

VI. Chemical Weed Control: -

The use of chemicals that selectively kill weeds in crops is an integral part of many modern weed management systems. The specific *pesticides* for controlling weeds are called *herbicides*. Herbicide comes from the Latin herba, meaning “plant,” and caedere, meaning “to kill.” Therefore, herbicides are chemicals that kill plants. The definition accepted by the Weed Science Society of America is that an herbicide is “a chemical substance or cultured organism used to kill or suppress the growth of plants.” In effect, a herbicide disrupts the physiology of a plant over a long enough period to kill it or severely limit its growth.

Herbicides can be grouped in numerous ways, including chemical similarity, mechanism of action (how they kill the plant), herbicide movement within the plant (mobile versus immobile), selectivity (selective versus nonselective), and application and use patterns. Herbicides can control weeds beyond the reach of the cultivator. Weeds directly within the crop row, in closely seeded (drilled) crops such as small grains, and in no-tillage can be managed with herbicides much more easily than with cultivation. Control of weeds that compete directly with the crop in the row is especially important to minimize crop yield losses.

Effective herbicide programs have increased the available cropping system choices available to farmers as these choices are not as much affected by existing weed problems. Effective herbicide programs aid growing crops in closely spaced rows for higher crop yields and ease of mechanical harvest.

Herbicides change the chemical environment of plants, which can be more easily manipulated than the climatic, edaphic, or biotic environment. Herbicides

- a. reduce or eliminate labor and machine requirements.
- b. modify crop production techniques.
- c. When used appropriately, they are production tools that increase farm efficiency, reduce horsepower, and perhaps reduce energy requirements.

Classification of Herbicides:-

Although there are several methods of herbicide classification, no single one is completely adequate.

1. **Weed control spectrum:-** such as broad or narrow leaf weed control

2. **Labeled crop usage:** - such as controlling of weeds in corn or wheat crops.
3. **Chemical families:** - according to this method the herbicides were grouped as inorganic and organic as first step after that according to the chemical groups.
4. **Selectivity:** - Selective herbicides kill or stunt weeds in a crop without harming the crop beyond the point of economic recovery. Nonselective herbicides kill all plants when applied at the right rate.
5. **Application time:** -Almost all herbicides must be applied at a particular time to maximize control and selectivity. The first is prior to planting, or pre-planting, when the application is immediately before planting or as early as several weeks prior to planting. The second application time is pre-emergence to the crop, the weed, or both. It is after planting, but prior to emergence of the crop or weed. Post-emergence applications are after the crop, weed, or both have emerged. While there is another method of application named herbigation when herbicides were applied with irrigation water either by surface of sprinkler systems.
6. **Mode of action:** - Mode of action means the entire sequence of events from introduction of a herbicide into the environment to the death of the plant. The mechanism of action is the primary biochemical or biophysical event that the herbicide directly affects. For example, the imidazolinone and sulfonylurea herbicides inhibit the synthesis of certain essential amino acids, which is the mechanism of action, whereas the mode of action is the subsequent chain of responses that lead to plant death.

- **Herbicide formulation:-**

Herbicides are originally manufactured in chemically pure forms which are too toxic for their direct use in the fields. Therefore, these technical grade herbicides are formulated by commercial firms into easy to use formulations as emulsified concentrates (EC), wet-able powders (W.P.), and dry granules (G). In the spray-able formulation, suitable carriers and adjuvants are added to improve the herbicide applicability and efficiency. In any herbicide formulation that available in the market, the chemical that is directly responsible for the herbicidal effect is called **active**

ingredient (a.i.).

Soluble salts, Emulsifiable concentrates (EC), Wet-able powders (WP), Dry flowables (DF), Flowables (F), Water soluble powders (SP), Ultra-Low-Volume Concentrates (ULV), Granules, Fumigants.

Adjuvants: -these are chemicals that improve the herbicidal effect without being phytotoxic by themselves, these compounds could be

- **Wetting Agents:** - Also called surfactants or surface active agent, some weed foliage may not get wet by the aqueous herbicide spray such as *Cynodon dactylon* but when the wetting agent is added the spray immediately wets the foliage of the weed. In many commercial herbicide formulations the wetting agents are already provided.
- **Stabilizing agents:** - when an emulsion concentrate is placed in water, it soon tends to oil-out in the surface, unless either a suitable stabilizing agent is added to it or it is constantly agitated. The stabilizing agent disperses the emulsion concentrate into minute droplets throughout the body of the water in the tank and maintains this system in this state all through the spray work in the field.
- **Dispersing agents:** - this agent stabilizes the suspension of a wet-table powder. In its absence the wet-table powder particles tend to settle at the bottom of the tank, unless constantly agitated. Stabilizing and dispersing agents must be added pre-mixed with the herbicide powders by the formulates.
- **Filming agents (Stickers):** - these adjuvants added to the herbicide concentrates to hold the toxicants in intimate contact with the plant surface against their otherwise washing away by rain.
- **Activators:** - cooperate in giving fillip to the phytotoxicity of the herbicide by improving their absorption and translocation in the target plants.
- **Drift control agents:** - these substances reduce the spray drift possibilities by either; (1) increasing the droplet size, (2) forming foam, (3) making invert emulsion. This agent is particularly important in aerial application of herbicides.
- **Chemistry of Herbicides:-**

The *Herbicide Handbook* of the Weed Science Society of America has a listing of

specific information for each herbicide that includes the following:

1. *Nomenclature* (common name, chemical family, chemical name, manufacturer)
2. *Chemical and physical properties of the pure chemical* (chemical structure, molecular formula, molecular weight, description, density, melting and boiling points, vapor pressure, solubility, stability, etc.)
3. *Herbicide uses*
4. *Use precautions*
5. *Behavior in plants (symptomology, absorption and translocation, mechanism of action, metabolism, non-herbicidal biological properties, and mechanism of resistance in weeds)*
6. *Behavior in soil (sorption (KOC, Kd) persistence (carryover potential, half-life), mobility, volatilization, and formulation effects)*
7. *Toxicological properties: acute, including oral and dermal LD50, inhalation LC50, eye, and skin irritation and skin sensitization; sub-chronic, including 90-day dietary for mouse, rat, and dog; chronic, including 12-, 18-, and 24-month feeding studies for mouse, rat, and dog, respectively; teratogenicity on rats and rabbits; reproduction on rats; mutagenicity, including gene mutation and structural chromosome aberration; and wildlife effects, on birds, fish, insects, and selected microorganisms use classification.*
8. *Synthesis and analytical methods.*
9. *Sources of additional information.*

Herbicides have three names with which all users should be familiar. The first is the **chemical name**, the second is the **common name**, and the third is the **trade name**. There are more than 200 chemicals classified as herbicides. For standardization purposes, this text uses the listing of common and chemical names of herbicides as approved by the Weed Science Society of America and provided in *Weed Science* (1999, Vol. 47, pp. 764–769). This listing includes many herbicides that are no longer manufactured or are not sold in the United States.