramids Bt Crop Plants**

It is a genetically engineered crop plant which produces 2 or more than 2 Bt toxic chemicals that kills the same pests and are highly utilized by the scientists to create resistance delay of the insect pests. But some experiments and researches show that some insects got resistant against these pyramid Bt crops as well. It is due to when the protein of the mid gut of insect matches well to the Bt crops amino acid profile but this happens due to mutations. It reduces to the mid gut binding receptors. From this mechanism, we can easily understand the systems of the management to overcome resistance problems (Carriere et al., 2015).

**Molecular Systems of the Resistance**

To learn about the different mechanisms to overcome the resistivity problems, it is necessary for us to analyze the molecular biology of the Bt crops. First of all, we take the example of the *H. armigera* that deliberated the resistant characters towards Cry1Ac by the mutation process in the promoter regions of HaTryR. The insect pest easily adapted to the Cry1Ac by reducing the expression of the trypsin. So, the Bt crops produced activated toxins other than the protoxins. Another mechanism of resistance is loss of the carbohydrate modifying enzymes that produce resistance to Bt plants. This is more dangerous than the mutations in single receptors. The big example is the resistance of nematode against Bt toxins. The nematode name is *Caenorhabditis elegans* (Coates, 2015).

**Resistance Controlling Systems**

**Refuges Methodology**

This is a primary and basic method to overcome the problem of pests resistance. In this method, the susceptible insect pests are mated with resistant ones by producing the reduced resistant insect pests because the all eles crossover by the other alleles and then offspring are susceptible to Bt toxins. We can simply say that by this method the new generation of insect pest have fifty percent chances at least to be resistant against the Bt crops. This is the very important and best method to overcome the problem of resistivity of insect pests (Denholm et al., 2002).

**Pyramided Crop Plants**

This is the very simple method in which the construction at molecular level of Bt crops is done in this way that it produce two or more than 2 Bt toxins at the same time for a same pest. This allows the different chemicals to kill the insect pest very easily. This system is adopted by many countries of the world and this is very important technique (Dennehy et al., 2004).

**Modified Forms of Bt Toxins**

In this methodology, the toxins produced by Bt crops are checked which are resistant to insect pest and then either the amount of toxins is modified or other version of toxins is added by genetic engineering. This produces the modified versions of the Bt toxins that are very helpful to combat the resistant insect pests (Ding et al., 2013).

**Use of Sterile Insect**

This is very common method which has been used for decades. In this method, male transgene are released. They mate with the resistant ones female and have alleles for sterility. Then, these produced offspring are highly susceptible and then our goal is easily achieved. The best example of it is P. xylostella (Downes et al., 2010).

**Natural Enemy**

The spray of natural enemies on the population of insect pest resistant is very easy method. The population of P. xylostella was reduced when Corymbia maculata was sprayed on non Bt plants. This method is included in the integrated pest management of Bt crops (Elzaki et al., 2015).

## CONCLUSION

It is concluded that Bt is the good used method of insect pest killing in agriculture sector. Bt crops are very resistant to the insect pests as they produce the toxins that kill the insects. But there are many difficulties which create problem of insect pest resistivity like the amino acids profile matches well to the Bt toxins. This is very harmful and happens due to mutations but we can overcome these problems by many methods like refuges systems, pyramided plants and some others.

**Future Prospects**

In future, by different new techniques inventions we can overcome the problems of Bt crops susceptibility to insect pest resistance. We can summarize that in future by inventing new technologies we may be able to handle the insect pest resistance problems in a schematic way.

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