

Chapter 7

Protecting Honeybees from Pesticide Poisoning

What is a pesticide?

Pests harm crops by feeding on or drawing nutrition from various parts of a plant - including the roots, stem, leaves and fruits, etc and thus decrease yield and crop quality. Pests include fungi, various insects and their caterpillars, rodents, and some plants (weeds). In order to have higher yields and a better quality crop, farmers must control pests. There are various methods of control: non-chemical, chemical, and integrated (combining both chemical and non-chemical). Chemical methods kill pests using poisonous chemicals called pesticides. There are different types of pesticides to control different organisms. For example, insecticides kill insects; acaricides kill mites; herbicides kill weeds; and fungicides kill fungi.

What problems are associated with indiscriminate pesticide use?

Controlling pests by the indiscriminate use of pesticides creates a number of environmental problems. These include elimination of beneficial insects—insect pollinators (such as honeybees and other wild bees) and natural enemies of the pests—resurgence of secondary pests owing to the elimination of their natural enemies, and pollution of the environment. Moreover, the use of pesticides on fruits and vegetables can be dangerous for human beings: fruits and vegetables should not be marketed soon after spraying. Pesticides should be used with great care.

How do pesticides kill bees?

A pesticide kills a bee when it is absorbed by the bee in one of three ways: orally, respiratorily, or dermally.

Oral Intake

This happens when nectar and pollen are contaminated. Contamination of nectar occurs in plants treated with systemic pesticides. For example, if dimethoate is applied at the rate of 11 kg/ha it can kill bees by nectar contamination. Contamination of pollen with micro-encapsulated insecticides is a major cause of bee poisoning. Foraging bees collect insecticide along with pollen and store it in the brood frames. Nurse bees feed the contaminated pollen to the developing brood. This results in the total loss of the colony: foraging bees are killed while collecting and transporting contaminated pollen, nurse bees are killed while storing and feeding pollen, and the brood are killed by eating poisoned pollen.

Respiratory Intake

Some pesticides, for example, DDVP and chlordane, remain present in the air after application in sufficient concentrations to be absorbed by bees through their respiratory system (trachea). The bees then die. Also, pesticides with fumigant properties release toxic volatile compounds that are absorbed by beeswax. Bees exposed to contaminated combs die within two to six minutes.

Dermal Intake

The major way by which pesticides are absorbed is through the bee's outer surface ('skin') by direct contact (dermal intake). The most likely sources of contamination are interception of pesticide droplets in the air during spraying operations and contact with sprayed surfaces. The toxicity of airborne droplets varies according to the method of application and the amount of pesticide available to the bees.

What are the effects of pesticide poisoning on honeybees?

A pesticide usually kills only the type of pest for which it is developed. For example, insecticides are developed to kill insects and do not usually kill plants or other organisms. Bees are insects and are most likely to be killed by insecticides. They are either paralysed or killed or made susceptible to disease. Some insecticides are more harmful to bees than others. However, all pesticides should be used very carefully. Consequences of pesticide poisoning are described below.

- Bees visit flowers to collect nectar and pollen, therefore, pesticide application during flowering kills many bees. Insecticides and acaricides kill bees directly, whereas herbicides kill them by reducing their food sources when plants are killed. Pesticide poisoning of bees results in partial or total loss of colonies.
- Bees exposed to sub-lethal doses of some pesticides, for example, parathion, can lose their sense of time - either because of changes in their biological clock or changes in the manner they communicate time to other bees.
- Sub-lethal doses of some pesticides also result in disruption of a bee's communication system.
- Pesticide poisoning can make colonies more susceptible to disease. Reports show that outbreaks of European Foulbrood and Sacbrood Virus infections were observed after applications of carbaryl insecticide. The first record of Chalkbrood disease in *Apis mellifera* came from colonies exposed to fenetrothion spray.
- Pesticide poisoning affects colony strength because there is a break in the brood-rearing cycle. Such colonies cease foraging, and as a result there is a sharp decline in food storage. Bees in these colonies also attack incoming foragers at the hive entrance.

What are the symptoms of bee poisoning?

Honeybees react differently to different pesticides. Most fungicides and herbicides are less toxic to bees. Common symptoms of pesticide poisoning include the following.

- One of the obvious signs of pesticide poisoning is the presence of a large number of dead or dying bees at the hive entrance (Figure 7.1). These bees are foragers who have been exposed to pesticides sprayed on to flowering plants. FAO has produced mortality figures that can be used as guidelines to assess the extent of bee poisoning by pesticides (Table 3).
- Another sign is the presence of a moist and sticky mass of dead bees at the hive entrance. This results from

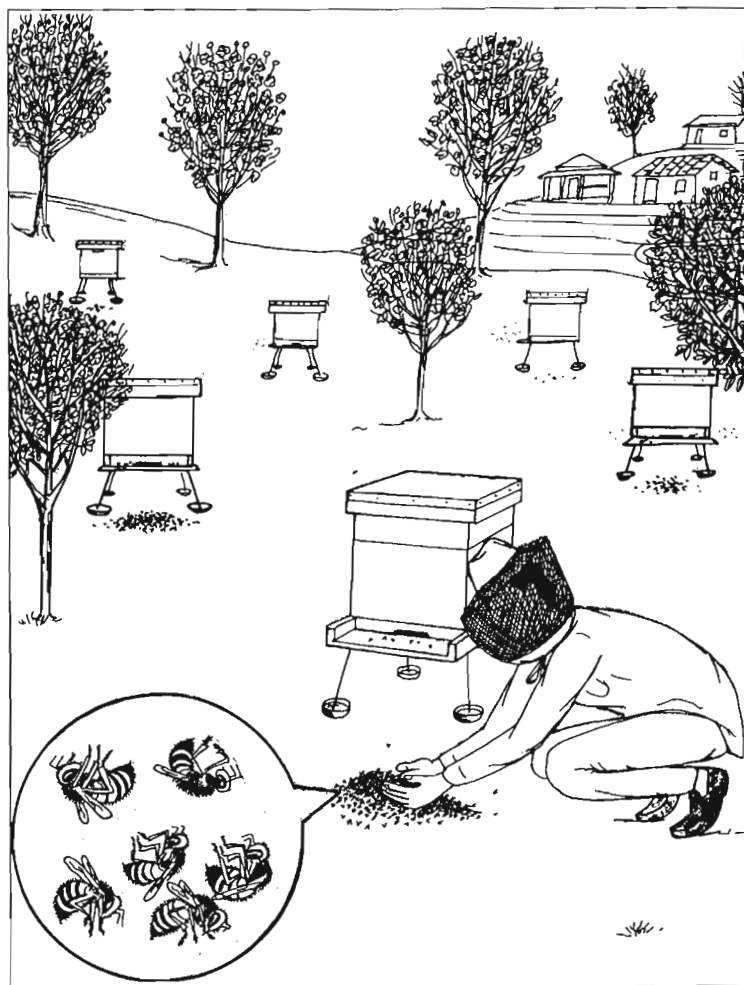


Figure 7.1: Presence of a large number of dead or dying bees in front of the hive entrance is the main symptom of pesticide poisoning.

Table 3: Extent of bee poisoning by pesticides

Number of dead bees per day at hive entrance	Level of poisoning
100	Normal death rate
200-400	Low
500-1000	Medium
Over 1000	High
Source: FAO (1986) 63/3	

poisoning by some fast-acting pesticides, e.g., organophosphorus pesticides. Dying bees extend their tongues through which nectar is regurgitated resulting in sticky and moist dead bees.

- Fast-acting insecticides kill foraging bees in the field itself. Only some of them manage to return to the hive. Sometimes, the whole colony may die instantly. Stronger colonies suffer greater losses from pesticide poisoning than weaker ones because they have larger numbers of foraging bees.
- Foraging bees often carry residual pesticides in their pollen loads while returning to the hive. As a result, the behaviour of bees in the hive changes abruptly. Honeybees in such colonies become more aggressive or agitated. When a hive containing pesticide-affected bees is opened, the bees fly out of the hive sometimes straight at the face of the beekeeper handling them.
- Other symptoms include stupefaction, paralysis, and abnormal, jerky, or spinning movements. Carbaryl poisoning causes bees to crawl around the hive entrance. They lose their ability to fly and ultimately die two or three days after poisoning.
- The hive entrance of pesticide-affected colonies is completely blocked because nurse bees lose their ability to clean dead bees from the hive.

How can bee deaths from pesticide poisoning be prevented?

In the Hindu Kush-Himalayan region, fruit and vegetable growers use hive bees for pollination of their crops. These

growers also use pesticides indiscriminately. For example, apple growers in the north-west Indian Himalayas and in the Chinese Himalayas treat their crops with pesticides seven to eight times a season. Natural insect pollinators and honeybees are frequently killed.

Methods are now available that ensure the selective use of pesticides at the right time and in the appropriate formulation and concentrations. As a result of this, bee poisoning by pesticides can be reduced to a minimum. Both crop growers and beekeepers should take measures to prevent bee losses resulting from pesticide poisoning.

Prevention of bee poisoning by crop growers

Pollination by honeybees is of great importance to farmers. The death of bees caused by pesticides means reduced yields and quality of crops. The safe use of pesticides and prevention of bee death by pesticide poisoning are explained below.

- If a crop is pollinated by bees and other insects then try to use non-chemical methods of pest control, i.e., either physical, cultural, biological, or integrated methods. Pesticides should be used only if it is really necessary: when pests cannot be controlled by non-chemical methods. Non-chemical methods of pest control are described in Annex I.
- As far as possible, do not apply pesticides during the flowering period of crops. Apply them either a week before or a week after flowering (Figure 7.2).
- If the use of pesticides during flowering is unavoidable, then warn local beekeepers 2-3 days before pesticide application (Figure 7.3).
- Use a pesticide that is least toxic to bees. Pesticides can be classified into three groups: highly toxic, moderately toxic, and least toxic (see Annex II).
- Select a formulation that is less toxic to bees. It is recognised that liquid or spray formulations are safer than wettable powder or dust formulations. Insecticide formulations are classified in order of toxicity: dust >

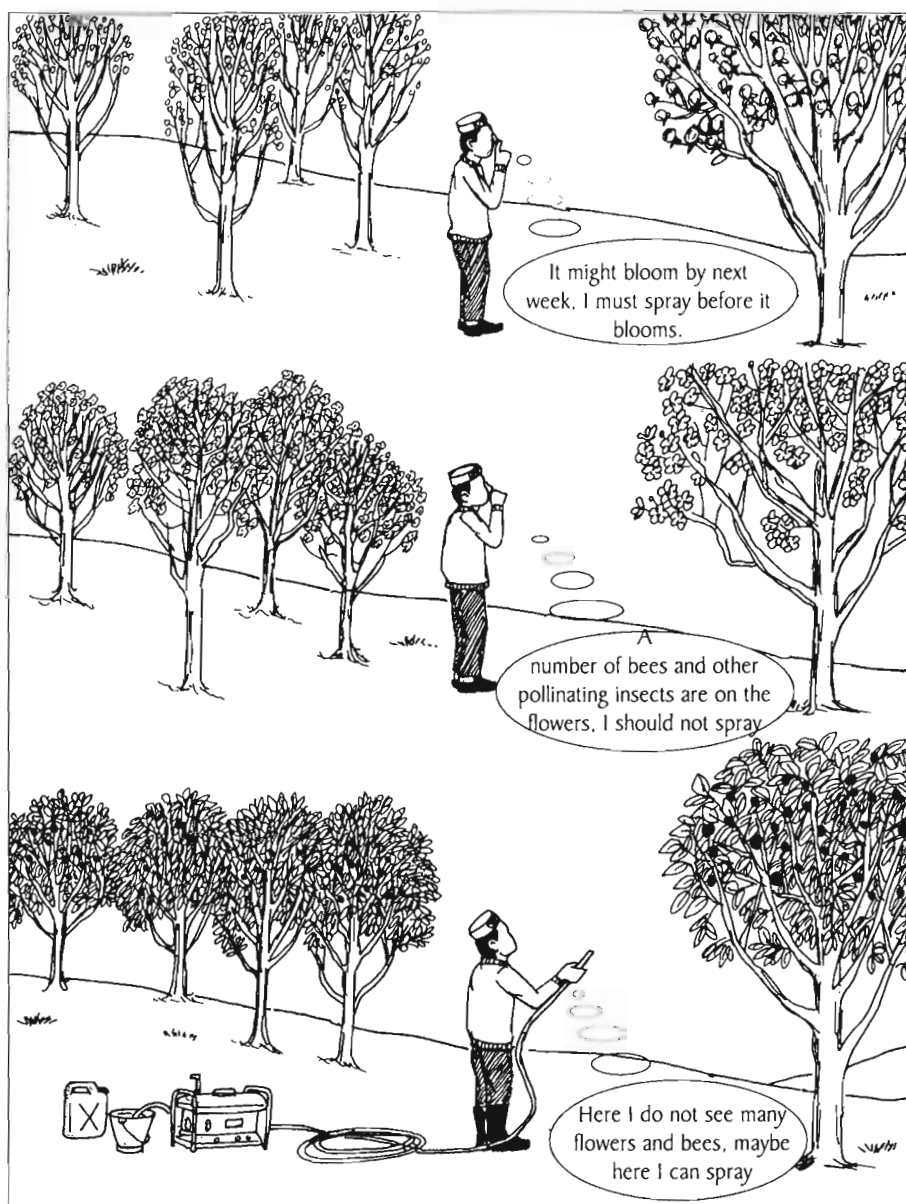


Figure 7.2: To avoid killing the bees (and other insect pollinators) foraging on a crop, pesticides should be sprayed a few days before or after the flowering of the crop.

wettable powder > liquid suspensions > emulsifiable concentrate or soluble powder or liquid solution.

- Select pesticides that have a short residual effect (Annex II).

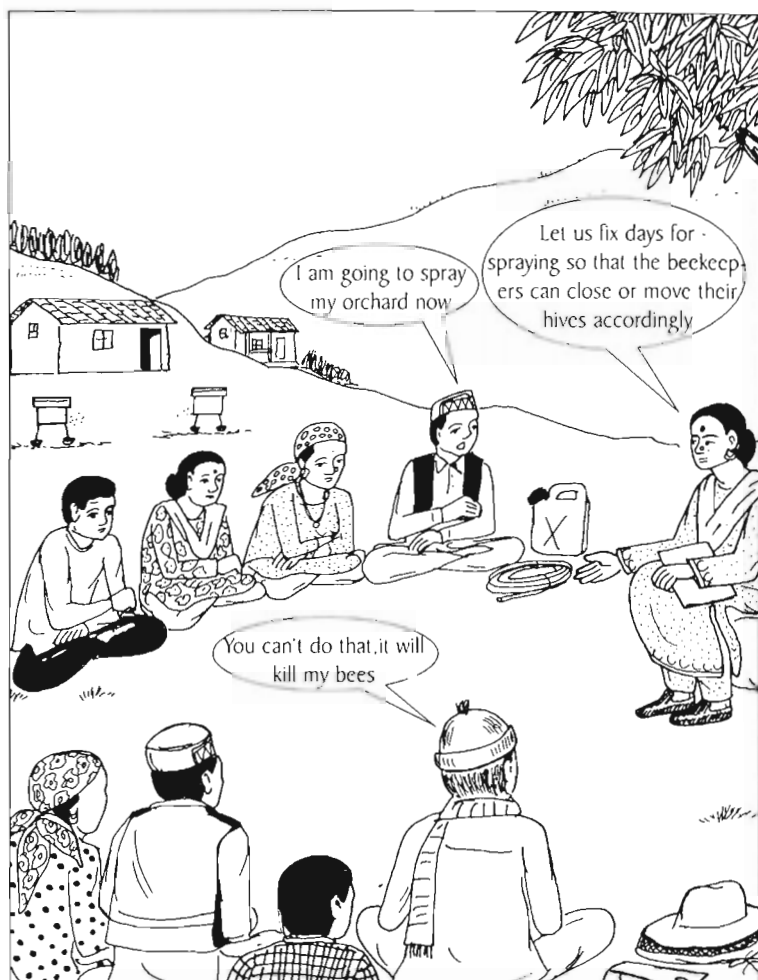


Figure 7.3: Villagers need to take a collective decision on spray schedules so that beekeepers can protect their honeybees during that period.

- Avoid using broad-spectrum pesticides because they are much more hazardous than selective pesticides, which are safer for bees and other insect pollinators.
- Before applying pesticides, make sure that there are no bees or other pollinating/beneficial insects on the crop. Do not apply pesticides during the daytime when most bees and other natural insect pollinators are foraging. Apply them during late evening or at night when bees are in their hives (Figure 7.4).

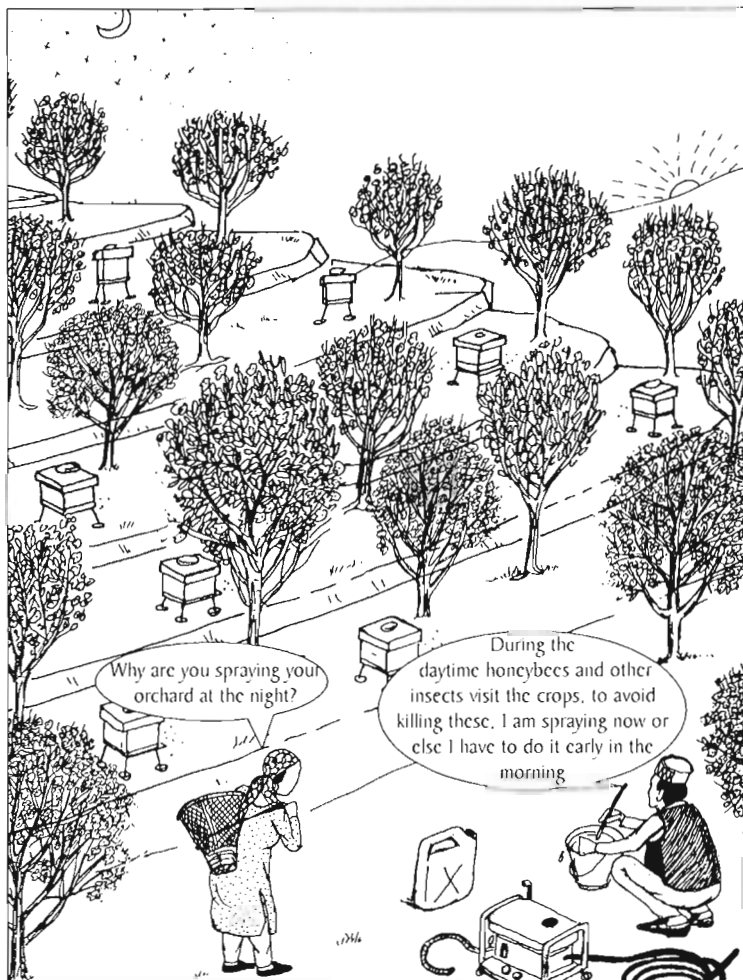


Figure 7.4: Spraying pesticides either early in the morning or during the late evening avoids killing bees and other insect pollinators visiting the crop.

- Apply pesticides in still weather, not when it is windy. If applied when it is windy, pesticides can drift on to other flowering plants and directly on to bees and beehives (Figure 7.5).

Protection of bees by beekeepers

- When pesticides are applied to a flowering crop (even when all protective measures to save bees are taken), there is still a risk that bees visiting flowers will be killed.

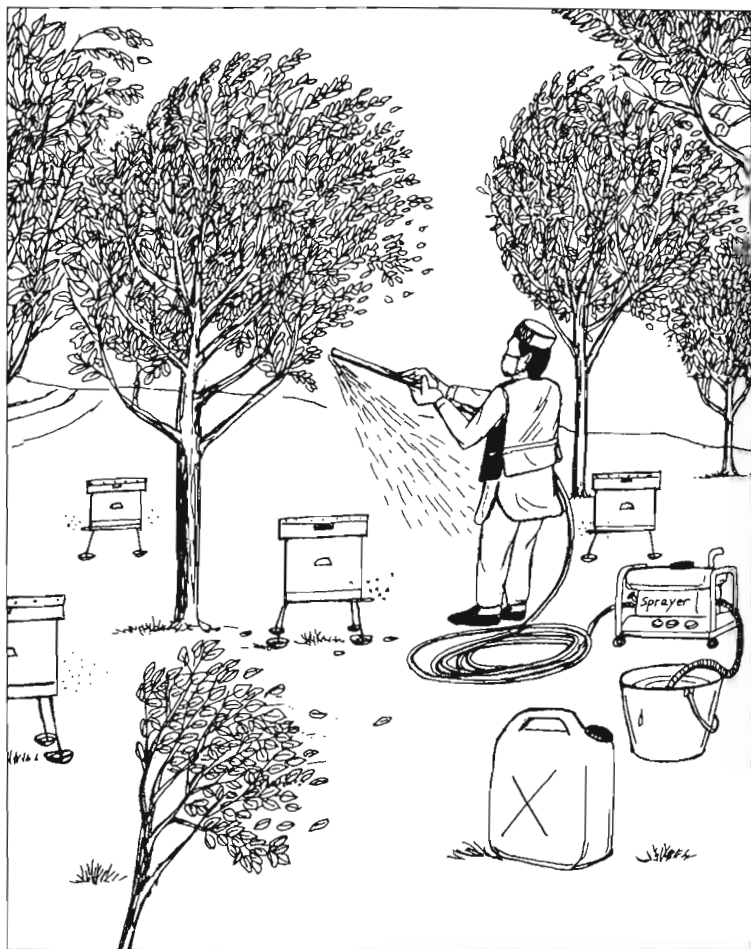


Figure 7.5: Pesticides should be applied in still weather; if applied in windy weather the pesticides can drift on to other flowering crops or directly to the bees and beehives and kill them.

Therefore, for a beekeeper, it is important to do the following when pesticides are to be applied. Move hives temporarily to another site at least 2 km away for *Apis cerana* and 5 km away for *Apis mellifera* (Figure 7.6). Return them to the first site only after the pesticide is no longer toxic to bees.

- Close the hives before moving and ensure that they are properly ventilated. If you cannot move the hives, close them in the field. To move bees to another area, close the hives in the evening when all forager bees are inside

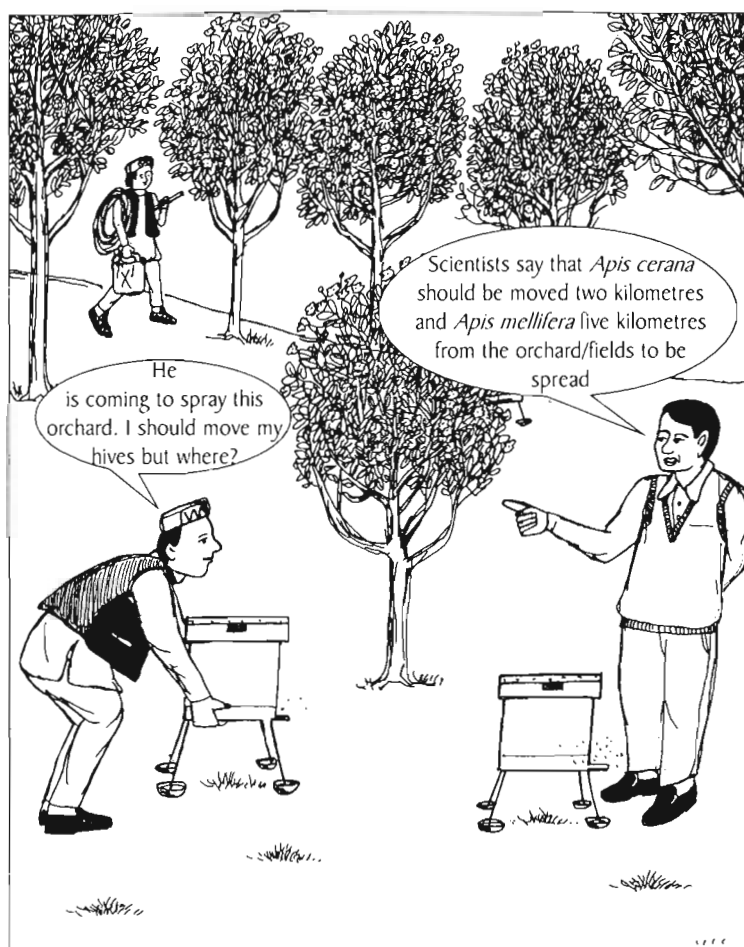


Figure 7.6: If it is absolutely necessary to spray pesticides during flowering, beehives should be closed or moved away from the orchard / field to be sprayed.

and secure them properly with ropes or plastic belts (see Chapter 4). If possible, transport the hives at night.

- If hives cannot be transported to another place then close hive entrances with material that allows proper ventilation and does not allow the bees to fly out, e.g., 3-4 mm wire mesh or loosely woven material. Hives should be kept closed until the pesticide that has been applied it is no longer toxic. To calculate how long a pesticide will remain toxic, learn its name from the person applying it and look it up in one of the three toxicity groups given in Annex II.

How can human beings and livestock be protected from pesticide poisoning?

Pesticides are not only toxic to bees and other insects but also to humans, livestock and other living beings. Therefore, while applying pesticides, the following things should be kept in mind to avoid poisoning.

- Carefully read the instructions given on the label of the pesticide container and follow them.
- Use protective clothing such as a hat, long-sleeved shirt, long trousers, face mask, goggles, and rubber or neoprene gloves and shoes while spraying pesticides
- Do not eat, drink, or smoke while handling and applying pesticides.
- After applying pesticides, wash hands, face, and body thoroughly with soap.
- Do not keep pesticides within the reach of children
- Do not allow children to touch/apply pesticides.
- Never use defective or leaking equipment.
- Do not apply dust or powdered formulations on windy days because they can be blown into your face and body.
- Avoid contact with recently sprayed crops.
- If pesticide contamination occurs, change your clothes and thoroughly wash the contaminated area of the skin with soap as soon as possible.
- Do not wash pesticide containers in ponds, streams, or other water sources.
- Dispose of pesticides and their containers safely, e.g., in a pit, so that they will not endanger people and other living beings.
- Do not use empty pesticide containers for any other purposes, such as food or water carriers or as cooking pots, because they cannot be cleaned thoroughly enough to make them safe.
- Always keep pesticides in their original labelled containers.
- Before harvesting crops, observe the recommended safety interval.
- In the case of poisoning, obtain medical help quickly and show the pesticide label to the person giving medical attention.