

# Effect of insecticides on honey bees biology essay



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## **Introduction:**

Pollinators are very important for the production of any crop as they play very important role for pollination of the flowers and crops. Bees are considered one of the major pollinators of the agricultural crops. The study of this issue is very important as well as difficult due to the complex interaction of bees with their hosts. Many environmental factors are involved in the complexity of this interaction (Schmid, 1975). Honey bees are good pollinators but they are not common for all crops (Batra 1995). Most people are interested in honey and wax production by bees but some honey bees are used in orchard pollination, where they take nectar and pollen for the purpose (Cheung 1973).

Honey bees are most vulnerable pollinators of agricultural crops as USDA estimated the financial value of these profitable pollinators that is approximately 15- 20 dollars billion per year (Johnson 2010). On the other hand, they are very sensitive insects as they are disturbed by the common environmental factor like pollution. Pesticides are the chemicals that are most widely used to control pests in crop production. When different chemicals are applied to the crops, they not only affect the pests of the crops but also harm the beneficial insects as pollinators, predators and parasites etc. This harmful effect disturbs the natural balance between the insects and their natural hosts.

The table below shows the dependence of agricultural crops on honey bee pollination. Almond, Alfalfa, Apple, peaches, carrots, sunflower, onion, broccoli and citrus with other field crops are given with their dependence.

Estimated value of Honey Bee to US crop production, 2000 estimates

(Johnson, 2010)

Use of chemicals (Pesticides) in agricultural crops is important to get required production on one side while on other side, safety of honey bees and other natural enemies from these chemicals are also required. But if these chemicals are not used against insect pests of the crops, it will also create problems for producers as they can not be able to get such production that can fulfill the food requirements of nation or worldwide.

Large number of bee colony developers is present in The United States that provides bees as pollinators, commercially to different crop producers. U. S. Department of Agriculture's (USDA) 2007 Census point out that 2.9 million bee colonies are used for 28,000 operations in the United States. Increasing use of chemicals (insecticides and pesticides) to control the other problems of crop production disturbs honey bees' populations either natural or reared commercially. Johnson 2010 gave the map that shows the disorder in honey bees' colonies in different states in 2009.

<http://beealert.blackfoot.net/>

Johnson (2010) gave the reasons for colonies collapses in his report by the data collected under the information provided by USDA.

These colony losses in honey bees disturbs Agricultural economy of the country, so scientists try to explore that chemicals that are less or not harmful for the pollinators and they started performing different experiment by using different chemicals to check their efficacy against honey bees

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activities and pollination. Complete give up of chemicals is not possible as they effect the production of different agricultural crops (Akca et al. 2009), but these chemicals should be use under certain limits. According to the Pretty 1995, the over usage of these agrochemicals make the soil and environment deteriorated and on the other side genetic diversity of the living organisms is also disturbed. Many scientists focused on all non target insects while some are more specific towards the pollinators, their behavior and activities against insecticides which are commonly used for crop pests (Liong et al. 1998; Qadri et al. 1994).

Different chemicals and methodologies are carried by different scientists to explain the effectiveness of certain chemicals against honey bee normal functioning. Some of them are given here.

### **Methodologies by Different scientists and their results:**

Akca et al. 2009 performed an experiment by using 8 chemicals against worker honey bees. They used residual film method for each chemical. Physical conditions for experiment were 25O C and 75% RH and data was collected after 1, 8, 16 and 24 hours. Honey bees of 20 days or less were used in experiments. Three different doses for each chemical were used (recommended, 1/2 and 1/4 of recommended) at same physical conditions.

Above is the table that shows the chemical used, their recommended doses and their groups to which these chemicals belong.

Their results revealed that all of the insecticides with all doses are toxic to the honey bees after last three intervals except Azadirectin. All chemicals are significantly toxic to time and doses while the mortality goes on

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decreasing when dose was reduced. Among all toxic compounds, they found that Sevin XLR was the most fast acting and toxic to the honey bees.

Under the light of this experiment, it was concluded that the chemicals that are botanical in nature have less or no toxic to the honey bees. They are organic in nature and environmentally safe. The scientists concluded that it is needed to find out bio-chemicals that does not effect adversely to the bees but have good control of pests.

Needham and Stevenson 1973 performed an experiment by using three chemicals, Malathion EC, Azinphos-methyl EC and Endosulfan WP. They performed experiment under natural conditions in field. They sprayed chemicals while bees were foraging on the oil seed rape crops and notice the mortality after 1 and 28 days. They found that mortality was maximum for Malathion and then Azinphos-methyl while for Endosulfan it was very low. Table for results of these chemicals is given below.

For this result, they concluded that the formulations of the chemicals play important role for their toxicity. For this conclusion, they performed another experiment by taking two chemicals, Endosulfan and Azinphos-methyl with both formulations. The method of experiment was same as before. But this time, they found that the wetablepowder (WP) formulations were mote toxic than emulsifiable concentrate (EC). The table for results is given as:

It is revealed from the results that again Azinphos-methyl was more toxic than Endosulfan no matter what the concentration was. Though all chemicals had effect on Acetyl cholinesterase of the brain of honey bees. So they

concluded that the choice of chemical is more important than the concentrations of the chemicals.

In the same way different experiment with different hypothesis are carried out by different scientists to show the effect of chemicals on the activity of honey bees as a pollinator and their role for the crop production. Some of the literature review is given below about the work on honey bees against different chemical and different methodologies by different scientists.

### **Review of Literature:**

Akca et al. (2009) studied the effect of eight different insecticides on honey bees and check their acute toxicity level on hazelnut pests. They used Karate, Deltanete, Sevin, Oncol, Mesurol and Neem @ of their recommended dose and below (1/2 and 1/4 of recommended dose) against Honeybees.

They found that Azadirechtin is most safe and environmental friendly insecticide as compare to all other. They also revealed from their experiment that Sevin is one of the most dangerous insecticides for the honeybee activity. In their experiment they recommend that Azadirechtin should be used to control the Hazelnut pests.

Batra (1995) presented a review article about the importance of the honey bees as a pollinator for different crops. He described the situations before and after the application of agricultural practices in a field crop that disturb the population of bees to the hosts.

Halm et al. (2005) presented “ New Risk Assessment Approach for Systemic Insecticides: The Case of Honey Bees and Imidacloprid (Gaucho)”. This publication explains an approach to estimate the risk of systemic insecticides

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more precisely. They estimated two levels that were levels of exposure (PEC) and toxicity (PNEC). PECs are determined for different Honey bees' categories in order to estimate the amount of contaminated pollen and nectar consumed. PNECs are estimated or calculated for chronic, acute and sublethal toxicities of the test chemical. All of the experiment was done under field conditions. These assessments are used to describe the risks of the systemic insecticides against honey bees.

Iwasa et al. (2004) performed an experiment on honey bees by taking different neonicotinoids in topical application in laboratory. They found that nitro-substituted compounds like imadacloprid and dinotefuran were more toxic as compared to Cyano-substituted compounds like acetamaprid and thiacloprid. They also studied the effect of some synergists like piperonyl butoxide, triflumizole and propiconazole. They observed that these synergists increased the effect of cyano-substituted compounds towards more toxic while nitro-substituted compounds were not affected by these synergists.

Kevan (1999) gave the name, bioindicators to the honey bees. According to him, pollinators and pollination is important for all ecosystems specially agriculture. They are as sensitive to the changes in environment as they are getting easily harmed by the competitors, diseases, predators and parasites on one side while they are easily defeated by the physical and chemical factors like chemical application and habitat modification. According to Kevan, honeybees are indicators of the atmospheric pollutions as they are functionally disturbed by the abnormalities in the environment.

Montana, Department of agriculture (2007) published a report about the role of pesticides and honey bees in the production of agricultural crops. In this report, they described that insecticides application not only control the other pests of the crops but also disturb the honey bee population while on the other hand if insecticides are not applied to control the other pests of the crop, the production by the crops is also disturbed. So in this guideline, they give some general suggestions and ideas for the application of insecticides and chemicals to control the insect pests of the crops.

Needham and Stevenson (1973) studied the effect of 3 organophosphates on foraging bees and their pollination ability was tested under the influence of these (Endosulfan WP, Azinphos-methyl EC and Malathion EC) chemicals. According to their results, Endosulfan was safer among all three. According to their observations, they concluded that the other two chemicals except Endosulfan, difference of formulations (wetable powder and Emulsifiable concentrate) is also one of the factors that made these chemicals more toxic than Endosulfan.

Surviliene et al. (2009) published an article “ Investigation of Pesticides Effect on Pollination of Bumblebees in Greenhouse Tomatoes”. In this article, they checked the effect of different chemicals on the bumblebee hives with different doses. They concluded that with the specific recommended doses of some specific chemicals did not affect the bee activities and lives while some chemicals badly affect the bees and their activities. As they used triazamat with 1 ml/lit concentration, Azadirachtin with 5ml/lit and propamocarb hydrochloride with 1.5 /ha. They did not notice any bad effect on



bumblebees while tolyfluanid with 1.5 mg/lit had negative effect on bee colonies and activities.

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[Publications/2007/Full\\_Report/Volume\\_1, \\_Chapter\\_1\\_US/st99\\_1\\_029\\_031. pdf.](http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_US/st99_1_029_031.pdf)