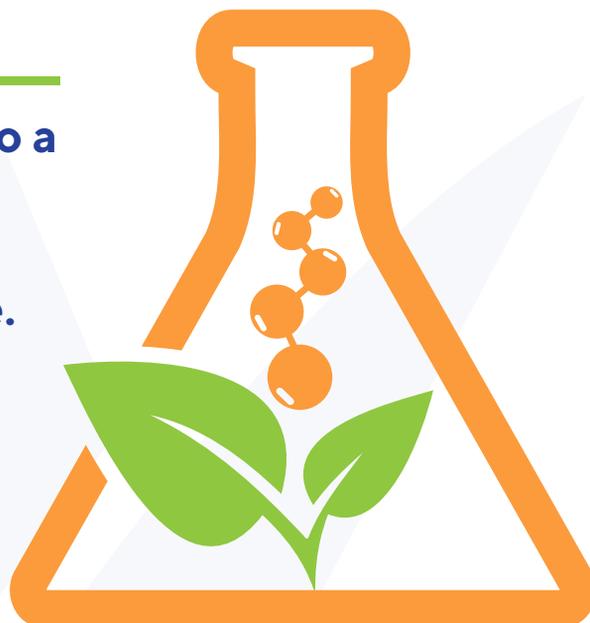


ADJUVANTS

by Crop Excellence®

ADJUVANTS are materials added to a tank mix to enhance or modify the pesticide and/or the physical characteristics of the spray mixture. Adjuvants have become increasingly important to the production, marketing, application, and effective use of crop protection chemicals.



There are hundreds of pesticides registered by the U.S. Environmental Protection Agency that have specific recommendations for the use of adjuvants. These recommendations require the addition of specific TYPES of adjuvants that provide certain FUNCTIONS, such as increasing pesticide efficacy and/or minimizing or eliminating spray application problems.

Adjuvants affect pesticide efficacy by modifying the spray solution to increase the wetting, spreading, sticking, and penetrating characteristics of the solution. Adjuvants may also reduce or eliminate common spray application problems by dispersing, suspending, and solubilizing pesticides or by reducing evaporation, degradation, foaming, and drift.

Although adjuvants have been commercially available for many years, they may well be the most misunderstood crop protection products on the market today. While an adjuvant may provide several of the properties listed above, no single adjuvant can perform all adjuvant functions. Consistent and effective results from the use of adjuvants will depend upon proper adjuvant selection; specific to a particular pesticide, weed spectrum, and environmental condition.



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ADJUVANT TYPES

While there are many types of adjuvants providing a wide variety of functions, some of the most common are:

- | | |
|---|-------------------------------------|
| 1) Nonionic Surfactants | 6) Drift Control Agents |
| 2) Organosilicone Surfactants | 7) Antifoaming and Defoaming Agents |
| 3) Crop Oil Concentrates | 8) Ammonium Sulfate Solutions |
| 4) Methylated Seed Oil (MSO) Concentrates | 9) Water Conditioners |
| 5) Methylated Seed Oil (MSO) with Non-ionic Organosilicones | 10) Foam Marker Concentrates |

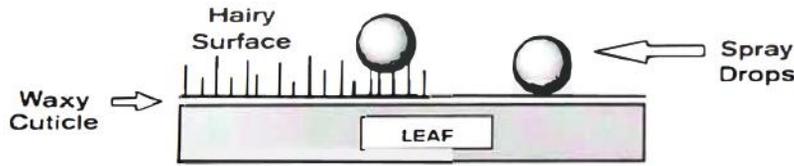
NONIONIC SURFACTANTS

A **SURFACTANT** is a material that improves the emulsifying, dispersing, spreading, wetting, or other surface-modifying properties of liquids.

Surfactant = Surface-Active Agent

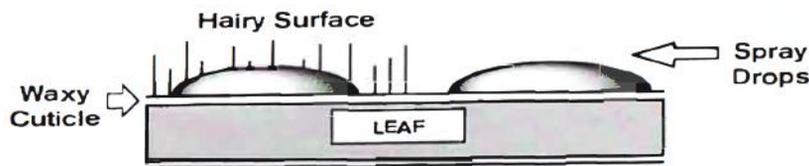
A surfactant will reduce the internal energy of a spray droplet that holds the droplet into a sphere and causes it to "bead up" on leaf surfaces. This energy is called **SURFACE TENSION** and is measured and expressed in dynes/cm. The greater the surface tension of a spray droplet, the more it will "bead up" on the leaf surface. The surface tension of water is generally recognized to be 72 dynes/cm.

Without a Surfactant



Surfactants lower the surface tension of the spray droplet, increasing coverage of the leaf surface. Most quality surfactants will reduce the surface tension of the spray solution to 20-30 dynes/cm. In general, the addition of surfactants to spray tank mixtures will result in quick wetting, more uniform droplet distribution and greater coverage of the leaf surface.

With a Surfactant



"Maximum Coverage"

While the most commonly used surfactants provide increased wetting and coverage of the leaf surface, many surfactants also contain **PENETRANTS** that will assist in the transportation of the pesticide into the leaf's internal transportation system. A surfactant/penetrant modifies the waxy cuticle of a leaf, allowing the pesticide to penetrate through the "barriers" and into the transportation system. This is particularly important when using systemic pesticides that must translocate within the plant to be effective.



Crop Oil Concentrate Checklist

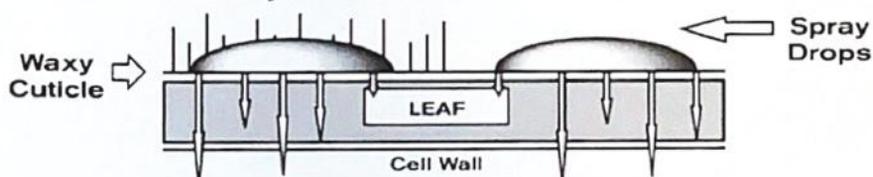
- ✔ Contains 15 – 20% w/w of a quality surfactant/emulsifier.
- ✔ Contains a highly refined paraffin oil specifically designed for agricultural spray adjuvants having a minimum UR of 92.
- ✔ Provides excellent emulsifying and dispersing characteristics to prevent tank mix separation.
- ✔ Raw materials are exempt from the requirements of a tolerance for use on growing crops and raw agricultural commodities.

METHYLATED SEED OIL (MSO) CONCENTRATES

METHYLATED SEED OIL (MSO) CONCENTRATES are emulsifiable, chemically-modified vegetable oil products designed to increase plant penetration and pesticide absorption. MSO concentrates generally contain blends of aliphatic C16-C18 methyl esters from the chemical reaction (transesterification) of various crop-derived seed oils with methanol. This methyl ester combination is further enhanced with the addition of an emulsifier/ surfactant blend.

A major barrier in penetrating the plant cuticle is the epicuticular wax. This "surface wax" is one of the most important components of the cuticle as far as foliar retention and penetration of herbicidal sprays are concerned. MSO concentrates (which have chemical structures similar to this surface wax) are effective in breaking through this cuticle barrier by way of dissolution of the epicuticular wax.

With Methylated Seed Oils



"Coverage, Penetration and Transportation"

By penetrating the waxy cuticle of the plant, MSO concentrates increase pesticide absorption into the leaf's internal transportation system, providing significant herbicide activity enhancement. MSO concentrates are especially effective when weeds are on the larger side or during periods when plants are under moisture or temperature stress. Under these circumstances, the epicuticular wax on the plant's cuticle is built up as part of its survival mechanism. Therefore, the solubility characteristics of MSO concentrates are desirable to effectively penetrate the waxy cuticle and allow the pesticide to translocate throughout the plants transportation system.

A significant (and often overlooked) portion of MSO concentrates is the emulsifier/ surfactant blend. This blend must sufficiently emulsify and disperse the methyl esters to prevent tank mix separation. The emulsifier/surfactant blend must also provide adequate spreading and wetting characteristics to allow complete coverage of the plant surface.



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What is a Micron?

Spray particles are measured and expressed in units called MICRONS. The worst drift problems are from the smallest, non-visible particles. A droplet with a size of 50 microns is not visible to the naked eye and may be carried indefinitely in the air due to normal air turbulence. There are 25,400 microns in an inch!

While reducing pesticidal spray drift is the main function of drift control agents, by increasing the average particle size of the spray solution to a range of 250 - 500 microns, they also increase the amount of technical material being deposited on the intended target area. This increased deposition reduces the costs of the application to the grower by ensuring complete coverage and activity of the spray solution. Additionally, many drift control agents reduce the rate of evaporation of the spray solution, thereby increasing the time available for activation and penetration.

Although particle size is the most important factor effecting drift, it is certainly not the only variable to be considered when evaluating the tendency of a spray solution to drift. Additional factors that must be taken into consideration include nozzle type and position, spray pressure, chemical formulation, environmental conditions and others. Effective reduction of spray drift is subject to an accurate evaluation of all conditions, and the use of common sense and sound application technology. Drift controls will retard, but cannot totally eliminate drift.

ANTIFOAMING AND DEFOAMING AGENTS

***ANTIFOAMING AND DEFOAMING ADDITIVES* are typically 10% silicone-based emulsions. These products are designed to provide excellent foam control in most water-based systems.**

Foam generation is a problem in many spray tank combinations, particularly with Glyphosate. As the product description suggests, these formulations can be used prior to mixing as a foam preventive or after foam generation as a defoamer. The following properties are desirable in an Antifoaming-Defoaming Agent.

- ❖ Quickly dispersible
- ❖ High degree of spreadability
- ❖ Compatible with all Glyphosate formulations
- ❖ Stable formulation
- ❖ Low usage rates 1/2 - 2 ounces per 100 gallons of solution

AMMONIUM SULFATE SOLUTIONS

These products are designed to replace dry Ammonium Sulfate in situations where the herbicide label calls for Ammonium Sulfate. AMS solutions are designed to alleviate tank mix problems commonly associated with dry AMS. When used as directed, AMS solutions maximize the activity and effectiveness of certain herbicides in post emergence applications. These products typically contain a drift control component, which increases spray droplet diameter, and allow more spray to hit the intended target.



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WATER CONDITIONERS

These formulations typically contain Ammonium Sulfate, acidifiers, buffering, and chelating agents and are designed for use with pesticides affected by hard water conditions. These products offer the following benefits:

- ❖ Prevents hard water cation interaction with pesticidal salts
- ❖ Provides ammoniacal nitrogen
- ❖ Reduces the pH of the tank mix
- ❖ Controls alkalinity caused by carbonate compounds
- ❖ Enhances uptake of herbicide in various plant species
- ❖ Aids in mixability and solubility of certain pesticides, especially Glyphosates, 2,4-D amines and Garlon salts

FOAM MARKER CONCENTRATES

FOAM MARKER CONCENTRATES are blends of high foaming surfactants and foam stabilizers, used with foam generating equipment to produce a dense foam for marking treated areas of a field.

These products are designed to provide consistent and stable foam in all water hardness's and weather conditions. These formulations are easy to use and typically used at a 100:1 dilution rate. Foam markers should be economical, non-flammable, and effective without the use of expensive chemical water softeners.

ADDITIONAL ADJUVANTS

- Compatability Agents:** Materials that reduce or eliminate problems of separation or clumping by improving stability and uniform distribution.
- Stickers:** Materials that assist the spray deposit in adhering or sticking to the sprayed surface. Stickers protect the pesticide from washing off the plant surface due to rainfall, heavy dew, or irrigation.
- Nitrogen Solutions:** Nitrogen fertilizers for use as an adjuvant to increase pesticide uptake.
- Tank Cleaners:** These products ore formulated to remove herbicide residues in spray equipment that plain water will not remove. This eliminates the risk of herbicide injury on desirable crops.

A Final Reminder and "Excellent Advice"

Some of the products presented in this brochure, and others not listed, have similar or overlapping functions and/or modes of action. However, all of these products are extremely different in chemical composition and effectiveness. Consistent and effective results from the use of adjuvants will depend upon proper selection. This determination must be based upon ALL factors relevant to weed management and crop protection. These include pesticide selection, weed spectrum, environmental conditions, phytotoxicity, and others.

A critical variable effecting consistent and reliable results from the use of adjuvants is QUALITY. Unfortunately, evaluation of the quality of a surfactant is, of best, quite difficult since they are not regulated by the EPA. Two of the most important considerations should be the history of performance and the source of supply of the adjuvant. The best protection when choosing a quality adjuvant is knowledge. It is with this in mind that Crop Excellence® has produced this brochure.



