

HERBICIDE FORMULATIONS

Important Terms

active ingredient
adjuvant
agitation
amine
antifoaming agent
aqueous suspension
crop oil
crop oil concentrate
drift inhibitor
dry flowable
emulsifiable concentrate

emulsion
ester
eye irritation
flowable
formulation
granule
inert ingredient
inhalation hazard
methylated seed oil
nonionic surfactant
nonvolatile

oil
organo-silicone
pellet
penetrant
soluble powder
solution
sticker
surfactant
suspension
water-dispersible granule
water-soluble concentrate
wettable powder

INTRODUCTION

The **active ingredient** in a herbicide is the chemical that controls the target weed. The herbicide product you purchase is rarely made up only of active ingredients. Often the herbicide is diluted in water or a petroleum solvent, and other chemicals are added before the product is offered for sale. These other chemicals may include wetting agents, spreaders, stickers, extenders, or diluents. They usually make the product easier to apply and more convenient to handle. This mixture of active and **inert ingredients** (inactive) is called a **formulation**.

TYPES OF FORMULATIONS – ADVANTAGES AND DISADVANTAGES

A single active ingredient often is sold in several different kinds of formulations. You must choose the formulation that will be best for each use. In making your choice, consider:

- application equipment available and best suited for the job,
- hazard of drift and runoff (nearness to sensitive areas, likelihood of wind or rain),
- safety to applicator, helpers, and others likely to be exposed,
- growth patterns of the plant (granular vs. foliar spray), and
- cost.

Dry Formulations

Granule (G)

This is a ready-to-use dry mixture of a small amount of active ingredient with inert carriers. Most are made by applying a liquid formulation of the active ingredient to coarse particles (granules) of some porous material such as clay, sand or plant material. Granule particles are much larger than dust particles; will pass through a 4-mesh sieve but not through an 80-mesh sieve (the number of wires per inch). The herbicide is absorbed into the granule, or coats the outside of it, or both. Inert ingredients may be added to make the formulation handle well. The amount of active ingredient usually ranges from 1 to 15 percent. They are most often used as soil treatments where they have the advantage of weight to

carry them through foliage to the ground. They do not cling to plant foliage, but they may be trapped in the whorls of some plants. Granular formulations should always be used dry. Never mix them with water. Granules should not be applied to frozen soil or on steep slopes. Since all are soil active, application in close proximity to root systems of nontarget plants is also a special hazard. The relative large particle size of granules minimizes drift potential and reduces inhalation hazard. Granules also have a low dermal hazard. Examples: Top-Site, Sprakill 13, Arsenal 0.5 G.

Advantages:

- ready to use,
- easy to apply,
- will fall through dense foliage,
- minimizes drift potential,
- reduced inhalation and dermal hazard, and
- simple application equipment.

Disadvantages:

- limited foliage use,
- expensive per pound active ingredient,
- needs moisture to activate herbicide action,
- bulk quantities necessary can be logistical problem,
- hazardous on steep slopes, on frozen soil, and around nontarget plants,
- can be attractive to nontarget organisms such as birds, and
- difficult to spread uniformly around obstacles.

Pellet (P)

Pellets are similar to granules, but their manufacture is different. The active ingredient is combined with inert materials to form a slurry (a thick liquid mixture). This slurry is then extruded under pressure through a die and cut at desired lengths to produce a particle that is relatively uniform in size and shape, but is much larger than a granule. Pellets are similar to granules in that they are ready to use, are applied in the dry form, and contain a small amount of active ingredient (usually 10 to 20 percent by weight) combined with inert carrier. Pelleted formulations may be applied by hand or mechanically, and are used for soil treatment. While drift is not a problem with this formulation, pellets should not be applied to frozen soil. Use on steep slopes or in close proximity to root systems of nontarget plants are also special hazards. Pellets provide a high degree of applicator safety. Example: Spike 20P

Advantages:

- ready to use,
- easily applied by hand,
- reduced applicator hazard,
- minimum drift potential, and
- effective spot treatment method.

Disadvantages:

- active ingredient expensive,
- hazardous on steep slopes, close to desired plants, and on frozen soil,
- bulk quantities necessary can be logistical problem, and
- difficult to spread uniformly around obstacles.

Wettable Powder (WP or W)

Wettable powders are finely ground solids, typically mineral clays, to which an active ingredient is sorbed. They provide an effective way to apply an active ingredient in a water spray that is not readily soluble in water. These dry preparations look like dust, contain a high percent active ingredient (usually

50 percent or more) and are mixed with water for application. Wettable powders form a **suspension** rather than true solution when added to water. Good **agitation** (mixing) is needed in the spray tank to maintain the suspension. Good wettable powders spray well and do not clog screens. They can be abrasive to pumps and nozzles. The powdery nature of this formulation does present an **inhalation hazard** to the applicator during mixing and loading. Example: Spike 80W.

Advantages:

- easy to store, transport and handle, and
- relatively inexpensive.

Disadvantages:

- inhalation hazard while pouring the powder,
- requires agitation,
- may clog strainer and screens,
- abrasive to sprayers,
- residues may be visible, and
- concentrate spills can be difficult to clean up from porous surfaces.

Soluble Powder (SP)

This is a dry formulation that contains a high percent (usually above 50 percent) active ingredient. Soluble powders look like wettable powders but they form a true solution when added to water. Agitation in the spray tank will help this formulation to dissolve. After dissolving, no more agitation is usually needed. Few herbicides are available in this formulation because few active ingredients are soluble in water. Soluble powders are nonabrasive to equipment. Inhalation hazard is a characteristic of this formulation. Example: Solution.

Advantages:

- easy to mix,
- limited agitation required, and
- easy to store, transport, and handle.

Disadvantages:

- inhalation hazard while pouring powder, and
- concentrate spills can be difficult to clean up from porous surfaces.

Water-Dispersible Granule or Dry Flowable (WDG or DF)

Dry flowables are manufactured in the same way as wettable powders except that the powder is aggregated into granular particles. They are mixed with water and applied in a spray exactly like a wettable powder. This dry formulation usually contains 70 to 90 percent active ingredient. The formulation pours easily without the windblown dust associated with wettable powders and readily disperses in water to form a suspension. Constant agitation is required. Because of their larger particle size, inhalation hazard for the applicator is reduced. The labels of some dry flowables do permit application of the product in the dry state, with special application equipment. Example: Diuron 80, Escort, Karmex IWC, Oust, Sahara, Velpar DF.

Advantages:

- easy to store, transport, and handle,
- reduced applicator exposure when mixing the dry formulations, and
- concentrate spills are most easy to clean up from porous surfaces.

Disadvantages:

- good agitation required,

- residues may be visible,
- abrasive to sprayers,
- may be slightly more expensive than other dry formulations, and
- rapid pouring from large container can cause mixing problem when product mass settles to bottom of the tank.

Liquid Formulations

Liquid formulations do not exhibit the variety of physical forms possible with dry formulations. However, liquid formulations differ markedly in the nature of their characteristics that influence selection, rate and method of application, and environmental impact.

Water-Soluble Concentrate (WSC)

Water-soluble concentrates form a true **solution** when added to water and are applied with water as the carrier. These herbicides usually have an **amine** (ammonium salt) or mineral salt in the molecule that enables water solubility. These formulations are essentially **nonvolatile**. There are usually 2 to 6 pounds of active ingredient per gallon of formulation. Agitation is not necessary to maintain the herbicide in solution. Example: Arsenal, Formula 40, Garlon 3A, Krenite, Roundup Pro, Tordon K, Vanquish, Veteran 720.

Advantages:

- readily mixes with water,
- equipment cleans up easily,
- essentially nonvolatile,
- not abrasive to equipment,
- will not plug strainers, and
- no agitation necessary.

Disadvantages:

- eye irritation** with some salts,
- some products are reactive with unlined steel tanks, and
- mixing concentrates together could have compatibility problems.

Emulsifiable Concentrate (E or EC)

An emulsifiable concentrate formulation usually contains the active ingredient, one or more petroleum solvents, and an emulsifier that allows the formulation to be mixed with water. Emulsifiable concentrates usually contain 2 to 8 pounds of active ingredient per gallon. These concentrates are soluble in oil and form an emulsion in water. The emulsion-forming characteristic results from the addition of adjuvants to the herbicide formulation. The oil droplet containing the herbicide is dispersed in the water (oil-in-water emulsion). The milky colored appearance when mixed with water is typical of emulsifiable concentrates. Usually by-pass agitation is sufficient to keep the emulsion from separating. There usually is a **dermal** (skin contact) hazard associated with this formulation.

It is not uncommon for the growth regulator herbicides to be formulated as emulsifiable concentrates as well as water-soluble concentrates. The emulsifiable concentrate formulation (**ester**) is generally more phytotoxic than its water-soluble (amine) counterpart. The ester form is more toxic to fish than the amine form. These ester forms have a potential to be volatile and suggested maximum soil or air temperatures may appear on the herbicide label. Example: Garlon 4.

Advantages:

- little agitation required,
- not abrasive,

- will not settle out or separate when equipment is running, and
- little visible residue on surfaces.

Disadvantages:

- phytotoxic hazard usually greater than water soluble concentrate,
- easily absorbed through skin of humans or animals,
- solvents may cause rubber or plastic hoses, gaskets, and pump parts and surfaces to deteriorate,
- may cause pitting or discoloration of painted finishes,
- may be corrosive,
- volatility potential, and
- equipment cleaning more difficult.

Flowable or Aqueous Suspension (F, L or AS)

In this formulation, very finely ground solid material is suspended in a liquid. Liquid flowables usually contain a high concentration (4 pounds or more) of active ingredient and are mixed with water for application. The formulation has the same major characteristics as a wettable powder; it forms a suspension when added to water, and it enables the application of water-insoluble herbicides in water. They seldom clog spray nozzles and they need only moderate agitation. Example: Diuron 4L.

Advantages:

- can be mixed with water, and
- no inhalation hazard.

Disadvantages:

- agitation is needed after mixing, and
- may leave a visible residue.

ADJUVANTS

The pure form of many herbicides is not soluble in water. Since usually only a few ounces or pounds of this material are to be spread evenly over a full acre of land, the herbicide is diluted in water. Some are already blended into the herbicide; others are purchased separately and added to the herbicide solution in the spray tank. An **adjuvant** is any material that is added to a herbicide solution to enhance or modify the performance of the solution.

There are three important types of adjuvants used with herbicides. Activator adjuvants include surfactants, wetting agents, penetrants, and oils. Activator agents are the best known class of adjuvants because they are normally purchased separately by the user and added to the solution in the spray tank. Spray modifier agents include stickers, spreaders, thickening agents, film formers, and foams. Utility modifiers include emulsifiers, dispersants, stabilizing agents, coupling agents, co-solvents, compatibility agents and anti-foam agents. Utility modifier agents, and to a lesser degree spray modifier agents, are usually found as part of the herbicide formulation and, thus, are added to the herbicide product by the manufacturer.

Important types of activator adjuvants include:

- surfactants**, which reduce water surface tension and improve dispersion of the spray,
- penetrants**, which aid in herbicide movement into the plant,
- oils**, which improve solution spreading and leaf penetration,
- stickers**,
- drift inhibitors**, and
- antifoaming agents**.

Surfactants

Previously it was generally believed that any product that lowered the surface tension of water or increased the wettability of a spray solution could be used as a surfactant. Even soaps and household detergents were sometimes used. However, soaps and detergents can combine with hard water to form precipitates or scums that can interfere with the performance of spray equipment. Agricultural surfactants do not form precipitates and can be used equally well in hard and soft water. Many liquid detergents and soaps make too much foam for use in a spray tank. Most liquid detergents have a fairly low concentration of surfactant (10 to 20 percent) compared with a 50 to 90 percent concentration for agricultural surfactants.

The most important group of surfactants is the nonionic type. **Nonionic** surfactants do not form an overall electrical charge. They are good dispersing agents, stable in cold water, and have low toxicity to both plants and mammals. Surfactants tend to increase the effectiveness of the herbicide on all plants.

Another group of surfactants is the **organo-silicones**. These products are used at much lower rates than nonionic surfactants and are more effective at reducing surface tension of the spray droplet. Surface tension is so reduced that the spray solution can penetrate the stomates on the leaf surface. This does not usually occur with nonionic surfactants.

Oils

Crop oils, crop oil concentrates, and methylated seed oils, like surfactants, improve the spreading of the herbicide solution. Being oil instead of water, they keep the leaf surface moist longer than water, allowing more time for the herbicide to penetrate, thus increasing the amount that will enter the plant. Crop oil concentrates contain 80 to 83 percent oil and 17 to 20 percent surfactant and are used at rates similar to the nonionic surfactants.

Spray modifier agents include:

- stickers, which reduce the possibility that the herbicide will be washed off the leaves,
- drift inhibitors, which thicken the spray solution to reduce drift, and
- antifoaming agents, which reduce or prevent foam from forming.

Stickers

A sticker is an adjuvant that causes the herbicide to adhere to the plant foliage, thus reducing the possibility that rain will wash it off before the herbicide can penetrate. Many stickers are blended with wetting agents so that they both increase the spray coverage and provide better adhesion action. When combined, the product is often called a "spreader/sticker."

Drift Inhibitors

Other adjuvants serve other specialized functions. Drift inhibitors or thickeners are used to control drift. These may be powders, granules, or liquids that cause the spray solution to be more cohesive; less subject to wind shear as it leaves the nozzles so as to reduce the amount of very small spray droplets.

Antifoaming Agents

Air gap filling or mechanical agitation in partially full tanks can cause excessive foaming. Antifoaming agents cut down on frothing so that the tank can be filled more easily. These are usually silicone-containing products that are used in relatively small amounts to breakdown the foam.

- Preemergence -- used before crop or weeds emerge. May refer to use after crops emerge or are established, but before weeds emerge.
- Postemergence -- used after the crop or weeds have emerged.

How To Use

Terms that tell you how to apply the herbicide product include:

- Band -- application to a strip over or along a crop row
- Basal -- application to stems or trunks at or just above the ground line
- Broadcast -- uniform application to an entire specific area
- Directed -- aiming the herbicide at a portion of a plant
- Drench -- saturating the soil with a herbicide
- Foliar -- application to the leaves of plants
- Soil application -- application to the soil rather than to vegetation
- Spot treatment -- application to a small area

WHAT IS ON THE LABEL?

Federal law requires every pesticide product to have a label that clearly shows the brand name, name and address of the registrant, net contents, product registration number, establishment number, ingredient statement, warning or precautionary statements, use classification, signal word, and use directions. Although EPA establishes standards for location and content of certain label information, manufacturers control much of the design and layout. Information contained on most labels can be divided into four major categories: product information, safety information, environmental information, and use information. Some labels are easier to understand than others. Knowing where to look on labels for specific kinds of information makes for a better understanding of the correct use of herbicides.

Product Information

Brand, Trade or Product Name

A **brand name** is the name used by a manufacturer to identify a herbicide as its product. It is the most identifiable name for the product. Brand names are usually capitalized. Example: Karmex IWC.

A brand name is usually not used in the ingredient statement, but appears plainly on the front panel of the label. An applicator must beware of choosing a herbicide product by brand name alone. Many companies use the same basic name with only minor variations to designate entirely different herbicide products.

Type of Formulation

Different types of herbicide formulations (such as liquids, wettable powders, and granules) require different methods of handling. The label will usually tell you what type of formulation the package contains. The herbicide may be available in more than one formulation.

Type of Pesticide

The type of pesticide usually is listed on the front panel of the label. This short statement usually indicates in general terms what the product will control. Examples:

- insecticide for control of certain insects on fruits, nuts, and ornamentals
- soil fungicide
- herbicide for the control of trees, brush, and weeds
- algacide

Ingredient Statement

Every herbicide label must list what is in the product. The list is written so that you can see quickly what the active ingredients are and the amount of each. The active ingredients are the portions of the formulation that actually controls the target plants. The amount of each active ingredient is given as a percentage by weight.

Chemical Name. The **chemical name** is the scientific name for an active ingredient. Example: 3-(3,4-dichlorophenyl)-1,1-dimethylurea.

Common Name. Because herbicides have complex chemical names, many are given a shorter **common name**. Only common names that are officially accepted by the Environmental Protection Agency may be used to identify an active ingredient on the herbicide label. The official common name may be followed by the chemical name in the list of active ingredients. Common names are usually not capitalized. Example: diuron.

When an accepted common name is available, it may be used with the chemical name in the active ingredient section on the label. By purchasing herbicides by the common or chemical names, you will always be certain of getting the right active ingredient.

Inert Ingredient. **Inert ingredients** allow active ingredients to be formulated into different products. As part of the formulation, they determine a product's handling properties and influence toxicity, and methods of application. There are no pest control claims for inert ingredients. Inert ingredients are not listed individually but the total amount will be indicated as a percentage by weight. The amounts of active and inert ingredients will total 100 percent.

Net Contents

The **net content** statement tells how much is in the container. This can be expressed as pounds or ounces for dry formulations and as fluid ounces, pints, quarts, and gallons for liquids. Liquid formulations usually list the pounds of active ingredient per gallon of product. Net content is always stated in terms of the largest suitable units, such as "1 pound" rather than "16 ounces."

Manufacturer

The law requires the manufacturer or distributor of a product to put the name and address of the company on the label so you will know who made or sold the product.

Registration Number

An EPA **registration number** (for example, EPA Reg. No. 3120-280-AA) appears on all herbicide labels. This indicates that the federal government has approved the herbicide label. In cases of special local needs, herbicide products may be approved by a state. These registrations are designated, for example, as EPA SLN No. KS-770009. In this case, SLN indicates "special local need" and KS means that the product is registered for use in Kansas.

Establishment Number

The **establishment number** (for example, EPA Est. No. 51840-AZ-1) appears on either the herbicide label or container. It identifies the facility that produced the product. If there is a problem with the package or product, the facility that made the product can be traced.

Lot Number

All herbicide containers will also have a Lot Number printed on the outside. This identifies the specific batch as it progressed through the manufacturing process. It is the most useful number for tracing problems regarding the product.

Classification Statement

Every herbicide product that has been listed by the EPA as **Restricted Use Pesticide** must carry this statement in a prominent place at the top of the front panel of the herbicide label. Some states may “restrict” a product in certain concentrations, or the uses of a certain product. You should be familiar with a particular State’s requirements and applicator certification requirements.

RESTRICTED USE PESTICIDE

For retail sale to and use only by certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator's certification.

Use Information

The instructions on how to use the herbicide are an important part of the label for you. This section is often the largest part of the label. This is the best way you can find out the right way to apply the product. The use instructions will tell you:

- the weeds that the manufacturer claims the product will control,
- the sites of application,
- the proper equipment to be used,
- how much to use,
- mixing directions,
- compatibility with other often-used products,
- phytotoxicity and other possible injury or staining problems,
- where the material should be applied, and
- when it should be applied.

Labels for herbicides often list the least number of days that must pass between the application and harvest of crops, or slaughter, or grazing of livestock. These are intervals set by EPA to allow time for the herbicide to break down in the environment. These intervals reduce the possibility residues on food, feed, or animal products and possibility of injuring grazing animals. This information may appear as a chart or it may be listed just after application directions.

Reentry Statement

The **reentry** statement tells you how much time must pass before people can reenter a treated area without appropriate protective clothing. These reentry intervals are set by both EPA and some states. The reentry statement may be printed in a box under the heading "Reentry" or it may be in a section such as "Important," "Note," or "General Information." Generally reentry statements are used in conjunction with “Agricultural” activities. If no reentry statement appears on the label, the usual waiting period is at least until the spray has dried before reentering or allowing others to reenter a treated area without protective clothing.

The minimum protective clothing for early reentry following right-of-way treatments is listed on the product label and usually includes:

- long-sleeved shirt,
- long-legged trousers or coveralls,
- hat, and
- sturdy shoes with socks.

Gloves and eye protection may also be listed.

Storage and Disposal

All herbicide labels contain general instructions for the appropriate storage and disposal of the herbicide and its container. State and local laws vary considerably, so specific instructions usually are not included. Typical statements include:

- Not for use or storage in or around the home.
- Store away from fertilizers, insecticides, fungicides, and seeds.
- Store at temperatures above 32^o F (0^o C).
- Do not re-use container.
- Do not contaminate water, food, or feed by storage and disposal.
- Open dumping is prohibited.
- Triple rinse and offer this container for recycling or reconditioning, or dispose in an approved landfill or bury in a safe place.
- Use excess product or properly dispose in an approved landfill.
- Do not re-use bag. Burn or dispose in an approved landfill. (Most states have clean air laws that prohibit open burning as a disposal method.

One or more of these statements may appear on a herbicide label. You should try to determine the best storage and disposal procedures for your operation and location. These statements usually appear in a special section of the label titled "Storage and Disposal" or under "General Instructions."

Misuse Statement

This section will remind you that it is a violation of Federal law to use a product in a manner inconsistent with its labeling. Do not use a product on a site not listed on the label. Do not use it at more than the recommended rate. By following the label directions, you will get the best results the product can give.

Safety Information

Child Hazard Warning

All pesticide labels must bear the statement "**KEEP OUT OF REACH OF CHILDREN**".

Signal Words

To be effective, herbicides must control the target pest. By their nature, herbicides are toxic to the target plants. Some may also be hazardous to people. You get an idea of the toxicity of a product by reading the **signal word** and looking at the symbol on the label. Every product label must have a signal word. There are three general categories of herbicides based on toxicity. These are only categories, however, and there is a range of toxicity in each group. The signal words are set by law and must appear prominently on the front of the pesticide container. They provide a one-word summary of the product's potential toxicity to humans. The three signal words, in decreasing order of toxicity, are **DANGER** (highly toxic), **WARNING** (moderately toxic), and **CAUTION** (slightly toxic or relatively nontoxic).

A product's signal word is assigned on the basis of laboratory tests conducted on that particular product. Data are compiled from animal studies on exposure through ingestion, inhalation, and dermal (skin and eye) absorption. The route of exposure that shows the highest human toxicity potential determines the signal word assigned to the label. For example, if laboratory test results indicate that Product XYZ is moderately toxic if ingested, highly toxic if inhaled, and slightly toxic if absorbed through the skin or eyes, the signal word would be **DANGER** based on inhalation studies.

Hazards to Humans and Domestic Animals

All herbicide labels contain additional statements to help you protect yourself, your helpers, and other persons (or domestic animals) that may be exposed. Some statements indicate which route or routes of entry (mouth, skin, and lungs) you must particularly protect. Many herbicide products are hazardous by more than one route, so study these statements carefully. A DANGER signal word followed by "May be fatal if absorbed through skin or inhaled" gives you a far different warning than "Danger, Corrosive -- Causes eye damage and severe skin burns."

Typical statements sometimes found on a DANGER label include:

- Harmful if swallowed.
- May be fatal if absorbed through skin.
- Poisonous if inhaled.
- Corrosive - causes irreversible eye damage and severe skin burns.

Typical statements sometimes found on a WARNING label include:

- Harmful if swallowed or absorbed through skin.
- Causes skin and eye irritation.
- Avoid breathing dust or spray mist.

Typical statements sometimes found on a CAUTION label include:

- Harmful if swallowed.
- May irritate eyes, nose, throat, and skin.
- Avoid contact with eyes and skin.

Personal Protective Equipment (PPE) Statements

You cannot change the toxicity of a product, but by following warning statements on the label and wearing **personal protective equipment** listed on the label you can minimize your exposure. Herbicide labels vary in the type of protective clothing and equipment statements they contain. You are required to wear the protective clothing or equipment specified on the label. However, the lack of any statement or the mention of only certain equipment does not rule out the need for additional protection. Minimal protective equipment usually includes a long-sleeved shirt, long-legged trousers or coveralls, work boots, gloves, and eye protection (safety glasses, goggles or face shield). You may consider wearing rubberized or waterproof clothing if you will be wet by an overhead spray application.

Statement of Practical Treatment

These statements tell you the first aid treatments recommended in case of exposure or poisoning. Typical statements include:

- In case of contact with skin, wash immediately with plenty of soap and water.
- In case of contact with eyes, flush with water for 15 minutes and get medical attention.
- In case of inhalation exposure, move from contaminated area and get medical attention.
- If swallowed, drink large quantities of milk, egg white, or water -- do not induce vomiting.
- If swallowed, induce vomiting.

All DANGER labels and some WARNING and CAUTION labels contain a note to physicians describing the appropriate medical procedures for poisoning emergencies and may identify an antidote. Some labels have emergency telephone numbers listed for the physician to contact in case medical emergencies.

Other Precautionary Statements

Labels often list other precautions to take while handling the product. These are self-explanatory:

- Do not contaminate food or feed.

- Remove and wash contaminated clothing before re-use.
- Wash thoroughly after handling and before eating or smoking.
- Wear clean clothes daily.
- Do not allow children or domestic animals into the treated area.

These statements represent actions, which trained applicators usually follow regardless if they are printed on the label.

Physical or Chemical Hazards

These statements will tell you of any special fire, explosion, or chemical hazards the product may pose. For example:

- Flammable -- Do not use, pour, spill, or store near heat or open flame. Do not cut or weld container.
- Corrosive -- Store only in a corrosion-resistant tank.
- Do not store concentrate or mixed solution in an unlined steel tank

Environmental Information

Herbicides may be harmful to the environment. Some products are classified as RESTRICTED USE PESTICIDE because of a potential environmental hazard. Watch for special warning statements on the label concerning hazards to the environment. These statements should help you choose the safest product for a particular job and remind you to take extra precautions. If a particular herbicide is especially hazardous to wildlife, that will be stated on the label. For example:

- This product is highly toxic to bees.
- This product is toxic to fish.
- This product is toxic to birds and other wildlife.

Some of these statements appear on nearly every herbicide label. They are reminders of common sense actions to follow to avoid contaminating the environment. The absence of any or all of these statements DOES NOT indicate that you do not have to take adequate precautions. These statements follow a "specific toxicity statement" and provide practical steps to avoid harm to wildlife. Examples of general environmental statements include:

- Do not apply where runoff is likely to occur.
- Do not apply when weather conditions favor drift from treated areas.
- Do not contaminate water by cleaning of equipment or disposal of wastes.
- Do not apply directly to water.
- Do not allow drift on desirable plants or trees.
- Do not apply when bee activity is high.

SUMMARY

Read the label before purchasing the herbicide, to determine:

- whether this is the herbicide you need for the job. Never depend on the color of the label or on the product name when you purchase a herbicide. Labels of the same color and general make-up may contain widely different active ingredients.
- whether the herbicide can be applied using the application equipment available.

Read the label before you mix the herbicide to determine:

- necessary protective equipment for safe handling.
- what you can mix with the product (compatibility).
- how much product is required.
- the proper mixing procedure.

Read the label before applying the herbicide to determine:

- safety measures necessary.
- when to apply (including waiting period on crops and animals).
- where the herbicide can be used (railroads, rights-of-way, noncrop areas, industrial sites).
- how to apply.
- restrictions of use.

Read the label before storing or disposing of the herbicide and container, to determine:

- where and how to store.
- how to properly clean and dispose of the container.
- where and how to dispose of surplus herbicides or their containers.

- Use any equipment or method of application that is not prohibited by the label
- Mix two or more pesticides, if the rates do not exceed the recommended rate on each product, and the combination is not prohibited by the labels of the pesticides

Classification of Pesticide Uses

The Restricted Use Pesticide (RUP) classification is applied to products that, when used in accordance with label directions, **may** cause adverse effects to man or the environment. Products classified as RUP are clearly identified on the label. Applicators who purchase, use, or supervise the use of these pesticides must be certified to do so.

FIFRA considers a pesticide a general use material when the product, used in accordance with label directions, is not expected to cause adverse effect to man or the environment. General use products may be purchased and used by the general public. The labels on general use pesticides will not bear any descriptive statement regarding use classification. The EPA refers to general use products as “unclassified.”

Certification of Applicators

Persons who are not certified pesticide applicators may not purchase or use restricted pesticides unless they are directly supervised by a certified applicator. **Certification** demonstrates competency in the safe and effective handling and use of these pesticides. **Licensing** is the state’s permission to apply pesticides in that state. There are two types of applicators: commercial and private. **Commercial applicators** are persons who apply restricted use and general use pesticides for hire on property other than their own. Private applicators are persons who use restricted use pesticides on their own property. Commercial applicators are trained and tested in the general areas of safe use and handling of pesticides and they receive further training in one or more specific categories of application, including:

- Agricultural pest control (plant or animal)
- Forest pest control
- Ornamental and turf pest control
- Seed treatment
- Aquatic pest control
- Right-of-way pest control
- Industrial, institutional, structural, and health related pest control
- Public health pest control
- Regulatory pest control
- Demonstration and research pest control

Rights-of-way include highways and roads, public airports, railroads, electric utilities (including transformer stations and substations), and pipe lines. Plant growth along rights-of-way must be controlled to make sure that rights-of-way are safe, usable, and not harmful to the environment of the surrounding areas. It is illegal to apply pesticides in categories for which you are not certified.

Certification Standards

Persons who apply pesticides to rights-of-way must be certified in the Right-of-Way Pest Control category. The standards for issuing certification to commercial applicators are specific. Competency must be determined on the basis of a written examination. This examination includes the general standards applicable to all categories (Core) and the additional standards specifically identified for the Right-of-Way Pest Control category. State standards must be at least equal to federal standards. Each state will then issue a license, which is a permit to use certain pesticides in that state. Commercial applicators are licensed only for the category or categories for which they have proven to be competent to use and apply herbicides.

The general standards for testing competency include:

Label and Labeling Comprehension

- The general format and terminology of pesticide labels and labeling
- The understanding of instructions, warnings, terms, symbols, and other information commonly appearing on pesticide labels
- Classification of the product, general or restricted

Safety

- Pesticide toxicity and hazard to man and common exposure routes
- Common types and causes of pesticide accidents
- Precautions necessary to guard against injury to applicators and other individuals in or near treated areas
- Need for and use of protective clothing and equipment
- Symptoms of pesticide poisoning
- First aid and other procedures to be followed in case of a pesticide accident
- Proper identification, storage, transport, handling, mixing procedures, and disposal methods for pesticides and used pesticide containers

Environment

- Environmental consequences of the use and misuse of pesticides
- Weather and other climatic conditions
- Types of terrain, soil or other substrate
- Presence of fish, wildlife and other nontarget organisms
- Drainage patterns

Pests

- Recognition of relevant pests
- Pest development and biology as it may be relevant to problem identification and control

Pesticides

- Types of pesticides
- Types of formulations
- Compatibility, synergism, persistence, and animal and plant toxicity of the formulations
- Hazards and residues associated with use
- Factors which influence effectiveness or lead to problems such as resistance to pesticides
- Mixing procedures

Equipment

- Types of equipment, and advantages and limitations of each type
- Uses, maintenance and calibration

Application Techniques

- Methods and procedures used to apply various formulations of pesticides, solutions, and gases, together with knowledge of application techniques
- Prevention of drift and pesticide loss into the environment

Laws and Regulations

-Applicable state and federal laws and regulations

In addition to the general standards, commercial applicators must meet certain specific standards designated appropriate for their category of certification. Persons seeking certification in the Right-of-Way Pest Control category shall demonstrate practical knowledge of a wide variety of environments since rights-of-way can transverse many different terrains, including waterways. They shall demonstrate practical knowledge of problems of runoff, drift, excessive foliage destruction, and ability to recognize target organisms. They shall also demonstrate practical knowledge of the nature of herbicides and the need for containment of these pesticides within the right-of-way area, and the impact of their application activities on the adjacent areas and communities.

Penalties

If you violate FIFRA, you are subject to civil penalties or fines. They can be as much as \$5,000 for each offense. Violations of the law may also subject you to criminal penalties. They can be as much as \$25,000 or up to one year in prison, or both, for commercial applicators.

PESTICIDE REGISTRATIONS

Every pesticide that is bought, sold, or used in the United States must, by law, have a federal registration granted by EPA. EPA approves not only the product itself, but also each separate use for which it is intended, and the product label. States also require each product sold and used in that state to be registered with the state lead agency. Not all of the herbicides used in railroad vegetation management are registered in all of the states. In addition to federal registration there is a registration (known as SLN or 24 (c) registration) that allows a state, under special circumstances, to register additional uses for a federally registered pesticide. These registrations often involve adding application sites, pests, or alternate control techniques to those listed on the federally registered label. The applicator must have a copy of an SLN label in their possession in order to apply the pesticide for that purpose. These registrations are legal only in the state or local area specified in the SLN registration and could result in fines and penalties if used in other states. The manufacturers representatives will help keep you informed of SLN registrations that pertain to your work. These registrations are rare in rights-of-way use.

Record keeping

Keeping records of herbicide use is required by law. By federal regulations (FIFRA), records for each application of Restricted Use Pesticides (RUP) must be kept on file for a period of two years. Some states require records to be kept on ALL commercial pesticide applications, and may require records to be retained for a longer period of time. They may also require filing herbicide use records with the appropriate state agency. Applicators should check with the individual states.

Records are used to document proper herbicide usage. They can also provide information about the products used or the site conditions if a problem arises regarding the application. Records allow you to compare the results obtained from different herbicides from year to year. The more information that is on record, the more useful the records will be to you. All the information will be right there in front of you. Records are best kept on a standard form to be sure all the necessary data is logged every time.

Important information includes:

- Time of day and date of application
- Target (weeds treated)
- Equipment used
- Herbicides used - common name and brand name

Formulation and percent active ingredient
EPA registration number
Establishment and lot numbers (in case of cross contamination or failure to control)
Total formulation added to tank or hopper
Amount of mixture used
Acres treated
Location
Weather - include wind direction, speed, and temperature (updated throughout the day)
Additional comments
Applicator (name and signature; some states require state applicator license number)

On every report, there should be a space for the applicator to make comments regarding the application that may include severity of infestation, weeds present, skipped areas, or any unusual occurrences that could have an impact on the results. The job is never finished until complete and accurate paper work is done.

SUMMARY

Federal and state laws require you to be certified and licensed to make commercial pesticide applications. The training and subsequent licenses and certifications that you receive make you a professional in your industry. Misusing or violating the laws and regulations can result in having those licenses revoked and paying fines.