

Adjuvants ¹

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Adjuvants are substances used with a herbicide or other pesticide to enhance performance. Adjuvants may be added to the product at the time of formulation, or by the applicator to the spray mix just prior to treatment. Adjuvants include surfactants, compatibility agents, anti-foaming agents and spray colorants (dyes), and drift control agents.

Care should be taken when selecting an adjuvant. Herbicide performance can differ depending on what type of adjuvant is used. The herbicide label will state if specific surfactants are required and the amount (%) of active ingredient it must contain. Crop injury or reduced herbicide activity may occur if these guidelines are not followed.

The intent of this publication is to list the different types of adjuvants used in pesticide application. In addition, this publication provides some background on how these materials aid in pesticide application and performance. It is **not** intended as a guide for selecting which adjuvant to use with a particular pesticide product.

SURFACTANTS

Surfactants (surface-active ingredients) are substances that improve the emulsifying, dispersing, spreading, wetting, or other surface modifying properties of liquids. A surfactant increases the spray coverage on the foliage. This helps more of the herbicide to be taken up in the plant. Surfactants include emulsifying agents, wetting agents (spreaders), crop oil concentrates, and stickers.

Emulsifying Agents

An emulsion is a mixture of two incompletely mixed liquids, one of which is dispersed in the other. The surrounding liquid is called the *continuous phase*, while the dispersed liquid is known as the *discontinuous phase*. Emulsifying agents promote the suspension of one liquid in another.

There are two types of emulsions used in the application of herbicides. The type more commonly used is the "oil-in-water" emulsion, in which water is the continuous phase. When using this type of emulsion, the consistency of the spray mixture is

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The use of trade names in this publication is solely for the purpose of providing specific information. UF/IFAS does not guarantee or warranty the products named, and references to them in this publication does not signify our approval to the exclusion of other products of suitable composition. Use herbicides safely. Read and follow directions on the manufacturer's label. All chemicals should be used in accordance with directions on the manufacturer's label.

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usually similar to water. The second type of emulsion is the "water-in-oil" emulsion, in which the oil is the continuous phase. These emulsions, also referred to as "invert" emulsions, are normally rather viscous.

It seems that the character of the emulsifying agent is a large factor in determining the kind of emulsion that is formed. The "oil-in-water" emulsions are widely used in the formulation of herbicides to aid in getting an oil-soluble herbicide dispersed in a water mixture so that the active ingredient may be applied as a water spray. Invert emulsions are used to aid in drift control, to improve resistance of the herbicide treatment to the effects of weather (rain), to improve accuracy of delivery of the herbicide, and to enhance herbicide activity.

Wetting Agents (Spreaders)

Wetting agents or spreaders are added to spray mixtures to decrease the surface tension of the mixture, causing a larger portion of each spray droplet to come into contact with the surface of the vegetation. This is done to increase the coverage and thus the effectiveness of the herbicide, although in some cases it may alter herbicide selectivity.

There are four types of spreaders available: anionic, cationic, nonionic, and amphoteric. Anionic and cationic surfactants have electrical charges in water while nonionic surfactants do not have an overall electrical charge. Amphoteric may have positive or negative charges depending on the pH of the solution. Be sure that the type, if any, recommended in the herbicide label is selected. Most herbicides will recommend the use of a non-ionic type surfactant.

Crop Oil Concentrates

A crop oil concentrate refers to products that contain 80 to 85% petroleum or vegetable oil plus 15 to 20% surfactant and emulsifiers. An emulsifiable oil generally refers to products that contain about 98% oil and 1 to 2% emulsifiers. This group is often called nonphytotoxic oils and phytobland oils.

Silicone Surfactants

Silicone surfactants are silicone-based and provide a tremendous reduction in water surface tension at very low concentrations. Typical concentrations range from 0.10 to 0.25% on a volume/volume basis.

Stickers

Stickers are adjuvants that cause the herbicide to adhere to the plant foliage. They prevent runoff of the spray mixture from the target vegetation. By increasing the amount of spray remaining in contact with the vegetation and increasing the contact time of the herbicide, the desired result is an increase in the effectiveness of a herbicide application.

Surfactant Selection

The numerous types of surfactants available often lead to confusion. The following suggestions will aid in selecting a suitable surfactant:

1. Purchase a surfactant specifically manufactured and marketed for agricultural use. This is the case particularly for non-ionic surfactants, where only those sold specifically for pesticide use should be used.
2. Purchase a surfactant on the basis of percentage active ingredient. For example, it is less profitable to purchase a product with 10% active ingredient at \$4/gal than it is to purchase a product with 85% active ingredient at \$12/gal.
3. Isopropyl alcohol or water should not be considered as active ingredients. If the label on the container does not specifically state the percentage active ingredient in the container, ask the dealer for this information.
4. Products manufactured for household use should not be used with herbicides.
5. Be careful with claims that a surfactant may cost more, but can be used at lower concentrations than with conventional surfactants. Evidence does not exist that there is any one particular surfactant being marketed that is so effective that rates may be reduced and still obtain normal control.

6. Ignore claims such as: *the surfactant contains a silicone or some other agent that will help keep the spray equipment clean, or the surfactant increases water penetration into the soil, or the use of the surfactant will increase root penetration and nutrient uptake by the crop.*
7. There are no “miracle” surfactants. There are none that perform substantially better that justify a significant price increase.
8. Some products are recommended to be used with certain surfactants. Consult the label for the approved list.

droplets. Thickeners may also be used as drift control agents.

COMPATIBILITY AGENTS

These adjuvants are used to aid in the suspension of herbicides when they are combined with other pesticides or fertilizers. They are used primarily when the carrier solution is a liquid fertilizer.

ACIDIFIERS AND BUFFERS

Acidifiers are acids that can be added to herbicide spray mixtures if there is a need to neutralize alkaline solutions and lower the pH. Acidifiers do not have a buffering action. Buffers are capable of changing the pH of a water solution to a certain level, which will be maintained even if the pH of the solution changes.

ANTI-FOAMING AGENTS AND SPRAY COLORANTS

An anti-foaming agent can eliminate the excess foam that can result when certain herbicide mixtures undergo mixing or agitation in the spray tank. Spray colorants are dyes that can be added to the spray tank so an applicator can see the areas that have been treated.

DRIFT CONTROL AGENTS

Drift of herbicide sprays can be a problem when sensitive plants are in the vicinity of the site of application. One way to reduce herbicide drift is to increase the droplet size of the spray. Adjuvants (drift control agents) that are used to control drift do so in part by reducing the number of fine spray