

Insecticides beneficial or harmful biology essay



**ASSIGN
BUSTER**

As the world faces an increasing food scarcity, the biggest challenge for agricultural world is to enhance the food productivity to fulfil this increased demand. About 35% of world agricultural products is lost from pest attack due to insects, fungus, viruses, and bacteria, a adept pest control program is an important segment needed for any effort to increase the crop yields. The continuous exertion between human and his insect pest enemies started even before the start of civilization. Instead the large number of new techniques introduce by man in developing new and deadly treatments to fight the war against insects, but he has not been successful in controlling even one of the thousands of serious insect pests which damages his food and other agricultural crops, destroys his property and even attack himself and injure his domestic animals.

Many of the chemical insecticides and pesticides that are currently used to control insect pests are seriously poisonous to non-target organisms and may also be harmful for the human and animal health. These toxic chemicals also pollute water and soils, as most of the pesticides are recalcitrant to breakdown. Moreover, by using these chemicals in high quantity, most of the insect getting resistance to different pesticides.

Naturally the insect exist respite between the insect and humans, and this is known as ' balance in nature'. There are two opposing phenomenon are responsible for this balance, one one of them is the ' biotic potential i. e. the higher capacity of insect pests to reproduce and multiply and environment resistance by which their numbers are kept under check. The environment resistance can cause the death of adults before in the mortality of eggs, oviposition, pupae or larvae of the insects because of parasites, starvation,

desiccation, diseases, predators, and other unfavorable environmental factors.

The attempts to control insect by human have changed with passage of time from biological methods to artificial chemical control, and once again, we are interested to control these insect naturally . But the pesticides we are using now are comparatively more safe and less toxic than those used in the past, such as DDT, which can still a cause for concern. Long-term usage of these synthetic pesticides has been related with liver damage, immunotoxicity, cancer, reproductive problems and birth defects in humans and other animals (Kegley and Wise, 1998).

The undesirable results of green revolution include build up the residues of broadly used synthetic pesticides in various environmental mechanisms.

Several studies showed that insecticide can cause serious health problems such as cancer, birth defects and nerve damage. (Rekha et al., 2005).

Several types of pesticides and their area of effect are given in table 1. And Major countries using high dosage of pesticides are mentioned in table 2.

Table 1. Types of synthetic pesticides and their area of effect

Class

Examples

Area of Effect

Organochlorines

DDT, Dieldrin, Toxaphene, Aldrin

Reproductive, nervous, endocrine, and immune system

Organophosphates

Glyphosate, Diazinon, Malathion

Central nervous system

Carbamates

Aldicarb, Carbofuran, Carbaryl

Central nervous system

Pyrethroids

Deltamethrin, Fenpropanthrin, Cypermethrin

Poorly understood

Table 2. Major countries using high dosage of pesticide

Serial no

country

Pesticide used kg/hac

1

Costa Rica

51. 2 kg

2

Colombia

16. 7 kg

3

Netherlands

9.4 kg

4

Ecuador

6 kg

5

Portugal

5.3 kg

6

France

4.6 kg

7

Greece

2.8 kg

8

Uruguay

2. 7 kg

9

Suriname

2. 6 kg

10

Germany

2. 5 kg

11

Honduras

2. 5 kg

NationMaster (2002)

1.5 million tones of synthetic insecticides are produced every year, which accounts for a business worth US \$30 billion (McKenzie, 2001). Pakistan produces 8, 350 bales of cotton annually and ranks 4th in world cotton production (Nation Master, 2004)

After the introduction of DDT in the 1940s, insect pests are control almost extensively with chemical pesticides (Casida and Quistad 1998).

Comparitively easy to deliver, rapid action, and cheap to produce, highly effective chemical insecticides have been studied with intense optimism; problems associated with these chemicals did not begin to become apparent

<https://assignbuster.com/insecticides-beneficial-or-harmful-biology-essay/>

to most scientists until almost two decades after their first use. These limitations included low species specificity, which leads to losses in some useful insect species, disequilibrium of ecosystems results in elevation of minor pests to major pests, produces toxicity in vertebrate species including fish, mammals, and birds and resistance develops in target organisms.

Such resistance has been increased by the reducing availability of many synthetic chemicals, which enhance the regulatory restriction of insecticide use; market removal of insecticides no longer registered for public health use, and reduced profits of certain compounds. The combination of these factors results in worldwide pest-induced losses of food, feed and fiber of several billion dollars each year Elzen and Hardee, (2003). Tedford et al., (2004) described the evolution of resistance to many pesticides along with increased awareness of the potential environmental and human and animal health impacts of these chemicals

Most of the insecticides are toxic to human beings; WHO (world health organization) has classified their toxic effects into three classes from class Ia (extremely toxic) to class III (slightly toxic) and then "their active constituent unlikely to present acute hazard" (Anonymous, 2001). According to survey most insecticide deaths recorded in hospital, which are found to be self poisoning the human (Eddleston, 2000). The worldwide Burden of disease survey showed that 798 000 people died from conscious self-harm in 1990, and more than 75% of them were from undeveloped countries (Murray and Lopez, 1996). . More recent WHO studies showed that over 500, 000 people died from self poisoning in the western Pacific and Southeast Asia during 2000 alone (Anonymous, 2001). Suicide is the most common reason

of death in young Chinese women and Sri Lankan men and women (Murray and Lopez, 1996; Anonymous, 2001; Anonymous, 1997). Insecticides are the most important method of self poisoning in many rural areas and are linked with a high death rate (Eddleston, 2000).

The insecticide containing organochlorine is contaminating the food products which is a serious threat to the human progeny. (Bakore et al., 2004).

Recently, the experiments at the Central Cotton Research Institute (CCRI), Multan, showed that the two major cotton pests, the American whitefly and bollworm have developed resistance against common insecticide.

Ahmad et al., (2007)

Insecticide Resistance

The emergence of insecticide resistance in insect populations, as well as increased risk about the human health and environment are linked with certain agrochemicals, has encouraged the search for new arthropod-control approaches.

In cotton, vegetables and tobacco majority of insects showed resistance to insecticides (Rajmohan, 1998). *Helicoverpa armigera* (which is one of the most serious insect pests on cotton, cereals, vegetables and legumes) has shown resistance to many groups of agrochemicals in tomato, chillies, pigeonpea, cotton, groundnut, chickpea and sunflower. The emergence of resistance against top insecticides has imposed the application of higher doses of the same insecticide or increased number of insecticide applications.

Bt Plant pesticides

The development of resistance to many pesticides, along with increased awareness of the potential human, environmental and animal health impacts of these synthetic chemicals, has encouraged the search for new insecticidal compounds, new molecular targets, and alternative control methods (Tedford et al., 2004).

The Bt plant-pesticide named as Bt field corn, was first registered with the United States Environmental Protection Agency in 1995 (USEPA, 1999). In the US, less than 2% of the market, sprayable Bt formulations have been used in cotton, vegetable and fruit, aquatic, and other insecticide markets, and in the last few years new Bt formulations have continuously grown in a few fruits and specialty vegetable markets; Bt has remained the). Table 3 indicates different types of Bt biopesticides and the insects control by these biopesticides

Table 3. Types of Bt biopesticides and the insects control by these biopesticides.

Sr. No.

Bt strain

Bt Biopesticide (product name)

Insect controled

1

Kurstaki strain

Biobit, Dipel, MVP, Steward, Thuricide

Tent caterpillar, Fall webworm. , Leafroller, Redhumped caterpillar, Spiny elm caterpillar, Western spruce budworm., Pine budworm, Pine butterfly, Cabbage worm, Tomato and tobacco hornworm, Leafroller, European corn borer , Alfalfa caterpillar, alfalfa webworm.

2

Israelensis strains

Vectobac, Mosquito Dunks, Gnatrol, Bactimos

Mosquito, Black fly, Fungus gnat

3

San diego/tenebrionis strains

Trident, M-One, M-Trak, Foil, Novodor

Colorado potato beetle, Elm leaf beetle, Cottonwood leaf beetle.

4. Bt TRANSGENIC CROPS:

Major Bt transgenic plants include cotton, corn, rice, and potatoes. The expression of Bt delta-endotoxins in transgenic crops has been much more helpful against insects that can attack parts of the plant which may not well-protected by typical pesticide application. (Ely, 1993).

Gatehouse (2008) explain that Insect resistant in crops are one of the most successes of induction plant genetic engineering technology to agriculture; cotton (*Gossypium hirsutum*) which showed resistant to lepidopteran larvae

and corn resistant to both lepidopteran and coleopteran larvae (rootworms) that is now used worldwide in agriculture and have led to minimize the pesticide usage which also minimize cost of production (Toenniessen et al., 2003; Brookes and Barfoot, 2005)

The major source of the insecticid toxins produced in commercial transgenic crops is the soil born *Bacillus thuringiensis* (Bt). Bacterium of Bt show varying specificities of insecticidal activity toward insects, and constitute a large reservoir of gene pool which encodes for proteins produced by insecticides, which are accumulated in the crystalline structure which are produced by the bacteria on sporulation (Cry proteins, Cyt proteins) or expressed during bacterial vegetative growth (Vip proteins). There are three domains of Cry proteins have been thoroughly studied; the mechanism of action includes a proteolytic activation step, which is occurred in the insect gut after ingestion of food, followed by interaction of either one or two of domains II and III with receptors, on the outer surface of the insect gut epithelium cell. This interaction may leads to oligomerization of the protein, and domain I is responsible for the development of an open channel via the cell membrane. This results in ionic leakage can destroys the cell, which may cause the breakdown of the gut, bacterial proliferation, and finally cause destruction of the insect . Developed countries growing GM crops are mentioned in table 4.

Table 4. Major countries growing different GM crops

Rank

Country

Area (million hectares)

<https://assignbuster.com/insecticides-beneficial-or-harmful-biology-essay/>

Biotech Crops

1

USA

62. 5

Soybean, Maiz, Cotton, Canola, Squash, Papaya, alfalfa,

2

Argentina

21. 0

Soybean, Maiz, Cotton

3

Brazil

15. 8

Soybean, Maiz, Cotton

4

India

7. 6

Cotton

5

Canada

7. 6

Soybean, Maiz, Canola, Sugarbeet,

6

China

3. 8

Cotton, Tomato, Poplar, Petunia, Papaya, Sweet potato

7

Paraguay

2. 7

Soybean

8

South Africa

1. 8

Maize, Soybean, Cotton

9

Uruguay

0. 7

Soyabean, Maize

10

Bolivia

0. 6

Soybean

11

Philippines

0. 4

Maize

12

Australia

0. 2

Cotton, Canola, Carnation

13

Mexico

0. 1

Cotton, Soybean

14

Spain

0. 1

Maize

(ISAAA Executive Summary 2008)

Bacillus thuringiensis is known as Gram-positive bacterium which is widely used in agriculture sector as a bio-pesticide. The biocidal activity of Bt mainly exist in a parasporal protein inclusion body, or crystal. The inclusion is composed of one or few types of delta-endotoxins (Cry and Cyt proteins). Cry proteins are mostly toxic to different species from invertebrate phyla: arthropods (mainly insects), flatworms , nematodes, and protozoa. (Prieto-Samsonov et al., 1997).

Up till now more than 34 subspecies of *B. thuringiensis* have been recognized , some of the most knowb are used, include subspecies *kurstaki* (active against Lepidoptera), subspecies *israelensis* (active against Diptera, primarily mosquitoes and blackflies), and subspecies *tenebrionis* (which is against *Leptinotarsa decemlineata*, the Colorado potato beetle) (Whalon and McGaughey, 1998). There are different types of protiens active against the type of insects and some active protiens studied against insects are given in table 5 and 5. 1 repectively.

<https://assignbuster.com/insecticides-beneficial-or-harmful-biology-essay/>

Table 5. Different proteins active against insect

Sr. No

Protein Name

Insects Controled

1

Cry I

Lepidoptera specific

Hofte and Whiteley (1989)

2

CryII

Lepidoptera and Diptera

3

CryIII

Coleoptera specific

4

Cry IV

Diptera specific

5

VIP

Lepidopteran insects

Yu et al., 1997

6

Lectins, Defensins,

Protease inhibitors or Ribosome inactivating

proteins

expressed in transgenic to environmental stimuli plants in a

tissue or development-specific manner, or in response

(Boulter, 1993;

Sharma et al., 2004)

7

Cyt genes

active against dipteran and coleopteran pests, and moreover have shown
affects against hemipterans (true bugs) and dictyopterans (roaches and
termites)

(Frutos et al., 1999; Gould and Keeton, 1996)

Hvt

<https://assignbuster.com/insecticides-beneficial-or-harmful-biology-essay/>

Lepidopteran insects (*Helicoverpa armigera* and *Spodoptera littoralis* caterpillars)

Khan et al. (2006)

Table-5. 1: Some active proteins studied against insects

Sr. no

Gene

Target pest