Adjuvants Used With Herbicides: Factors to Consider

The terminology for herbicidal additives is confusing. It is often assumed that any material that lowers the surface tension of water in the spray mixture or increases the wettability of the spray solution on plant leaf surfaces is an adequate adjuvant. Since the exact role and function of agricultural adjuvants are not fully understood, the various terms that are used to describe spray adjuvants are often erroneously assumed to be synonymous.

The following discussion is intended to describe the different types of adjuvants that are used with herbicides and explain their role in increasing herbicide efficacy.

Adjuvants are materials that facilitate the activity of herbicides or that facilitate or modify characteristics of herbicide formulations or spray solutions.

It is obvious that, with this array of uses and purposes, the term adjuvant encompasses a wider meaning than wetting agent or surfactant. While all surfactants or wetting agents are adjuvants, not all adjuvants are surfactants or wetting agents. There are many adjuvants that have little, if any, effect on herbicidal activity.

Surfactants are materials that facilitate and accentuate the emulsifying, dispersing, spreading, wetting, or other surface modifying properties of liquids.

Wetting agents are compounds that, when added to a spray solution, cause it to cover plant surfaces more thoroughly.

Adjuvants are either included in herbicide formulations as part of the total product, or are sold as an additive to be mixed with herbicide products in a spray tank. Adjuvants can be classified according to their type of action, and the choice of an adjuvant should be based on the specific need to facilitate the herbicide being applied.

There are three basic types of adjuvants used with herbicides:

1. Activator adjuvants which include surfactants, wetting agents, penetrants, and oils
2. Spray modifier agents which include stickers, film formers, spreaders, spreader-stickers, deposit builders, thickening agents, and foams.
3. Utility modifiers which include emulsifiers, dispersants, stabilizing agents, coupling agents, Co solvents, compatibility agents, buffering agents, and anti-foam agents

Spray modifier agents and utility modifier adjuvants, are usually found as part of the herbicide formulation, and thus, are added to the herbicide product by the manufacturer. Activator agents are the best known class of adjuvants because they are normally purchased separately by the user and added to the herbicidal solution in the spray tank. However, there may be a need, at times, to add an adjuvant from any of the three classes to a spray solution to achieve a desired result.

Uses for Adjuvants in Herbicides

- Wetting agents
- Penetrants
- Spreaders
- Co-solvents
- Deposit builders (stickers)
- Stabilizing agents
- Drift control agents

Types of Adjuvants

- Anti-foam agents
- Buffering agents
- Compatibility agents
- Liquid fertilizer-herbicide mixtures
Adjuvants Use With Herbicides

Most of the commonly used postemergence herbicides will show increased activity when an activator agent is added to the spray mixture. The manufacturer of the herbicide will specify on the product label the specific type of adjuvant to add, as well as the concentration at which the adjuvant should be added in order to maximize the efficacy of the herbicide.

When an adjuvant is required in a herbicidal spray mixture, keep in mind the purpose for adding the adjuvant, and use the type of adjuvant that meets the required need.

If spray drift onto sensitive areas is a problem, buy a product to help control drift, not one which increases penetration of the herbicide into the plant foliage. If foaming in the spray tank is a problem, a product which will lower foaming activity should be considered.

Other than adding an adjuvant to decrease spray drift risk or prevent excessive foaming of the spray solution, on-farm adjuvants should primarily be used in accordance with the product label instructions to increase wetting and penetration of foliar applied herbicides. Thus, an activator is the most common adjuvant used on-farm.

Surfactants

Confusion frequently occurs concerning the proper selection and use of surfactants with herbicides. It is wrong to assume that any product that lowers the surface tension of water or increases the wettability of a spray solution can be used as a surfactant.

For example, such products as household soaps and detergents can combine with hard water to form precipitate or scum causing the herbicide to want to fall out of solution, whereas agricultural surfactants keep the herbicide in solution.

Anionic and cationic surfactants form electrical charges in water (negative and positive, respectively). Cationic surfactants can be toxic to plants and are not generally used with herbicides. Anionic surfactants have good foaming abilities and are often blended with nonionics to provide the wetting and emulsifying properties of a herbicide formulation. Nonionic surfactants do not form an overall charge. Amphoteric surfactants may or may not form a charge depending on the acidity of the spray solution.

Nonionic surfactants are the type usually sold for adding to herbicide spray solutions. These surfactants are good dispersing agents, stable in cold water, and have low toxicity to both plants and animals.

Crop Oils

Crop oils and crop oil concentrates, like surfactants, improve coverage of plant surfaces. However, crop oils keep the leaf surface moist longer than water alone or a water and surfactant mixture, allowing more time for the herbicide to penetrate, and thus, increasing the amount of herbicide that will enter the plant.

Crop oil concentrates contain (80 to 87% oil and 13 to 20% emulsifiers/surfactants and are used at rates of about 1 to 2 quarts per acre.

The oil component of crop oil concentrates can be derived from either petroleum oil (Crop Oil Concentrate, COC) or soybean/vegetable oil (Methylated Seed Oil, MSO). One of the most important uses of crop oil concentrates is postemergence herbicides used in corn and soybeans.

Inorganic Salts

In some cases, particularly with acid types of herbicides such as glyphosate, inorganic salts are added to herbicide solutions. While this practice is becoming increasingly popular, there is still relatively little known about the mechanism of action of inorganic salt additives in herbicide sprays. Several popularly used herbicides have included on their label the use of inorganic
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salts, alone or in combination with surfactants or crop oil concentrates.

Most research indicates that inorganic salts of the monovalent cations of ammonium (NH4+), potassium (K+), or sodium (Na+) salts generally result in the greatest increase in phytotoxicity of water soluble herbicides, with ammonium sulfate being the most popular salt additive. Other salts of divalent and trivalent cations such as calcium (Ca++), zinc (Zn++), and iron (Fe++), for the most part, decrease the activity of commonly used translocated herbicides such as 2,4-D or glyphosate.

Caution should be taken to use the correct inorganic salt that is suggested on the herbicide label, add it to the spray solution at the recommended concentration, and with the suggested surfactant or crop oil that is listed on the herbicide product label.

When purchasing a suitable agricultural adjuvant for herbicide use, consider the following suggestions:

1. Purchase an adjuvant that is manufactured and marketed for agricultural use with herbicides.

Do not purchase products made for household use. Many of these detergents are more expensive and less active than agricultural adjuvants. They may be mixed or combined with products that interact with herbicides to reduce the level of weed control. These products can cause foaming or equipment malfunction.

2. When purchasing a surfactant, buy on the basis of percent active ingredient. Most herbicide labels call for the use of a surfactant with 75% or greater active ingredient. Read the label carefully to determine the active ingredients listed on the surfactant label.

Do not consider isopropyl (isopropanol) and other alcohols or water as active ingredients. Some products list these solvents as part of the active ingredient or as functioning agents. Most spray adjuvants will clearly show on the label, active ingredients, inactive ingredients, and principal functioning agents as a percentage of the total.

3. Be wary of claims such as, “even though this adjuvant may cost much more, it can be used at lower concentrations than other adjuvants on the market.” Many adjuvants have had limited field testing. Little evidence exists to prove that a particular adjuvant is so effective that greatly reducing its concentration over other suitable adjuvants will result in equal or better weed control or reduce product cost.

4. Purchase agricultural adjuvants to improve herbicide coverage and penetration into plant foliage. Ignore claims such as “this product has certain properties which will keep the spray equipment clean,” or “this adjuvant will increase water penetration into the soil,” or “it will increase root penetration or nutrient uptake.”

There are no “miracle” adjuvants. Most activator adjuvants are good products and will increase the performance of foliar applied herbicides when used at the recommended rate suggested on the herbicide label. No adjuvant used in a herbicide spray solution can justify a greatly increased price per unit, and none is so effective that the use rates can be lowered below those recommended on the herbicide label.

Soil applied herbicides do not need additional adjuvants. Maximum weed control for soil applied herbicides can best be obtained by applying the proper use rate.

References

1. Adjuvants for Herbicides. 1982. Published by the Weed Science Society of America, Champaign, IL.