

Lecture -9

HERBICIDES – ADVANTAGES AND LIMITATION OF HERBICIDE USAGE IN INDIA

In the past 50 years much has been learned about the use of herbicides and about their strengths and weaknesses. After 50 years, it is an appropriate time to re-evaluate their role in agriculture. The use of herbicides is increasing day by day. This is because the other alternative control measures do not provide an effective and economic substitute for herbicides in many situations. The efficacy and safety of herbicides are greatly influenced by soil and climate. These vary greatly between countries as does the legislation controlling their use.

Advantages of herbicides

On weed control

- They kill unwanted plants.
- They are easy to use
- Herbicides can be used on closely planted crops where other methods cannot be used.
- Most of the time one application of the herbicide is enough whereas other methods have to be continually used.
- They work fast. They can be removed quickly in critical situations.
- Herbicides are relatively cheap, and most of the time cheaper than manual weeding.

On crop growth

- They can destroy plants bearing diseases.
- They help the crops grow by destroying the weed that causes harmful effects which include competition for water, nutrients and light; interference of weeds with crop growth by the release of toxins; modification of soil and air temperatures and the harbouring of pests.
- They can be safely used as the manual and mechanical removing of weeds can destroy the crop.

Others

- They are relatively safe on lands which may erode.
- Non-selective herbicides can effectively clear fields, where houses and roads can then be built.

Disadvantages of herbicides

Effects of Herbicides on environment

Herbicides vary greatly in chemical composition and in the degree of threat they pose to the environment. Many of the herbicides are highly persistent. It is widely recognised that the main reason accounting for residues of certain herbicides like simazine and other triazines in

ground and surface water was the widespread use of these herbicides at high doses on hard surfaces.

- **Soil:** Some herbicides are non-biodegradable and are harmful for a long period of time. Heavy dose of herbicides affect microbial population of the soil. With herbicides targeting amino acid synthesis in both plants and microbes, there is a possibility that N₂ fixation may be inhibited by the application of certain herbicides.
- **Water:** The improper use of pesticides and herbicides may also cause the storm water infiltration into groundwater. When these pesticides and herbicides contaminants dissolve in storm water they infiltrate the groundwater and then the surface waters, such as ponds, streams, rivers and lakes. These chemicals may also find their way into the soil and deeper groundwater units polluting them.
- **Living organisms:** Most herbicides are specifically plant poisons, and are not very toxic to animals. However, by changing the vegetation of treated sites, herbicide use also changes the habitat of birds, mammals, insects, and other animals through changes in the nature of their habitat. Herbivores may eat the plants treated with herbicides and then carnivores eat the herbivores. The toxic herbicide would be passed up the food chain increasing in concentration each time resulting in cancers and even deaths.

Anxiety about chemical residues in the environment has increased greatly in the last decade. These fears and concern about possible litigation have led many land managers to reappraise their weed control strategies. Change has also been forced on them by the decrease in the number of approved herbicides as a result of the high cost of registration. In addition, approval has been withdrawn from more toxic and persistent herbicides.

Effects of Herbicides on Humans

Among the many effects of pesticides and herbicides, perhaps the most alarming is the danger they pose to human health. People are directly affected by toxicity of some herbicides, during the course of their occupation (i.e., when spraying pesticides), or indirectly affected when exposed through drift or residues on food, and wildlife.

- Pesticides and herbicides can cause a number of health problems such as heart congestion, lung and kidney damage, low blood pressure, muscle damage, weight loss and adrenal glands damage.
- Arbitrary and indiscriminate usage of herbicides and pesticides can result in endometriosis, a common cause of infertility in women.

- Herbicides and pesticides have been suspected by the National Cancer Research Institute as a probable cause of certain cancers (i.e., cancers of the brain, prostate, stomach and lip, as well as leukemia, skin melanomas, etc.) especially among farmers.
- The National Academy of Sciences reported that infants and children, because of their developing physiology, are susceptible to the negative effects of herbicides and pesticides in comparison to adults.

Effect of herbicides on crop plant

An important problem with broadcast applications is that they are non-selective. They are toxic to a wide variety of plant species, and not just the weeds. If herbicides are not used properly, damage may be caused to crop plants, especially if too large dose is used, or if spraying occurs during a time when the crop species is sensitive to the herbicide. Unintended but economically important damage to crop plants is sometimes a consequence of the inappropriate use of herbicides.

Build-up of resistant biotypes

Apart from their effect on the environment, another major problem with herbicides has been the build-up of herbicide-resistant biotypes where the same herbicide has been used repeatedly for a number of years. This problem was not clearly foreseen at the start of the herbicide revolution but, since the early 1980s, triazine resistance has developed in most countries where these herbicides have been used. The usefulness of a number of other herbicides, including paraquat, dichlofopmethyl and sulfonylurea types has been affected by the development of resistant biotypes.

Methods of dealing with this problem include prevention of weed seed shedding, crop rotation, herbicide rotation, control of weed escapes and tillage practices. Crop rotation is not relevant in an amenity situation where the 'crops' are usually perennial but other control measures may be appropriate in certain situations. If weeds are prevented from setting seed, resistant biotypes cannot develop.

This could be achieved if land managers were made more aware of the threat of resistant biotypes and made greater efforts in intensively managed areas to prevent weeds from shedding seeds by the use of a rotation of herbicides supplemented by physical means such as mulching, hand hoeing and hand weeding.

Modern, intensively managed agricultural and forestry systems have an intrinsic reliance on the use of herbicides and other pesticides. Unfortunately, the use of herbicides and other pesticides carries risks to humans through exposure to these potentially toxic chemicals, and to ecosystems through direct toxicity caused to non-target species, and through changes in

habitat. Nevertheless, until newer and more pest-specific solutions to weed-management problems are developed, there will be a continued reliance on herbicides in agriculture, forestry, and for other purposes, such as lawn care.



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HERBICIDE CLASSIFICATION, FORMULATIONS AND METHODS OF APPLICATION

Herbicide: It is a chemical used to kill some targeted plants.

Principles of chemical weed control

The selectivity exhibited by certain chemicals to cultivated crops in controlling its associated weeds without affecting the crops forms basis for the chemical weed control. Such selectivity may be due to differences in the morphology, differential absorption, differential translocation, differential deactivation etc.

CLASSIFICATION OF HERBICIDES

1) Based on Method of application

- i) **Soil applied herbicides:** Herbicide act through root and other underground parts of weeds. Eg. Fluchloralin
- ii) **Foliage applied herbicides:** Herbicide primarily active on the plant foliage Eg. Glyphosate, Paraquat

2) Based on Mode of action

- i) **Selective herbicide:** A herbicide is considered as selective when in a mixed growth of plant species, it kills some species without injuring the others. Eg. Atrazine
- ii) **Non-selective herbicide:** It destroys majority of treated vegetation Eg. Paraquat

3 Based on mobility

- i) **Contact herbicide:** A contact herbicide kills those plant parts with which it comes in direct contact Eg. Paraquat
- ii) **Translocated herbicide:** Herbicide which tends to move from treated part to untreated areas through xylem / phloem depending on the nature of its molecule. Eg. Glyphosate

4) Based on Time of application

i) Pre - plant application (PPI)

Application of herbicides before the crop is planted or sown. Soil application as well as foliar application is done here. For example, fluchloralin can be applied to soil and incorporated before sowing rainfed groundnut while glyphosate can be applied on the foliage of perennial weeds like *Cyperus rotundus* before planting of any crop.



ii) Pre – emergence