

Part 4: Pesticide Formulations

What Is a Pesticide Formulation?

How to Choose a Formulation

Different Types of Formulations

Combining Different Formulations

Key Questions About Pesticide Formulations

- Why isn't there only one kind of pesticide formulation? Wouldn't it be simpler?
- What difference can a pesticide's formulation make on crop injury? pest control? application equipment?
- How would you know if you could tank-mix two pesticides with different formulations?

What Is a Pesticide Formulation?

A formulation is a mixture of the active ingredient in a pesticide with other inert (inactive) substances. Different formulations may be used differently. Some are to be used direct from the package, while others need to be diluted with water, oil, or other carriers. The reason for mixing the active ingredient with other substances is to make handling and application safer, easier, and more accurate.

Some active ingredients do not dissolve in water or oil. Others can only be manufactured as solids. Still others are liquids or gases in their original forms. By mixing the active ingredient with other materials such as solvents, wetting agents, stickers, powders, or granules, manufacturers produce formulations that can be handled accurately and safely by application machinery. A few pesticides are now formulated for controlled release. These pesticides allow the active ingredient to be slowly released after application. This provides better control for certain pests at possibly lower rates and over a longer period of time.

How to Choose a Formulation

A single pesticide is often sold in different formulations. Different formulations of the same active ingredient often behave differently. For example, some types of formulation may mix in water better, while others may increase the chance of crop injury. Choose the formulation that is suitable for the job. Things to consider include:

- Percent of active ingredient.
- Ease in handling and mixing.
- Personal safety risk.
- Type of environment (agriculture, forest, urban, etc.).
- Effectiveness against the pest.

- Habits of the pest.
- The crop to be protected.
- Type of application machinery.
- Danger of drift or runoff.
- Possible injury to crop.
- Cost.

Different Types of Formulations

Emulsifiable concentrates (EC) are liquid formulations in which the active ingredient has been dissolved in oil or other solvents and an emulsifier has been added so that the formulation can be mixed with water or oil for spraying. ECs, along with wettable powders (WP) are the most widely used formulations. An EC usually contains two to six pounds of active ingredient per gallon. ECs are easy to handle and require little agitation. Some crops are sensitive to the ECs of some insecticides; in these cases use a different formulation of the active ingredient (for example, a wettable powder).

High concentrate liquids, spray concentrates, and ultra low volume (ULV) concentrates may be thought of as special EC formulations. They usually contain a high concentration of the active ingredient, as much as eight or more pounds per gallon. Most are made to be mixed with water or oil. ULV concentrates are made to be used directly without dilution; they contain little but the pesticide itself.

Low concentrate liquids or oil solutions (S) contain low amounts of the active ingredient. They are made to be used as purchased, with no further dilution. This type of formulation is often sold for use in controlling household pests, for mothproofing, or in barns as a space spray or spray for livestock.

Flowable liquids (F or L) are made with active ingredients that do not dissolve well in water or oil. The active ingredient is very finely ground and suspended in a liquid along with suspending agents, adjuvants, and other ingredients. The formulation can then be mixed with water and applied. Flowables do not clog spray nozzles, require moderate agitation, and in many ways are as easy to handle as EC formulations.

Solutions and water soluble concentrates (S) are liquids in their original state and are completely soluble in water or other organic solvents. Properly prepared solutions do not leave unsightly residues and will not clog spray equipment. But some can damage crops, so you may have to use another formulation.

Encapsulated pesticides are a fairly new type of formulation. The active ingredient is contained in an extremely small capsule. The capsules are suspended in a liquid. This formulation is mixed with water and applied with conventional sprayers. It is relatively easy and safe to use, but can be

a significant hazard for bees because the bees may take the capsules back to the hive with pollen.

Dusts (D) are a very finely ground mixture of the active ingredient combined with talc, clay, powdered nut hulls, or other such materials. They are used dry; never mix them with water. Some active ingredients that may harm a crop if applied as an EC can be applied without harm as a dust. The percentage of active ingredient is usually quite low. Dust formulations are available for use on seeds, plants, and animals.

Granules (G) are dry particles made up of porous materials, such as corn cobs or walnut shells, to which the active ingredient has been applied. The percentage of active ingredient is lower than in an EC but usually higher than that of a dust formulation. They are usually safer to apply than ECs or dusts. Granular pesticide formulations are most often used as soil treatments. They can be applied directly to the soil or over plants, since they usually do not cling to plant foliage.

Wettable powders (WP) are dry powdered pesticide formulations. They look like dusts but, unlike dusts, they contain wetting and dispersing agents. They are usually more concentrated than dusts, containing 15 to 95 percent active ingredient. The formulation does not form a true solution, so agitation is required in the spray tank to keep the formulation in suspension. Some active ingredients which cannot be formulated into ECs can be formulated into WPs. Good wettable powder formulations spray well and do not clog nozzles, but they are abrasive to pumps and nozzles. Most WPs are less likely than ECs to damage sensitive plants.

Soluble powders (SP), like wettable powders, are dry formulations, but when added to water they dissolve completely and form solutions. Agitation in the spray tank may be needed to get them to dissolve, but, once in solution, agitation is not needed. The percentage of active ingredient is usually high compared to ECs and WPs. Not many SP formulations are available.

Dry flowables look like granules, but are used in the same way as wettable powders. They have several advantages over WPs: they can be poured from their container and measured by volume like a liquid; they are safer to handle because there is little dust in the air when they are measured and mixed. They contain very high concentrations of active ingredient.

Pressure-liquefied gases and fumigants. Some active ingredients are gases that kill when absorbed or inhaled. They are often stored under pressure. Under pressure, the gas may turn to liquid. These formulations may be injected into the soil, released under tarps, or released into a grain storage elevator. Some liquid formulations not stored under pressure turn to gases or vapors after they have been applied to the soil or crop. If the formulation is an insecticide, the vapors of the active ingredient often do most of the killing of the pest. If it is a herbicide, the liquid has to be incorporated into the soil before it turns to a gas; otherwise it will be lost to the atmosphere. Phosphine, one of the most common fumigants for stored grain, is inserted as a solid capsule into the grain, where it vaporizes. Fumigants pose a serious safety risk because they are highly toxic and easily inhaled. They can also burn the skin.

Poisonous baits are foods or other substances mixed with a pesticide that will attract and be eaten by pests and cause their death. They are used to control mice, rats, and other rodents and animals. Baits are also used to control ants, flies, or other insects, including some soil pests. Bait

formulations can be used in whole areas or for spot treatment, indoors and out. The percentage of active ingredient is low compared to ECs and other formulations.

Aerosols are sold mainly for garden and home use, not for agricultural use. They contain one or more pesticides in the same formulation in a can under pressure. Usually the percentage of active ingredients is very low. Their main advantage is that they are convenient to use.

Invert emulsions contain a water-soluble pesticide dispersed in an oil carrier. They require a special kind of emulsifier that allows the pesticide to be mixed with a large volume of oil, usually a fuel oil. When applied, invert emulsions form large droplets which do not drift easily. Invert emulsions are most often used along rights-of-way where there is a problem of pesticide drift on non-target plants.

Adjuvants

An adjuvant is an inert material added to a pesticide formulation. It helps increase the effectiveness of the active ingredient. Most pesticide formulations contain at least a small percentage of additives.

Some applicators also add adjuvants when mixing for special applications. Check the label first because some labels have cautions against adding adjuvants.

Common adjuvants include wetting agents, spreaders, stickers, foaming agents, and compatibility agents.

Combining Different Formulations

Sometimes various pesticides are combined. Some pesticides are registered for use in combination with a liquid fertilizer. If pesticides may be combined safely and effectively, they are called *compatible*. If not, they are called *incompatible*. Incompatibility can be physical or chemical.

Physical incompatibility means that the chemicals cannot physically be mixed together. Solid materials may become deposited at the bottom of the spray tank or the ingredients may become separated into two or more layers following agitation. In some cases, separate parts may come together or foaming or curdling may occur. If chemicals are physically incompatible, the mixture may not be sprayable or the concentrations may vary.

Chemical incompatibility. Even if some chemicals can be mixed together physically, there may be other kinds of incompatibility that may reduce effectiveness or cause injury to the plant.

Pesticide manufacturers try to anticipate combinations that farmers want to use and provide warnings on the label for incompatible mixtures.

Summary

Pesticides come in various formulations. Some are easier to use than others. Some are more effective than others in certain situations. The most commonly used formulations are emulsifiable concentrates and wettable powders, but there are many other types available. It is important to know which type of formulation is the safest and most effective for the crop and pest you wish to treat. Do not combine pesticides that are physically or chemically incompatible.