Lecture 6: Effect of agricultural inputs on bee activity – Pesticide poisoning

The use of pesticides has become inevitable in modern agriculture. Most of crops are attacked by some or the other pests. The control of insect pests, diseases and weeds, in most cases is done by applying some pesticide. Pesticides used on field crops for the control op pests have their own side effects, one of which is their toxicity to honey bees. Honeybees are susceptible to many pesticides, especially insecticides. Each year honeybee colonies are damaged or destroyed by pesticides, primarily insecticides. Such losses have devastating impact on the beekeepers, who may have to relocate damaged hives or perhaps even be forced out of business. It is very difficult to assess the extent of losses of bees from pesticides. Three types of harmful effects evident in agriculture are:

1. Loss in production of honey.
2. Contamination of bee products.
3. Reduction in the yield of cross-pollinated crops.

These effects may happen as a result of the direct exposure of bee fauna to pesticides or through indirect contact with their residues. Direct exposure occurs from treatment of bee hives with pesticides for disinfestation purpose or honey bees visiting the fields at the time of spray. While the indirect exposure occurs from spray drift from nearby fields or bee foraging in sprayed crops. Honeybees may also come in contact with spray fluid spilled inadvertently or thrown in the watercourses.

Symptom's of bee poisoning

Dead or dying bees near the entrance of hives /colonies.

Dead bees on the top of frames or bottom board.

Lack of recognition of guard bees.

General aggressiveness.

Fighting among bees at the entrance or inside of colonies.

Paralysed or stupefied bees crawling on nearby objects of the colony and also on blades of the grass.

Sudden cessation of food storage and brood rearing.

Dead and deserted brood in the hive.

Poor recognition of pollen and nectar.

And finally a depleted population of the colony.

Causes of poisoning

Bee poisoning mainly occurs when pesticides are applied to crop during bloom. It may also be caused by drift of toxic chemicals onto non-target areas or bees contacting residues of pesticides on plants for pollen and nectar and also bees drinking or contacting contaminated water in watercourses or spillage. If the chemical is highly poisonous the bees may get killed in or near the field. However, if the chemical has delayed action the bees may reach their hives but die near the entrance. Some of workers may even enter the hive and store nectar and pollen inside and thus, result in exposure of the nurse bees to the contaminated pollen, carried by the foragers and stored in the comb. The resultant cumulative effect of the contaminated pollen may lead to depletion of brood, death of young ones, nurse bees and other workers. Hence, not only the population of colony decreases substantially but also results in contamination of bee products.

Factors of bee poisoning

Many factors involving pesticides affect the potential for honey bee poisoning. The important factors are described below.

Plant growth stage: Severe bee poisoning most often results from spraying insecticides directly on flowering plants, either the crop itself or flowering weeds within its margins.

Relative toxicity of chemical: Pesticides vary in their toxicity to honeybees. Among the pesticides, most fungicides and herbicides are relatively less toxic to honeybees. Insecticides are most toxic. Honeybees are most vulnerable to broad-spectrum insecticides. Insecticides that are highly toxic can not be applied to blooming crop when bees are present without causing serious to colonies. Insecticide like dimethoate, malathion, methyl parathion etc. carbaryl come

under this category. However, insecticides like endosulfan are less toxic (Table 1).

Choice of formulation: different formulations even of same pesticide, often vary considerably in their toxicity to bee. Dust formulations are typically more hazardous than sprays because the are picked up on bee hairs. A wettable powder such as Sevin 80 S, would usually remain toxic in the field for a longer time than Sevin XLR Plus, an emulsifiable concentrate. Granular insecticides are less hazardous to bee. However, microencapsulated materials such as Penncap-M are particularly dangerous to use around bees because, the capsules have a tendency to adhere to bees due to their size and electrostatic charge.

Residual action: Residual activity of an insecticide is an important factor in determining its safety to pollinators. An insecticide that degrades rapidly can generally be applied with minimum risk when bees are not foraging.

Drift: Drift of spray application can cause significant bee poisoning, particularly when drift reaches colonies adjacent flowering weeds. In general sprays should not be applied when wind speed exceeds 10 km/hr.

Temperature: Temperature can have a substantial effect on bee poisoning hazard. If temperatures following treatment are unusually low, insecticide residues can remain toxic to bee many times longer than if normal temperature prevails.

Distance from treated fields: the most severally damaged colonies are usually closest to fields where insecticides are being applied. However, during periods of pollen or nectar shortage, hives within 6 – 7 km of the treated areas can be injured.

Time of application: evening application of a short residual insecticide can greatly reduce any potential for bee damage.

Minimizing pesticide hazards to bees / management practices

Proper understanding of above-mentioned principles can go a long way in reducing pesticide hazards to honey bees. The basic principle, of course, is that honey bees should not get exposed to the toxic effects of insecticides as far as possible. Reducing pesticide injury to honeybees requires communication and cooperation between beekeepers and farmers. Since both mutually benefit from honeybees, the beekeeper in terms of its products and the farmer in terms of

increased production of crops. While it is unlikely that all poisoning can be avoided, a balance must be struck between the effective use of insecticides, the preservation of pollinators and the rights of all – the beekeeper, farmers and the community.

GUIDELINES FOR BEEKEEPERS

It is most desirable that bee colonies should be maintained where use of pesticides or drift from pesticides is minimum. For this, the beekeeper should be fully conversant with the type of pesticides used in their locality, which in turn depends upon the cropping pattern and the pest complex. He / she should also be aware of normal wind currents prevalent in that area to protect against the harmful effects from drift.

If ever disinfestation of beehives becomes necessary he / she should use only the recommended chemicals, safe to the bees, for the purpose.

During bloom if the crops in the surrounding areas are being sprayed with the insecticides, it is always advisable to confine the bee within the hives. If it is apprehended that the spray programme will continue for a longer period, it is better to move the hives away to the safe location free from the drift in advance.

Apiarists and farmers should have close cooperation so that beneficial activity of bee is not jeopardized by the irrational use of pesticides by the latter.

Feeding of colonies with sugar syrup following pesticide application to reduce bee foraging may help substantially in reducing the exposure of bees to pesticides

Bee repellent like Methyl salicylate and MGK 874 (2 – hydroxyethl – N octyl sulphide) also reduces bee foraging

Addition of (adjuvant) Sylgard 309 silicone surfactant reduced honey bee mortality for some insecticides

Carbolic acid and creosite reduced activity of bees on cotton for few hours

GUIDELINES FOR FARMERS

The golden principle for the farmers is to use insecticides only when necessitated. For this purpose, integrated pest management approaches are available on most crops, which should be strictly practiced.

It is in the mutual interests of both that the farmer should intimate the spray programme in advance to the bee keeper.

If there is a choice for insecticides, the use should be restricted to the chemicals in the less hazardous groups.

The spray operation in the evening is always preferable as it not only gives better deposit and distribution (because of invert current) but also bee activity subsides.

Apply granules or sprays in preference to dusts. Pesticide formulation containing attractants like Sevimol, used for fruit fly control, should be discouraged as for as possible during the crop in bloom.

Examine fields and field margins before spraying to determine if bees are foraging on flowering weeds. Where feasible eliminate weeds by mowing or tillage.

Give careful consideration to position of bee colonies relative to wind speed and direction. Changing spray nozzles or reducing pressure can increase droplet size and reduce spray drift.

Table 1 Select list of insecticides according to bee hazard categories

Insecticide	**Formulation**
High hazard class category	
Carbaryl	D, WP
Cypermethrin	EC
Deltamethrin	EC
Diazinon	D, EC
Dichlorvos	EC
Dimethoate	EC
Fenitrothion	EC
Fenthion	EC
Fenvalerate	D, EC
Malathion	D, ULV, EC
Monocrotophos	EC
Methyl parathion	D, EC
Methomyl	D, WP
Low hazard category	
Endosulphan	EC

Fenthion	G
Phorate	G
Aldicarb	G
Carbofuran	G
Phosalone	EC
Fluvalinate	EC
Menazon	EC

Since pesticides are indispensable for crop protection, as an alternative scientists are continuously looking for such chemicals which are selective and repellent to bees, in addition to the development of a bee strain resistant to toxic effects of pesticides.

Beekeepers on their own through their organizationz may approach the enforcement agency for amendments in The Insecticides Act, 1968 for getting protection to these beneficial insects which is possible by restricting use of pesticides in apiculture zones.