AQUATIC WEED CONTROL

MECHANICS OF SPRAYING

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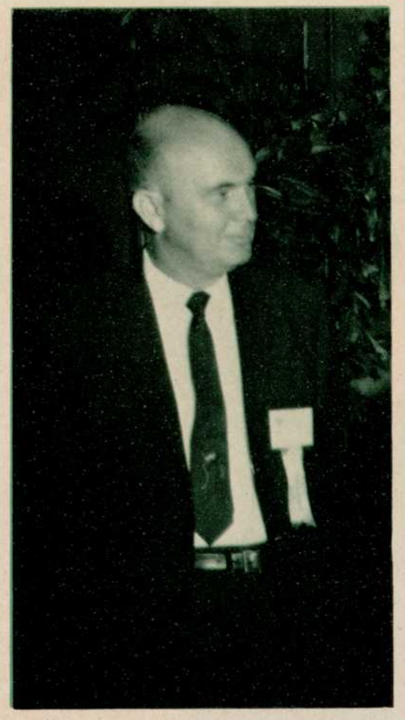

Wilson: "Understanding of the major principles increase your percentage of success."

WE APPLY HERBICIDES as a spray because:

—Water is a cheap readily available herbicide carrier.

—Small amounts of herbicide can be diluted in water and spread evenly over the entire area being treated.

—Large areas can be treated rapidly.

It sounds simple, yet many different factors from chemistry and physics are involved in spray application. Each of these factors can be compared to a brick in a wall, it plays a part but it is not the entire wall. Because of this, the following factors have been listed individually.

Spray Formulations

Most chemicals have to be modified in some manner so that they will mix with water. We call these different types of formulation. There are three major ones.

1. Solution—In this category the chemical can be dissolved by or mixed with water. The resulting solution does not separate into water and chemical if allowed to stand. Alter initial mixing agitation is not required. Most herbicides fall in this category.

2. Emulsions — This category of formulation is used to mix oil or oil-like chemicals with water. The better the grade of emulsion, the less agitation it requires to keep it mixed with water. A good emulsion looks like milk.

3. Wettable powders — Formulation of this type contain a pesticide that has been mixed with or sprayed on a "carrier" powder. The entire mixture has been treated with a wetting agent so that it will mix with water. Formulation of this type requires constant agitation.

The purpose of each of these types of formulation is to allow the use of water as a physical carrier so that small amounts of a pesticide can be spread uniformly over a large area. As soon as the spray hits the plant, the water part of the spray starts to evaporate or dry. As this occurs the herbicide comes in contact with the leaf and is deposited. As soon as the chemical is deposited it can begin to act.

Morphological Characteristics

The physical characteristics of a plant influence retention and uptake of an herbicide. Leaf shape, leaf position, type of leaf surface and the density of leaves all play major roles in the problem of getting enough herbicide into a plant to kill it. Collectively, the physical characteristics of a plant act as a group of "obstacles" to successful herbicide application. We must apply our herbicide in a manner to bypass or circumvent these obstacles in order to achieve weed control.

Plant characteristics that influence retention and uptake of herbicides.

Leaf Shape
- Broad—generally easier to kill
- Narrow—generally harder to kill

Leaf Position
- Horizontal—holds spray well
- Upright—spray tends to run off

Leaf Surface
- Waxy—spray beads, runs off
- Hairy—spray held out away from leaf surface
- Sculptured—sculpturing may channel spray—increases run off

Leaf Density
- Heavy—many leaves
- Light—few leaves

Nozzles

There many techniques and devices that have been developed for shattering a liquid into the small droplets that we call spray. All these devices use some form of energy to break up the liquid and create the tremendously expanded surface of many droplets. The most frequently used type of nozzle in weed control operation is the hydraulic pressure nozzle. For our purposes there are three main types of this nozzle which are identified by the spray patterns they create.

1. Straight stream jet—the spray emerges from a central orifice as a solid stream and breaks up into spray several feet from the nozzle.

2. Hollow Cone—the spray passes through a whirl plate and acquire a high revolution per minute before it passes through the spray disc orifice. Centrifugal force makes the stream form a hollow cone pattern.

Most of our adjustable spray guns such as the spray master, spraymeiser or "orchard" guns can be adjusted to produce either 1 or 2.

3. Flat fan patterns—these are nozzles in which the orifice is milled oblong so that the spray pattern is long and narrow.

a. Tee jet and Vee jet nozzles —these flat fan nozzles are most commonly used on spray booms. They provide very even coverage of a swath. Tee jets are low volume nozzles, Vee jets are high volume nozzles.

b. Off center nozzles (O. C. type) these nozzles provide a wide off-set flat fan spray, under proper conditions they can be used to cover as much as a 30-foot swath.

Surface Tension

Molecules are the sub-microscopic "bricks" of which all things are made. Each molecule exhibits "forces" or "pull" similar to a magnet. Water has surface tension because of its molecular structure which causes each water molecule to have a strong attraction for other water molecules. Molecules on the surface are pulled inward because there are no water molecules on the other side to exert force to pull. This inward force causes water to stay in the smallest possible area, which is a sphere or drop; in other words, surface tension causes water to form a "skin" and makes it form drops.

Spray Droplet Formation

The physicist recognizes several modes of droplet formation, however for our purposes weed control spray droplets are formed by two methods, aerodynamic breakup and instant atomization.

In aerodynamic breakup, the spray issues from the nozzle in a solid jet at high speed. At these high velocities the liquid jet travels straight initially, then due to aerodynamic forces, tends to be stripped apart into "primary" droplets. These droplets are tear shaped. The length of the tail on the primary droplet is proportional to the speed of the droplet at the time of break up. The higher the velocity of the drop the more the tail is elongated. Surface tension acts on this elongated tail causing it to break up into many secondary droplets.

Instant atomization is characterized by the spray issuing from the nozzle in a thin sheet. Due to the resistance format this sheet first develops "ridges" that separate from the sheet as filaments or threads of spray. Surface tension then reduces the threads into droplets.

The lower the spraying pressures, the lower the velocity of the spray. The lower the velocity, the less aerodynamic force present to shatter the spray into droplets. In other words, low pressure results in larger spray droplets.

Viscosity

Viscosity is the resistance a liquid has to flowing. We add thickeners, such as Vistik, to form a spray with syrup-like consistency.

Spray Droplet Size

Spray droplet size is governed by surface tension, viscosity and spray velocity.

Surfactants

Each of us has seen droplets of water on a newly-waxed car. We know that these droplets "stand up" and do not spread over or wet the waxed surface. This phenomena is caused by surface tension. Water can "wet" a substance if its molecules are attracted to the molecules of the substance being sprayed. If these two groups of molecules tend to repel each other then the water forms "beads" such as we see on a waxed car.

In most plants the outer layer of each leaf is made up of wax-like components. Herbicides that are applied as sprays to such plants tend to "bead" or even run off the leaves. In order to overcome this problem we add surfactants to our sprays.

"Surfactant" is a coined word which combines the words "Surface active agent." It is probably easiest to visualize the action of a surfactant as a chemical "public relations" compound. A good surfactant has two positions on its molecule. One of these poles is attractive to wax, the other pole is attractive to water.

When a spreader-sticker type surfactant is added to a spray it remains relatively inactive until the mixed spray is forced from the nozzle and spray droplets are formed. At this point the water-loving end of the surfactant molecules turns inward and the oil or wax-loving end of the molecule orients to the outside of the droplet. Upon impact with the leaf the surfactant forms a "go between" layer linking water to wax.

With surface tension reduced or eliminated the spray spreads on the leaf surface rather than forming a drop. Due to this spreading, greater efficiency is achieved through better coverage. In some cases it is even possible to reduce the amount of herbicide required by the addition of a surfactant.

Coverage

In order to obtain consistent herbicide kills it is necessary to apply sprays so that even coverage is achieved over the entire area. If we can use a boom-type sprayer that can be driven at a known speed while applying a known amount of spray per minute we can apply a very precise amount of herbicide

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classifieds

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per acre. It is almost impossible to apply sprays with hand-held guns and achieve uniform coverage. An alert sprayman can achieve a satisfactory degree of coverage, however it takes constant concentration.

Knowledge of the various factors that make up the mechanics of spray application will not guarantee a total absence of herbicide application failures; however, a thorough understanding of the major principles involved will increase your percentage of successes.

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