



# SOIL

---

## Herbicide Formulations

no. 0.558

by P. Miller and P. Westra <sup>1</sup>

### Quick Facts...

The primary kinds of herbicide formulations are:

Solution (may be designated S).

Soluble powder (may be designated SP).

Emulsifiable concentrate (may be designated E or EC).

Wettable powder (may be designated W or WP).

Liquid flowable (may be designated F or FL).

Dry flowables and water-dispersible granules (may be designated DF, DG or WDG).

Granules and pellets (may be designated G, P or PS).

Typically, pure herbicide molecules are of limited value to the end user. To give them practical value and usable, most herbicides are combined with appropriate solvents or surfactants to form a product called a *formulation*. Herbicides are available as formulations and rarely as the pure chemical. In addition, a given chemical may be formulated in a variety of differing formulations and sold under different trade names.

The primary reason for formulating a herbicide is to allow the user to dispense it in a convenient carrier, such as water. The primary purpose of the carrier is to enable the uniform distribution of a relatively small amount of herbicide over a comparatively large area. In addition to providing the consumer with a form of herbicide that is easy to handle, formulating a herbicide can enhance the phytotoxicity of the herbicide, improve the shelf-life (storage) of the herbicide, and protect the herbicide from adverse environmental conditions while in storage or transit.

Formulations vary according to the solubility of the herbicide active ingredient in water, oil and organic solvents, and the manner the formulation is applied (i.e., dispersed in a carrier such as water or applied as a dry formulation itself).

### Solution (S)

Solution formulations are designed for those active ingredients that dissolve readily in water. The formulation is a liquid and consists of the active ingredient and additives. When herbicides formulated as solutions are mixed with water, the active ingredient will not settle out of solution or separate.

### Soluble Powder (SP)

Soluble powder formulations are similar to Solutions (S) in that, when mixed with water, these dry formulations dissolve readily and form a true solution. The formulation is dry and consists of the active ingredient and additives. When thoroughly mixed, no further agitation is necessary to keep the active ingredient dissolved in solution. Few formulations of this type are available because few active ingredients are highly soluble in water.

### Emulsifiable Concentrate (E or EC)

Formulations of this type are liquids that contain the active ingredient, one or more solvents, and an emulsifier that allows mixing with water. Formulations of this type are highly concentrated and relatively inexpensive per pound of active ingredient; easy to handle, transport, and store; require little agitation (will not settle out or separate); and are not abrasive to machinery or spraying equipment. Formulations of this type may, however, have potentially

**Colorado  
State**  
University  
Cooperative  
Extension

© Colorado State University  
Cooperative Extension. 12/96.  
Reviewed 10/98.

[www.colostate.edu/Depts/CoopExt](http://www.colostate.edu/Depts/CoopExt)

greater phytotoxicity than other formulations; exhibit a potential for over- or underdosing through mixing or calibration errors; are more easily absorbed through skin of humans or animals; and contain solvents that may cause deterioration of rubber or plastic hoses and pump parts.

### **Wettable Powder (W or WP)**

Wettable powders are dry, finely ground formulations in which the active ingredient is combined with a finely ground carrier (usually mineral clay) along with other ingredients, to enhance the ability of the active ingredient plus carrier to suspend in water. The powder is mixed with water for application.

Wettable powders are one of the most widely used herbicide formulations and offer low cost and ease of storage, transport, and handling; lower phytotoxicity potential than ECs and other liquid formulations; and less skin and eye absorption hazard than ECs and other liquid formulations.

Some disadvantages are that they require constant and thorough agitation in the spray tank, are abrasive to pumps and nozzles (causing premature wear), may produce visible residues on plant and soil surfaces, and can create an inhalation hazard to the applicator while handling (pouring and mixing) the concentrated powder.

### **Liquid Flowable (F or FL)**

Liquid flowable formulations consist of finely ground active ingredient suspended in a liquid. Flowables are mixed with water for application, are easily handled and applied, and seldom clog nozzles. Some of their disadvantages are that they may leave a visible residue on plant and soil surfaces, and typically require constant and thorough agitation to remain in suspension.

### **Dry Flowables and Water-Dispersible Granules (DF, DG or WDG)**

Dry flowable and water-dispersible granule formulations are much like wettable powders except that the active ingredient is formulated on a large particle (granule) instead of onto a ground powder. This type of formulation offers essentially the same advantages and disadvantages as wettable powder formulations. However, these formulations generally are more easily mixed and measured than wettable powders. Because they create less dust when handling, they cause less inhalation hazard to the applicator during pouring and mixing.

### **Granules and Pellets (G, P or PS)**

Used exclusively for soil applied herbicides, the active ingredient is formulated onto large particles (granules or pellets). The primary advantages of this type of formulation are that the formulation is ready to use with simple application equipment (seeders or spreaders), and the drift potential is low because the particles are large and settle quickly. The disadvantages of these formulations are that they do not adhere to foliage (not intended for foliar applications), and may require mixing into the soil in order to achieve adequate herbicidal activity.

### **How and Why Should You Select a Specific Formulation Type?**

The active ingredient is the agent in a formulation that has a specific effect on a pest (weed). Select the formulation that will be best for an application and consider the following points:

What is the pest you are concerned with?

- How will the formulation affect the phytotoxicity of the undesirable plant(s) you wish to manage and/or the desirable plant(s) you wish to maintain?
- How will the formulation influence the compatibility of other crop protection chemicals?

What application machinery is available to you and most suited for the job?

- How will the formulation affect the life of your application equipment?
- Is your equipment designed for applying a particular formulation?

What concerns do you have with safety for the applicator and other people?

- An active ingredient may be available in a variety of formulations. These formulations may vary in ease of handling and human exposure potential.

Some of the specific issues to consider when selecting an herbicide formulation are described above. The table which follows illustrates the general features associated with a specific herbicide formulation, and can be used as an aid in selecting an herbicide based on differences in formulation.

Some of the information for this publication was adapted from the following sources: *Applying Pesticides Correctly*, Slide Set - Unit 6 (Harmful Effects), Slide Set - Unit 7 (Personal Protective Equipment), Slide Set - Unit 8 (Pesticide Handling Decisions), The Ohio State University, USDA, Office of Pesticide Programs, US EPA.

**Table 1: A comparison of herbicide formulation handling, application, and performance characteristics.**

Formulations	Mixing/Loading Hazards	Phytotoxicity	Effect on Application Equipment	Agitation Required	Method of Application	Compatible With Other Formulations
wettable powders	dust inhalation	safe	abrasive	yes	foliar and soil	highly
dry flowables/ water-dispersible powders	safe	safe	abrasive	yes	foliar and soil	good
soluble powders	dust inhalation	usually safe	non-abrasive	no	foliar and soil	fair
emulsifiable concentrates	spills and splashes	possible	may affect rubber parts	yes	foliar and soil	fair
liquid flowables	spills and splashes	possible	may affect rubber parts	yes	foliar and soil	fair
solutions	spills and splashes	safe	non-abrasive	no	foliar and soil	fair
granules and pellets	safe	safe	-	no	soil	-

<sup>1</sup>P. Miller, Colorado State University post-doctoral research fellow, and P. Westra, Cooperative Extension weed specialist and professor; bioagricultural sciences and pest management.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Milan A. Rewerts, Director of Cooperative Extension, Colorado State University, Fort Collins, Colorado. Cooperative Extension programs are available to all without discrimination. No endorsement of products mentioned is intended nor is criticism implied of products not mentioned.