

# Safe Handling and Precautionary Measures during Pesticide Usage

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**Abstract:** In agricultural crop production, pesticides are generally used to prevent or control pests, diseases, weeds and other plant pathogens owing to decrease yield losses and maintaining high product quality. However, the use of pesticides is very toxic and hazardous to human beings, animals and cause environmental pollution. The present short communication highlights the safe storage, transportation and disposal of pesticides, and their containers are integral to the safe use of pesticides. Farmers' behaviour should be keen towards pesticides use, i.e. self-protecting equipment must be used while dealing with pesticides. Pesticide must be stored and transported in proper packaging that prohibits their interaction with the outer environment, and use of any kind of flame near pesticides should be avoided. Use of pesticides without training must be discouraged, moreover, after application of pesticides proper washing of hands and clothes is advised. Farmers must wear mask during pesticide application and wash empty pesticide containers before their disposal.

**Keywords:** Pesticide, practices, precautions, strategies.

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## 1. Introduction

Population explosion requires agriculture intensification in order to meet the local and global food requirement (Garibaldi et al., 2019; Ramankutty et al., 2018; Tilman et al., 2011; Tramberend et al., 2019). Several plant protecting agents (pesticides) are used for this purpose. Pesticides use in modern farming is requisite to ensure the global food supply

(Jallow et al., 2017). They provide significant benefits to the farmers; hence their use has been increased all around the world. Pesticides include insecticides, fungicides and herbicides. The main classes of insecticides like organochlorines (e.g. Dichlorodiphenyltrichloroethane (DDT), lindane, dieldrin), which are very persistent in the environment (Kucher et al., 2018; Xu et al., 2019).

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**Table 1. List of banned pesticides in Punjab - Pakistan**

| Active ingredients                              |   |   |
|---|---|---|
| 1. Benzene Hexachloride (BHC)                   | 9. Binapacryl                                       | 17. Bromophos ethyl                             |
| 2. Cartafol                                     | 10. Chlordimeform                                   | 18. Chlorobenzilate                             |
| 3. Chlorthiophos                                | 11. Cyhexatin                                       | 19. Dalapon                                     |
| 4. DichloroDiphenyl Trichloroethane (DDT)       | 12. Diobromochloropropane +<br>Dibromochloropropene | 20. Dicrotophos                                 |
| 5. Dieldrin                                     | 13. Disulfoton                                      | 21. Endrin                                      |
| 6. Ethylene dichloride + Cabontenachloride      | 14. Leptophos                                       | 22. Mercury Compound                            |
| 7. Meviphos                                     | 15. Toxaphene                                       | 23. Zineb                                       |
| 8. Heptachlor                                   | 16. Methyl Parathion                                |   |
| Formulations                                    |   |   |
| 1. Dichlorvos (above 500 g L <sup>-1</sup> )    |   | 3. Monocrotophos (above 400 g L <sup>-1</sup> ) |
| 2. Methamidophos (above 600 g L <sup>-1</sup> ) |   | 4. Phosphoamidon (above 500 g L <sup>-1</sup> ) |
| Without registration                            |   |   |
| 1. Aldrin (POP/PIC)                             |   | 5. Mirex (POP)                                  |
| 2. Chlordane (POP/PIC)                          |   | 6. Dinoseb (PIC)                                |
| 3. Ethylene di bromide (PIC)                    |   | 7. Parathion (PIC)                              |
| 4. Fluroacetate (PIC)                           |   |   |

Source: Jabbar and Mallick, (1994); Ali, (2018).

Moreover, acetylcholinesterase inhibitors (organophosphates, e.g. parathion and carbamates) (Kumar et al., 2018) pyrethroids and other botanicals and fumigants (e.g. ethylene dibromide) are used as pesticides (Parks et al., 2019; Schaefer and Myers, 2017). Fungicides include organo-metals phenols and carbamates (Dias, 2012). Herbicides, a broad class of pesticides applied to eradicate nuisance plant species. These include pyridinium (e.g. paraquat), phenoxy compounds, organophosphates and substituted anilines (Au, 2003; Sherwani et al., 2015; Zimdahl, 2018). Various other compounds are used to control rodents, mites, ticks, molluscs, bacteria and algae (Shah and Saleem, 2002).

Organochlorines and organophosphates are among the well-known pesticide groups. The organochlorines act as neurotoxins to the target organisms (Jett, 2011; Mamta et al., 2019; Marrs and Karalliedde, 2012; Ndiath, 2019). Although the organochlorine pesticides have very limited toxicity for humans, as compared to other insecticides classes, however, they have significant potential for chronic toxicity and persistence in the environment. Therefore, numerous organochlorine pesticides are now banned or restricted use (Wesselling et al., 2005). They are probably the compounds of most concern to chronic environment exposure and recently have also been implicated as possible environmental endocrine disrupters. Organophosphates, extensively used

chemicals in agriculture, rarely accumulate in tissues and are measured as relatively safe due to faster rate of degradation. Chronic or acute exposure of organophosphates can result in varying degree of toxicity in animals, humans and plant. Organophosphates can block the activity of acetylcholinesterase, leading to various physiological abnormalities, including the central nervous system. Moreover, organophosphate induced enzyme inhibition can disrupt the standard growth mechanism (Patel et al., 2019; Sidhu et al., 2019; Stopford, 1985). However, they are often extremely toxic, non-selective and more instances of acute poisoning have occurred with organophosphate than with any other insecticides class (Patel et al., 2019);

The extensive and improper use of pesticides may pose a severe threat to public health and the environment (Jallow et al., 2017). Many laws are present which ban the production and use of some pesticides. One of the aims of the United Nations (UN) Stockholm Convention on Persistent Organic Pollutants (Shad, 2018) was to restrict the use of pesticides, including DDT. There are numerous persistent pesticides, banned in developed countries but still used in developing nations. Additionally, less persistent but more toxic pesticides are also in practices in developing countries, without the presence of adequate regulations (Wesselling et al., 2005).

## 2. Pesticide use and its Rationale

Despite the apparent beneficial effect of pesticide use, they are hazardous to human health (Aktar et al., 2009) mostly through high-level occupational exposure and accidental poisoning incidents, although low-level exposure remained a cause of public concerns (Levine, 1991).

There are numerous ways in which humans can be exposed to pesticides through the environmental route (Khan, 2011). Farmers are vulnerable to hazards due to their direct contact with pesticides during storage, use, transportation and disposal. Chances of these risks are higher because farmers do not use personal protective equipment; also, they have less knowledge regarding toxicity and safe application strategies of pesticides (Sharifzadeh et al., 2019). Moreover, pesticides used domestically in wood preservatives or as household insecticides can be a vital source of exposure for the general public. Potential effects of pesticide residues in food and water, probably cause the most significant public anxiety, although reports of clinical poisoning by residues seem to be extremely rare. Analysis of reported consumer poisoning by the pesticides showed that most arise from spillage of pesticides onto food during storage or transport, eating a food article not intended for human consumption (e.g., treated grain or seed potatoes) and improper application of pesticides (Marrs, 1995). Much of the concern about pesticides use is based on their long-term accumulation in the environment and low-level, but chronic human exposure to these compounds which accord either directly or indirectly through the food chain. This has almost certainly been one of the main reasons for the increased popularity of organic food.

Information on the effects of occupational exposure through their use in sheep dips (Ray, 1998) has given rise to concern in some quarters about possible low-level environmental exposure to this group of pesticides. However, as with many other environmental contaminants, the lack of exposure data, and the uncertainties regarding low dose extrapolation preclude any firm conclusion being made regarding risk to the general public of environments exposure to pesticides (Khan et al., 2013).

Pesticides are designed to kill insects and other pests, competing with the humans or damaging crop plants. In addition to pest control, various pesticides also have severe impacts on the environment (Carvalho, 2017; Mahmood et al., 2016). Though,

most of the adverse effects are due to accidental or deliberate misuse of pesticides. Judicious use of pesticides may cause limited environmental impacts (Farrar et al., 2018).

## 3. Mitigating strategies to reduce the pesticide risks

### 3.1. Consumers' behaviour

Great care should be taken during storage, transportation and pesticide use. Minimum and judicious use of insecticides, incorporating integrated pest management can suppress pests (Damalas, 2016; Farrar et al., 2018). Health belief model (HBD) can be the right choice regarding farmer's behaviour (Sharifzadeh et al., 2019). Such problems can be solved by following means of external and internal stimuli, and launching of new policies and monitoring strategies for safe use of pesticides (Bhandari et al., 2018; Rezaei et al., 2018). External stimuli include the provision of required knowledge, guidance and proper training can help farmers to understand the healthy use of pesticides. Internal stimuli, including itching and headache, can modify the farmer's choice of pesticide use. Additionally, safety culture, i.e. provision of proper clothing or personal protection equipment, can enhance the confidence and satisfaction of farmers.

### 3.2 Pesticide Storage

Pesticides are critical for crop production enhancement, but they can be dangerous if mishandled. Specific precautionary measures or procedures are suggested to avoid safety issues during their storage (Saleem and Haq, 2002; Tariq et al., 2007). Pesticide storage place must be isolated from the populated and sensitive areas like water bodies and residential areas. Pesticides store must not be accessible by children or unauthorized persons. Pesticide storehouse must not be mistaken for food or beverage storehouse. Stored pesticides must be kept dry, in the shade and distant from chances of fire. Do not carry them in a vehicle that is also used to transport food.

1. Stores should be constructed away from sensitive areas like residential and water supply areas.
2. Stores should be fire resistant and capable to endure extremes temperatures and various chemical changes.
3. Design of the stores should be sound that it can contain spillage and leakage. Adequate light should be present in stores.

**Table 2. List of Various Kinds of Pesticide(s) with their Symptoms or Impacts of Poisoning, First Aid and Antidotes**

| Sr. No.                | Pesticide(s) Category                      | Symptoms/Impacts  | First Aid Recommendations  | Antidotes   |
|------------------------|--|---|--|---|
| <b>A. Insecticides</b> |  |   |  |   |
| i.                     | Chlorinated hydrocarbon insecticides       | Affect the central nervous system leading to anxiety, convulsions, excitement, tiredness and fatigue.   | Wash body, using soap, to remove the contaminant from the body. In case of ingestion, evacuate the stomach.  | Usual antidotes are paraldehyde or a water-soluble barbiturate given intramuscularly; thiopentone or intravenous administer diazepam.   |
| ii.                    | Organophosphate and carbamate insecticides | Inhibition of cholinesterase enzyme activity (in body tissue, blood and brain); weakness, muscular trembling, abdominal discomfort, chest tightness, vomiting, nausea, irritability or restlessness coupled with the constricted pupil. | Decontaminate the patient. Rest and respiration maintenance can improve the condition. Patient may need immediate hospitalization.   | In the case of apparent symptoms, the first dose of atropine sulfate (0.6 mg, two tablets) may relieve the affected person. A further dose of one tablet at an interval of 20-30 minutes can give strength. |
| <b>B. Fumigants</b>    |  |   |  |   |
| i.                     | Cyanides                                   | Metallic taste in the mouth, nose and throat irritation, dizziness, headache, constriction of chest weakness of limbs and a sensation of lack of air. Delayed treatment may cause death.  | Urgently shift the patient from the contaminated area to a clean environment. Patient needs rest and remove the contaminants by changing clothes and thorough skin wash. Artificial respiration can improve breathing. | Standard antidotes include cobalt EDTA or sodium thiosulfate and sodium nitrate. However, treatment should be given under the supervision of a medical practitioner.  |
| ii.                    | Methyl Bromide                             | Skin burning, pulmonary edema; disturbed central nervous system; abdominal discomfort; throat and eye irritation and headache.  | Removal and washing of contaminated clothing, skin and shoes. Treatment should be given under the supervision of a medical practitioner.   | For limited exposure, patient may recover without special treatment. However, in case of prolonged exposure antidote of dimercaprol is recommended. Symptomatic treatment is helpful (Fang et al., 2020).   |
| iii.                   | Ethylene dichloride                        | Causes liver or renal damage, and mucous membrane irritation.   | First aid help is given to the patient until full medical treatment is available.  | Specific antidote is not available. However, symptomatic treatment can fasten patient recovery.   |
| iv.                    | Ethylene dibromide                         | Blistering occurs on coma with skin causes irritation of the mucous membrane.   | Removal and washing of contaminated clothing and skin.   | Specific antidote is not available. However, symptomatic treatment can fasten patient recovery.   |
| v.                     | Phosphine                                  | Effect gastrointestinal tract and central nervous systems with nausea, abdominal pain, vomiting   | Emergency care or treatment is given to the patient before any   | Specific antidote is not available. However, symptomatic treatment can  |

|           |                                |  |  |  |
|-----------|--------------------------------|--|--|--|
|           |                                | and diarrhoea.   | regular medical assistance.  | fasten patient recovery.   |
| <b>C.</b> | <b>Herbicides</b>              |  |  |  |
| i         | Phenoxy acetates               | Cramps, hypersalivation, diarrhoea and vomiting, convulsions and mental confusion.   | Contaminated clothing should be removed, and skin washed thoroughly with soap and water.   | Specific antidote is not available. However, symptomatic treatment can fasten patient recovery.  |
| <b>D.</b> | <b>Fungicides</b>              |  |  |  |
| i.        | Organo-mercurial fungicides    | Toxicity of alkyl compounds is higher than aryl compounds (with phenol radical). In acute cases (both alkyl and aryl compounds) skin burning (with blisters and redness); mucous membrane irritation; renal damage; disturbed digestive system is generally reported symptoms. Chronic toxicity of alkyl compounds leads to central nervous system impairment. | Contaminated clothing should be removed, and skin washed thoroughly with soap and water.   | Acute toxicity: washing of poisoning stomach. Intramuscular dimercaprol, or oral dose of N-acetyl penicillamine (250 mg). Drug treatment should be given under the supervision of a medical practitioner (Carocci et al., 2014; Oruc, 2010). |
| ii.       | Inorganic mercurial fungicides | Mercuric chloride: causes coagulation, irritation and superficial cause of the tissue leading to mucous embrace discolouration. Internal abdominal pains with vomiting; and circulatory failure.   | Washing of poisoning stomach with formaldehyde sulphoxylate (5% solution). Contaminated clothing should be removed, and skin and hair washed thoroughly with soap and water. | Treatment with dimercaprol BAL or preferably N acetyl penicillamine proves useful. Drug treatment should be given under the supervision of a medical practitioner (Carocci et al., 2014).  |

Sources: Ali (2018); Shad (2018).

4. Store should be adequately ventilated, with suitable entrance and exits.
5. Use of any kind of flame and smoking should be prohibited in the area.
6. Pesticides should be stored accurately and securely that children, unauthorized people and animals should not approach them.
7. Proper warning signs should be present in stores.
8. Make sure that stores have appropriate first aid facilities, clothing place, washing facilities, fire extinguishers and place for empty containers.

### 3.2 During transportation

Pesticides should be transported with great care because any leakage may lead to serious environmental and health hazards in addition to the pesticide wastage. Such problems can be avoided by the adoption of following precautionary measures, during the transportation of pesticides

1. Packing material and containers should be sound enough to avoid any kind of rupture or leakage.
2. Pesticides should be packed in a way that can tolerate variations in temperature and humidity.
3. During transport, different kinds of pesticides should not be mixed or other agricultural inputs like weedicides should not be transported with insecticides or fertilizers.
4. Fire extinguishers should be present in vehicles.
5. Pesticides should be appropriately sealed that they cannot reach to the passengers, foodstuff and livestock.
6. Use protective gloves and proper clothing during the loading and unloading of pesticides. Moreover, container drop off form height should be prevented that may harm the packing of pesticides.
7. Traces of pesticides should not be present on the outer surface of the container.
8. During transportation, ensure that lids of the container are tightly closed.



9. Avoid fire, smoking, eating and drinking during pesticide handling.

### 3.3 During pesticides use

Specific principles should be followed during pesticide applications to make sure the safe use. These principles have been listed below, which may help to get efficient results without harming the environment, humans and livestock.

1. Staff employed for pesticide application must have adequate training.
2. Do not allow children to make contact with pesticides and keep them away from treated areas.
3. Keep irrelevant people away from the area where pesticides are being applied.
4. Follow the precautionary measures or seek advice for pesticide doses, application techniques, self-equipment, application timing, re-entry timing in the field and gap between successive applications etc.
5. Observe the weather conditions that may affect the pesticide applications, especially wind velocity, which may cause drift. This may blow away the pesticides making it useless for the field as well as harmful for the areas (crops, water, animals).
6. Rain is also an important factor that can wash out pesticides from the field, making application ineffective.
7. Wash clothes and hands with soap after spray applications and do not drink, eat or smoke during or right after the application of pesticides.
8. Do not siphon with mouth even from an empty container. Use clean water to blow the closed nozzles.
9. Never leave pesticide and application equipment unattended, instead place them on their specific locations carefully after washing.
10. In case of poisoning, take antidote and consult the physician immediately.
11. Use self-protecting equipment.
12. Do not use restricted use compounds.
13. Do not use pesticides without training and children (under 18) are prohibited from pesticides' use.

### 3.4 Disposal of pesticides wastes

After pesticide application, make sure that the treated area is clean and does not contain any pesticide waste, container or envelope and equipment is empty and clean. Never reuse empty envelopes, pesticide packing and containers for drinking and eating purposes for animals or people. All empty containers should be disposed of with proper care. The recommendations for this purpose are as follows:

1. Wash and puncture metal cans and drums and bury them.
2. Wash and puncture plastic containers, burn them and bury.
3. Cardboard packaging should be burnt or dumped carefully.
4. Plastic bags should be burnt in the areas away from dwellings, crops and stores etc.
5. Use mask during burning and keep children away from its smoke.

## 4. Conclusion

The overall optimization of pesticide handling and practices should be strictly according to the Government rules and regulations, which consider the public concerns about pesticides and their residues in human food that could contribute to decreasing antagonistic impacts of pesticides on the environment and human health. Education alone may not be enough to address this issue. Safety training and better pest management practices can alleviate pesticide-related issues. Moreover, there is a need to ensure the provision of affordable safety equipments, suitable for use in hot and humid agroclimatic conditions of Pakistan. Furthermore, farmer awareness, adequate information-sharing regarding the human health and environmental risks associated with pesticide handling and usage can be achieved through various training programs in all over Punjab.

**List of Abbreviations:** DDT, Dichloro-diphenyl trichloroethane; UN, United Nations; POPs, Persistent Organic Pollutants, HBD, Health Belief Model.

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