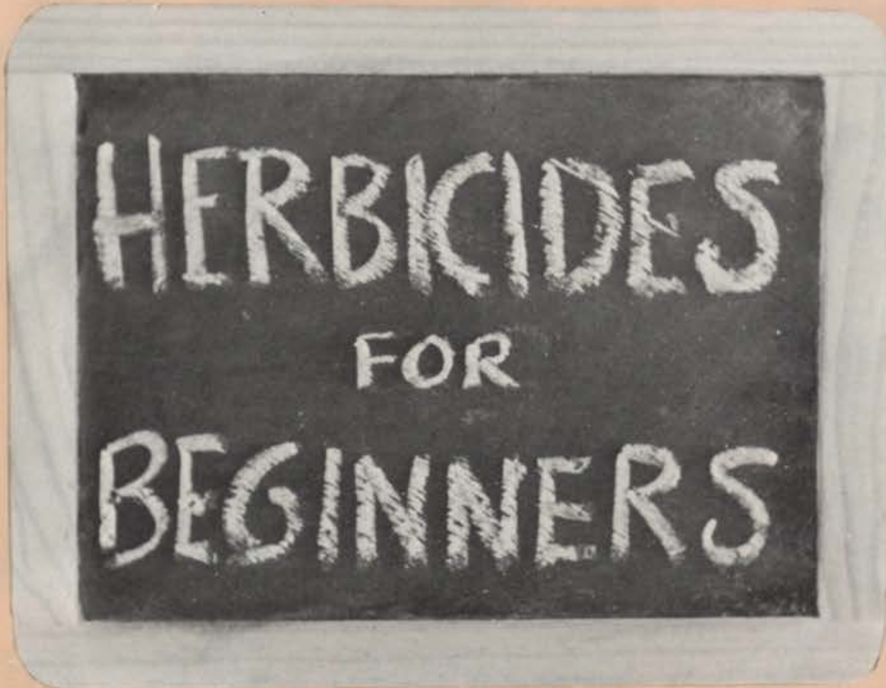
Here's an Outline to Orient Your New Employees...



WHERE DO YOU begin to explain to a new, untrained employee what he needs to know about herbicides?

Confronting him with most references — voluminous, technical and uninteresting — most likely would impress him only that the material is so dry it should replace the grammar book as the carrier for that mischievous schoolboy book-edge inscription: "In case of flood, stand on this."

What's needed is a quicky orientation that the average employee feels he can master in a few days, or at the most in a few weeks. Given the basic outline, the employee can then build on his knowledge as quickly as he is able or as the job requires.

Such an orientation has been developed by Allen F. Wiese, professor of agronomy, at Texas A&M University. It is used at A&M's annual weed control conference for orientation and review.

Prof. Wiese begins at the very beginning with definitions of the words basic to chemical weed control work. Following is his "Herbicides for Beginners."

WEED: An obnoxious growth, a plant growing where it is not desired.

HERBICIDE: A chemical used for killing or inhibiting the growth of plants.

Herbicide Names

1. Trademark or trade name is the name under which products are advertised and sold. If several manufacturers sell the product, there will be many trade names.

2. *Chemical name* refers to the name of active ingredients. This will not vary on different companies' labels unless the active ingredient is formulated in a different way. *Example:* (5-bromo-3-*sec*-butyl-6-methyluracil).

3. *Common name* — Short name or abbreviation for the active ingredient which is accepted by the Weed Science Society of America. *Example:* (bromacil).

Herbicide Labels

Herbicide labels contain the follow-information: (1) Trade name; (2) Chemical name of active ingredient; (3) Concentration of active ingredient (pounds per gallon or percent based on dry weight); (4) Instructions for use. (It is illegal and usually unsafe to use a herbicide for any situation not described on the label.) (5) Safety and use precautions; and (6) Manufacturer and address.

Types of Herbicides

It is impossible to make a rigid classification of herbicides. Each chemical compound that has herbicidal properties has particular characteristics, and as a result, many herbicides would fit into more than one place in any classification. A comprehensive classification would of necessity be based on herbicide chemistry. The following simple herbicide classification is made primarily for people planning to start work in industrial weed control.

1. *Foliage Herbicides* — Herbicides applied to top growth of plants.

a. *Contact herbicides*—These herbicides kill plant parts that are covered with spray. The visual effects usually appear within a few hours. There is little if any soil residual.

Examples: Herbicidal oils, dinitrophenols, petrachlorophenol, paraquat, and ammonium sulfamate.

b. *Translocated herbicides*—Herbicides that are absorbed into plants and move to and kill growing points, such as buds and root tips.

(1) *Broadleaf weed killers*—The phenoxy herbicides and one substituted benzoic acid are the most common herbicides in this group. These readily translocated herbicides are absorbed through both foliage and roots. At usual rates of application for foliage treatments, soil residual is from 1 to 4 weeks. They kill plants by upsetting the balance between synthesis and utilization of food.

Examples: 2,4-D, 2,4,5-T, MCPA, silvex, 2,4-DB, dicamba (Banvel).

(2) *Grass killers*—The only herbicide in this group is an aliphatic

acid. It is absorbed by foliage and roots and may persist in the soil for 1 to 3 months. It is used as a foliage treatment to control a large variety of annual and perennial grass plants. Usually more than one application is required to control perennials.

Example: dalapon (Dowpon).

2. *Soil Sterilants* — Herbicides that are applied to and act primarily through the soil.

a. *Little soil residual* — Soil persistence is usually from 1 to 3 weeks. These chemicals are sometimes referred to as soil fumigants and are very toxic to all forms of plant and animal life including weed seed and fungus spores. They are generally used to fumigate seedbeds for nursery stock and areas such as golf-greens and football fields where weed and disease-free turf needs to be established rapidly.

Examples: methyl bromide, carbon disulfide, and chloropicrin.

b. *Long soil residual*—These materials usually persist in soil from 1 to 3 years.

(1) *Broadleaf weed killers* — Herbicides in this group are a benzoic acid, picolinic acid, phenylacetic acid and a benzyloxypropanol. These chemicals kill plants by upsetting internal metabolism similar to the phenoxy herbicides. These herbicides are usually water soluble and leach up to six feet into the soil where they are absorbed by roots. Foliage uptake may occur, but kill of perennial plants is usually by root absorption. High dosages in the soil will prevent growth of both annual grasses and broadleaf weeds. Perennial grasses are not usually killed. These herbicides are used to kill deep rooted perennial broadleaf weeds such as field bindweed.

Examples: 2,3,6-TBA (Benzac 1281, Trysben 200, and Benzabor); picloram (Tordon formulations, and Borolin); fenac (Fenac); and 2,3,6-trichlorobenzyloxypropanol (Tritac).

(2) *Grass killers*—An aliphatic acid, trichloroacetic acid is the only herbicide available in this group. It is very similar to dalapon in chemical structure but differs in two functional characteristics. It has a longer period of soil persistence (three to six months), and is not readily absorbed by foliage. It leaches readily and is absorbed by roots.

Example: TCA (Sodium TCA).

(3) *Broadleaf and grass killers* —Chemical compounds that are used for general long term soil sterilization are the substituted ureas, substituted triazines, uracils, sodium borates and sodium chlorate.

These herbicides have a range of physical and chemical characteristics, and as a consequence, some of these materials work better under different soil and climatic conditions. In general, they are not absorbed by foliage but are readily absorbed by roots. They do not leach as far into the soil as those herbicides used for perennial broadleaf weed control. As a result, they are not very effective against those weeds.

Most of these herbicides inhibit photosynthesis and death is the result of slow starvation. Germinating annual weeds die as soon as food material in the seed is exhausted. Sodium chlorate upsets respiration and carbohydrate metabolism. Boron is an essential element for plant growth at a few pounds per acre but is highly toxic at higher rates of application. These herbicides are used at low rates to eliminate annual weeds on non-crop sites for 1 or 2 years. If perennial weeds are present, higher rates of application are necessary.

Examples: bromacil (Hyvar X); prometryne (Pramitol); monuron (Telvar); sodium chlorate; diuron (Karmex); sodium borates; and mixtures of these materials.

Herbicide Formulations

Most organic chemicals that are used for herbicides are not soluble in water. Consequently, in order to be useful, they must be prepared for convenient dispensing over the weed or crop. Herbicides must be prepared so that uniform applications of as little as ⅛ pound per acre can be made.

Herbicides have been formulated as solutions, emulsions, wettable powder, granules or pellets and dusts.

A *solution* is a physical homogeneous mixture of two or more substances. Most water solutions can be seen through easily. Sugar or salt in water and amine salts or 2,4-D form true solutions.

An *emulsion* is formed when one liquid is dispersed with another liquid but the two materials maintain their separate identity. Milk and ester formlations of 2,4-D are common emulsions. These emulsions appear milky and are called the oil-in-water type. Small droplets of oil are surrounded by water. These emulsions have the same viscosity as water. In water-in-oil emulsions, small drops of water are surrounded by oil, and viscosity varies.

Wettable powders form suspensions consisting of solid particles dispersed in either oil or water. The proper surfactants must be added in order for wettable powders to stay in suspension.

Where it is not essential that even distribution be obtained, herbicides can be formulated by sticking them to clay *granules* or by actually combining them into *pellets*. Recently, a new type of granule was prepared by sticking soil sterilants to small rock fragments.

In the past, herbicides have been prepared as dusts, much the same as insecticides and fungicides. However, dusts are extremely susceptible to drift and are no longer used.

Herbicide Concentration

Herbicide concentration varies. For example, 2,4-D may be purchased from one to six pounds per gallons. Consequently, it is very important to determine the active ingredient in any herbicide formulation. Two,4-D acid is usually formulated as an amine or an ester to make acceptable spray mixtures. In view of the fact that the acid is the toxic ingredient, 2,4-D, 2,4,5-T and similar herbicides should be carefully check for *acid equivalent.* If the formulation contains four pounds per gallon, one pound of acid will be contained in each quart. One pint is applied to an acre for a ½ pound per acre application. *Liquid formulations are usually made upon basis of liquid volume.* Dry formulations are usually measured in *dry weight and contain a certain percentage of active ingredient.* For instance, Dacthal 50W contains 50% active ingredient. In order to apply six pounds of active ingredient per acre it is necessary to apply 12 pounds of Dacthal 50W.

Herbicide Selectivity

A selective herbicide refers to a chemical that is more toxic to one plant than to another. This difference may be due to many factors and most important are:

Morphological or structural differences—The directed spray takes advantage of a height difference among the weeds and crops. The crop can be missed, because it is taller than the small weeds. Other plants are resistant to herbicides, because they have a waxy coating that will not allow herbicides to penetrate. Weeds on the other hand may be susceptible if they do not have this protection. Grass tends to have upright leaves, and does not intercept as much spray as flat-leafed plants.

Absorption of herbicides—In order to affect a plant, herbicides must enter. Some plant surfaces absorb herbicides easily and other plant surfaces repel herbicides.

Translocation differences — In order for herbicides to be effective, they must not only penetrate into the plant but also move to areas in the plant where they are effective. When herbicides are applied to leaf surfaces, the toxic material is usually transported upward or downward through the phloem. Soil herbicides are usually transported in the water stream in the xylem.

Physiological differences—As herbicides become more specific, physiological differences are accounting for a large part of selective toxicity. Herbicides upset various physiological processes involved in photosynthesis and respiration.

Herbicides in Soil

In order to be effective, herbicides applied to the soil must be at high enough concentration where the weed seeds are germinating to cause death. Frequently, selectivity of soil herbicides is based on the fact that herbicides are in the upper ¼-inch of soil where weed seeds germinate and crop seed are much deeper. If the herbicide is toxic to both weeds and crop, heavy rains may cause crop injury.

Soil type and organic matter will affect herbicide performance. The toxicity of an herbicide is related to the concentration in soil water. Silty clay loam holds about twice as much available water as fine sandy loam. Consequently, the amount of herbicide must be doubled on silty clay loam in order that the available soil water has a comparable concentration of herbicide. As the soil dries, it becomes more difficult for plants to absorb water..

The persistence of herbicides in the soil will be affected by the microbial decomposition, chemical decomposition, adsorption to soil colloids, leaching, volatility and photodecomposition.

Microbial decomposition—Various soil fungi can utilize herbicides, as carbonaceous organic matter for respiration. Anything that affects micro-organism growth usually changes the rate of herbicide decomposition. Herbicides persist much longer under dry and cold conditions than when it is warm and moist.

Chemical decomposition — There are not many chemical herbicides that are susceptible to oxidation, reduction, hydrolysis or hydration. Seasone is hydrolyzed into an active form of 2,4-D when placed in soil.

Adsorption to soil colloids—Herbicides are much like fertilizer and are rendered inactive when they are adsorbed on clay minerals or soil organic matter. Some herbicides are readily adsorbed and others are not. Treflan is highly adsorbed and must be thoroughly mixed in order to be effective. Tordon is very soluble and readily leaches into the soil profile.

Leaching—The persistence of herbicides may be determined by leaching. Herbicides used for perennial weed control must leach into the soil where the weed roots are to be killed.

"It's faultless . . . now change that!"

Volatility — All chemicals have a vapor pressure or have a tendency to evaporate. Evaporation of water is an example of volatility. Herbicides can be lost in the form of volatile gases. In some instances, herbicide volatility can be regulated by formulation. Ester formulations of 2,4-D volatilize easily compared with amine formulations.

Photodecomposition—Many herbicides are decomposed when subjected to ultra violet light from the sun, Monuron, diuron and norea are very susceptible to this type of breakdown.

Drift and Volatility

Most injury to susceptible plants is caused by drift and not volatility.

Spray Drift is the lateral or upward movement of airborne spray particles that occur from the time that the droplets leave the spray jet until hitting the soil or plant surface. The amount of drift depends on (1) the size of droplets (2) amount of wind and (3) the height above the ground that the spray is released. The size of the droplets depend on the spray pressure, the size of the spray orifice and the surface tension of the spray fluid.

In order to minimize drift, sprays should be applied at low pressure (15 to 25 psi) and a high gallonage.

In the last few years several methods of reducing drift have been attempted. The most advertised method has been with invert emulsions. Milk is an "oil-in-water" emulsion with a viscosity like water. Two,4-D esters make this type of emulsion and spray like water. If the emulsion is reversed or inverted to a "water-in-oil," it will be much more viscous and with proper methods can be sprayed in large droplets. Other methods of reducing drift are with shields, placing more nozzles on the boom, and markedly reducing pressure.

Spray Volatility is the tendency of a sprayed material to vaporize or give off fumes after it has hit the soil or plant surface. Volatility, because of the small amount of material involved, can only be a hazard where extremely sensitive crops are nearby. Cotton, for example, is sensitive to as little as 1/1000 lb/A of 2,4-D. Volatility can be controlled only be reducing the chemical's tendency to vaporize.