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.



ADJUVANT TYPES

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

- 1) Nonionic Surfactants
- 2) Organosilicone Surfactants
- 3) Crop Oil Concentrates
- 4) Methylated Seed Oil (MSO) Concentrates
- 5) Methylated Seed Oil (MSO) with Non-ionic Organosilicones

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"

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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 systematic pesticides that must translocate within the plant to be effective.

- 6) Drift Control Agents
- 7) Antifoaming and Defoaming Agents
- 8) Ammonium Sulfate Solutions
- 9) Water Conditioners
- 10) Foam Marker Concentrates

With a Surfactant/Penetrant



"Maximum Coverage + Penetration"

What should I look for in a Nonionic Surfactant?

Although most pesticide labels require that a surfactant contain at least 80% active ingredient, this determination can prove difficult since surfactants are unregulated by the EPA and the term "active ingredient" is not definitive. In an effort to reduce costs, many surfactants contain excessive amounts of alcohols, oils or glycols as part of their active ingredients. Although these "diluents" may provide some benefit to the adjuvant formulation, when used in extreme amounts they serve no purpose, other than to reduce the surfactant cost.

Whereas it can be difficult and often impossible to determine the exact percentage of an active ingredient in a particular surfactant, the following guidelines and specifications can be used in the evaluation of a surfactant:

- 1) The surfactant should have a history of performance and nonphytotoxity.
- 2) At least 50 % of the formulated product should be composed of a high quality nonionic surfactant (defined as a material that has a surface tension (0.25 % Aq.) of less than 50 dynes/cm).
- 3) The nonionic surfactant should have an HLB ratio (defined as the hydrophilic to lipophilic balance of the molecule) between 12-17.
- 4) The formulated product should have a surface tension (0.25% Aq.) of less than 30 dynes/cm.
- 5) The surfactant should have a Draves Wetting Time (0.25% Aq.) of less than 30 seconds.
- 6) The surfactant should contain less than 10% alcohol.
- 7) The percentage of solids in an adjuvant is NOT a good determinant of a quality surfactant (certain diluents may register as solids but have no beneficial adjuvant qualities).

An accurate evaluation of a quality surfactant CANNOT be made on the basis of only one of the above specifications. Over-reliance on a single parameter is fraught with difficulty. While a single criteria may be useful to establish trends and determine an approximate range of desired physical properties, one specification is NOT adequate to make an accurate determination of quality. Therefore, ALL of the above guidelines should be used collectively when making an evaluation of a surfactant.



ORGANOSILICONE SURFACTANTS

ORGANOSILICONE SURFACTANTS were developed for water-based herbicide applications in agriculture, horticulture, industrial, turf and forestry operations.

These products may be used with most pesticides and fertilizer products. They are also recommended for use with non-selective herbicides and other pesticides including those used to desiccate or defoliate. Organosilicones are designed to enhance the following properties to spray solutions:

- V Quick spreading and wetting
- V Uniform droplet distribution
- Absorption on leaf and stem surfaces

CROP OIL CONCENTRATES

CROP OIL CONCENTRATES are emulsifiable petroleum oil-based products containing 15 to 20% w/w surfactant/emulsifier and a minimum of 80% w/w phytobland oil. They are used to enhance performance of postemergence pesticides through increased coverage and penetration of the leaf surface.

Crop oil concentrates modify the waxy cuticle of a leaf, allowing the pesticide to penetrate into the transportation system of the plant. They are also effective in reducing the surface tension of the spray droplets and increasing retention and drying time. These properties ensure uniform droplet distribution and increased absorption of the pesticide for improved efficacy.

Base oil selection and unsulfonated residue are two of the most critical and misunderstood properties in the evaluation and selection of a quality crop oil concentrate.

Base Oil Selection

PARAFFINIC OILS are generally the most suitable for use in crop oil concentrates and are characterized by saturated open chain hydrocarbons. Paraffins are the most stable hydrocarbon structure in application s requiring oxidation, heat and light stability. Accordingly, paraffins are the predominant hydrocarbon structure found in superior crop oil concentrates because they are less likely to react and cause phytotoxicity.

NAPHTHENIC OILS are generally regarded as a less suitable choice for use in agricultural spray adjuvants. Characterized by saturated hydrocarbons in a ring structure, naphthenic oils are more likely lo cause phytotoxicity.

Unsulfonated Residue (UR)

UNSULFONATED RESIDUE (UR) measures the degree of refinement or purity of the oil. It is an indication of the percentage of stable unreactive hydrocarbons in the oil. A paraffinic oil with high UR indicates a high level of unreactive compounds and less chance of phytotoxicity. Crop oil concentrates should contain a paraffinic oil with a minimum of 92% to minimize any phytotoxicity problems.

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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.
- Y 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, chemicallymodified 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.





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.



A Guide to MSO Concentrates

- Y The methyl esters should be from 100% crop-derived vegetable oil.
- The methyl ester composition should be a minimum of 75% UNSATURATES (Unsaturated methyl esters will be less phytotoxic, provide maximum performance and lower the pour point of the MSO for easier handling).
- The MSO concentrate should be used when weeds are on the larger side or during periods when plants are under moisture or temperature stress.
- The MSO concentrate should provide excellent emulsifying and dispersing characteristics to prevent tank mix separation.
- ★ The MSO concentrate must deliver adequate spreading and wetting to ensure complete coverage of the plant surface.

METHYLATED SEED OIL (MSO) WITH NON-IONIC ORGANOSILICONES

MSO WITH ORGANOSILICONES are unique multifunctional spray additives. They combine a highly refined and modified spray oil with high quality Organosilicone surfactants.

These formulations are designed to improve the activity and effectiveness of certain herbicide sprays in post emergence applications. These products are designed for use with those pesticides and products whose labels recommend the addition of a spray adjuvant lo improve coverage. MSO with Organosilicones promote the following characteristics lo the spray solution:

- ✤ Fast spreading
- Vniform distribution
- Improved absorption of spray on leaf and stem surfaces
- **W** Reduces the negative effects of adverse environmental conditions

DRIFT CONTROL AGENTS

DRIFT CONTROL AGENTS are materials used in liquid spray mixtures to reduce physical drift and improve the deposition of pesticide sprays. Spray drift is defined as the movement of a spray solution to an area other than the intended site of application. Some of the many consequences of drift include a lower level of control, skips and/or overlaps, phytotoxicity and possible environmental concerns.

Drift control agents affect the physical properties of the spray solution, allowing for a more uniform and consistent spray pattern. A key variable contributing to pesticide spray drift is the particle size and distribution of the spray. Drift control agents effectively reduce the number of "fine" particles and increase the "average particle size" to a range of 250–500 microns.

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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 ore 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 ore desirable in an Antifoaming-Defoaming Agent.

- V 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 lank 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:	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.



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MIXMASTER® Acidifier / Compatibility Agent / Cotton Spindle Cleaner



ON-POINT™ Drift Retardent (DRA)



CLEAR EXCELLENCE™ Liquid Tank Cleaner / Commercial Detergent



SUDBLASTER® Liquid Silicone Defoamer



SUDBLASTER® X-TREME® Liquid Silicone Defoamer



CE ROW MARKER High Visibility Foam Marker



BUOY® Crop + Ornamenal Frost Control Protection



FARM FRESH® Odor Reducing Spray Adjuvant Technology



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X-CELERANT® AMS Replacement, Drift Retardent, Non-AMS Water Conditioner. Defoamer, Water Conditioner





CASTNET® Surfactant & Drift Retardant



REGISTER® X-TREME® Non-Ionic Wetter / Sticker /



STRONGHOLD® Deposition Aid



TRADEMARK® Non-Ionic Surfactant



KINGTIDE® Non-Ionic / Spreader / Penetrant



SWIFTKICK® Fungicide /

