



***Loveland***  
**PRODUCTS**

***Get Growing***

***ABC's of Spraying***

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## RATIONALE FOR ADJUVANT USE

For decades, research has demonstrated the performance of pesticides, fertilizers and plant growth regulators is constrained by physical and environmental factors that may suppress their effectiveness. Using adjuvants with spray applications has proven to (a) improve or otherwise facilitate the physical handling characteristics of pesticides and nutritional sprays; (b) improve performance effectiveness and consistency of sprayables; (c) legally comply with the labeled use requirements of pesticides and nutritionals. Many of the factors that limit spray performance can be alleviated or managed with specific adjuvant products.

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## MANAGING CONSTRAINTS TO PESTICIDE PERFORMANCE WITH ADJUVANT PRODUCTS

### I. Water

- A. pH (acidity/alkalinity) - Managed with ACIDIFICATION AGENT (ACIDIFIERS), OR ALKALINIZATION AGENTS.
- B. Water hardness (mineral content) - Managed with WATER CONDITIONING AGENTS.

### II. Spray droplet formation (atomization)

- A. Size (small droplet component) - Managed with DRIFT REDUCTION AGENTS.
- B. Size distribution within the droplet spectrum - Managed with DRIFT REDUCTION AGENTS and ADJUVANTS with droplet size management properties.

### III. Drop impact behavior

- A. Losses due to bounce, shatter and run-off - Managed with DEPOSITION/RETENTION AGENTS (STICKERS). Initial retention will also be affected by this type of adjuvant.

### IV. Post-impact drop behavior

- A. Spreading of individual droplets (influenced by surface tension of water) - Managed with SURFACTANTS / SPREADERS / WETTERS, utilized at low rates.
- B. Retention (rainfastness) - Managed with DEPOSITION / RETENTION AGENTS (STICKERS).
- C. Distribution of droplets upon the target surface - Managed with a variety of adjuvant products such as DEPOSITION / RETENTION AGENTS and some penetrating adjuvants such as LI 700® and Liberate®.
- D. Penetration (passive) - Managed with ORGANOSILICONE SURFACTANTS (“SUPERWETTERS”), which reduce surface tension of water to very low levels.

## V. The Target

- A. Waxy cuticular surfaces (primary barrier to uptake and penetration) - Managed with PENETRATING AGENTS, which can actively disrupt the cuticle.

The following adjuvant types are utilized as penetrating agents:

1. Oils - containing varying levels of emulsifiers:
    - (a) Petroleum/paraffinic - Crop oils, Crop Oil Concentrates
    - (b) Vegetable based - Various sources of oils
    - (c) Chemically modified vegetable oil - Methyl/ethyl esters
  2. Conventional surfactants/wetters/spreaders utilized at high rates.
  3. Specifically designed surfactant/penetrant products such as LI 700® and Liberate®, which contain soybean extracts.
- B. Sub-cuticular tissues (can also act as barriers but more to the translocation of absorbed materials) - Managed with adjuvants having the ability to actively assist translocation. LI 700 has been documented as being a TRANSLOCATION AGENT.

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### THE FOLLOWING POINTS REGARDING ADJUVANT PRODUCTS ARE IMPORTANT AND SHOULD BE CONSIDERED AS THEY ARE BEING UTILIZED WITH PESTICIDES:

- Adjuvants are not pesticides. They should be considered as tools to assist the management of pesticide performance.
- Adjuvants are not all alike. They differ greatly in their properties (chemistry), function, dose requirements, specificity of use and quality.
- Performance of pesticides is highly interactive with numerous factors. Examples: method of application, environmental conditions and the target pest.
- It is important to be able to identify factors that constrain the performance of pesticides. Many can be managed with the use of adjuvant products.
- Individual constraining factors (i.e. water pH) may be small, however it is important to realize that when several "small or seemingly insignificant" factors occur simultaneously, they can combine to produce an overall large effect.
- Know the adjuvants you use. Find out what properties they have and what dose is required to achieve optimum results. Reliable, creditable suppliers can provide you with the information you require or will be able to refer you to someone who can.

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## ADJUVANTS - A LOOK TO THE FUTURE

### INTRODUCTION

Within the range of currently available agri-chemical products, there exists a unique group of products called adjuvants. These products have the ability to greatly influence the performance of pesticidal materials by working through means of both physical and chemical processes. Adjuvants should be considered as management tools that can enhance the level and consistency of performance. Improvement in these areas can be attributed to the ability of the adjuvant to compensate for the variables that impact performance.

The use of adjuvant products as management tools for agri-chemical application will provide measures to:

1. Improve or otherwise facilitate the physical handling characteristics of agri-chemicals.
2. Improve performance effectiveness and consistency by:
  - a. Reduction or minimization of pesticide losses.
  - b. Enhancing or maximizing the effect of pesticides.
3. Comply with legal requirements for their use.

Clearly, the expansion of world agriculture production will be one of the most demanding challenges of the future. The ability to improve production efficiency will be closely tied to agri-chemicals. As adjuvant products have demonstrated their utility in enhancing agri-chemical performance, there is little doubt that adjuvants will play an increasing role in the future.

Loveland Products, Inc. will continue to be active in three areas with regard to adjuvants:

1. Research and development of unique and functional products to meet the specific and changing needs of the agri-chemical industry.
2. Manufacture of quality products according to state of the art procedures and adherence to strict quality control standards.
3. Distribution, both domestically and internationally, to organizations attuned to handling specialty products.

Loveland Products is dedicated to the support of its clientele by providing technical expertise, training and superior promotional efforts to the product line. Our company offers a full line of adjuvants and remains on the cutting edge of adjuvant development. The following sections will contain information regarding adjuvant categories, terminology and mode of action.

## ADJUVANT CLASSIFICATION

As a matter of convenience, adjuvants can be grouped into several distinct categories. The following is a list of these categories.

### A. Wetting/spreading agents (surfactants):

Sometimes referred to as wetting agents or spreaders. Generally used for the purpose of improving coverage and penetration of agricultural chemicals.

Activator 90	Phase® II
Flame®	Scanner®
Franchise®	Spreader 90
Freeway®	Tactic
LI 700®	Vader®
Liberate®	Weather Gard Complete
Phase®	

### B. Penetrating surfactants:

#### 1. Soybean oil derivatives:

Compadre®	MSO® with LECI-TECH®
Franchise®	Vader®
LI 700®	Weather Gard Complete
Liberate®	

#### 2. Methylated seed oils:

Occasionally referred to as methyl esters. The products in this group are specific in their adjuvant effect. They function exceptionally well with many herbicide chemistries. Vegetable seed oils all contain constituents called fatty acids. These organic acids may be transformed by a process called esterification by reacting with an alcohol. In methyl ester production, the fatty acids are esterified with methyl alcohol. The end result is a seed oil with new properties of solvency and water affinity.

Amigo®	Phase®
MSO® with LECI-TECH®	Phase® II

#### 3. Emulsified petroleum based oils:

Commonly called crop oil concentrates or oil surfactants. The usual ratio is 16 to 20% surfactant emulsifier and 84 to 80% petroleum based oil.

Effective	Maximizer®
Herbimax®	

### C. Organosilicone super wetters:

These products dramatically reduce surface tension to allow thorough penetration and maximum wetting and spreading properties on nearly all plant surfaces.

Freeway®	Phase® II
Hi-Wett®	Tactic
Phase®	Widespread® Max

### D. Stickers:

This category name was chosen to designate an adjuvant that primarily imparts the property of adhesion of spray solutions. As a result of this property being added, spray droplets will have improved deposition and retention.

Attach®	Tactic
Bond Max®	

### E. Water conditioning agents:

When certain herbicide chemistries, such as glyphosate, sulfonyleurea, imidazilone, and phenoxy are added to water, the negative charges in the herbicide molecules attract the positive ions (cations) in water (i.e. calcium, potassium, magnesium). The herbicide and these cations form a strong complex, which can prevent or hinder uptake of the herbicide into the plant, effectively reducing herbicide performance. Water conditioners sequester and chelate cations freeing the herbicide molecules to perform more effectively.

Amaze Gold®	Gunsmoke®
Choice® Weather Master	Surfate®
Effective	Weather Gard Complete
Flame®	

### F. Nitrogen containing adjuvants:

These products have historically been used with herbicides, and are sometimes regarded as anti-antagonism agents to be used in conjunction with surfactant adjuvants. Success with this type of product seems to be specific with certain herbicide chemistries, weed species and carrier volumes. The exact mode of action of this group is still being debated; however, it is generally felt that their use promotes uptake and/or translocation of the herbicide. There may be some activity related to reducing impact of certain aspects of minerals in the spray water.

Amaze Gold®	Quad 7
Flame®	Surfate®
Phase® II	Thrust®

### G. Basic N blend:

Basic blends provide a higher pH combination of fertilizer source and non-ionic surfactant, facilitating solubility of sulfonyleurea and stabilizing the mixture for micro rates on sugar beets.

Quad 7
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## H. Droplet size management (drift reduction):

### 1. *Polymers:*

This category of adjuvant product is usually a viscoelastic (having both viscous and elastic properties) polymer that is added to spray solutions to reduce the production of fine droplets. It is known that very small droplets (usually under 150 microns in diameter) are most susceptible to non-application as well as off-target application. Drift reduction polymers tend to increase the size (and weight) of droplets produced by a spray nozzle and as a consequence, reduce opportunity for losses and off-target application.

**Reign®**

**Thrust®**

**Reign® LC**

### 2. *Soybean-Based:*

It is now known that many of the polymer-based products suffer degradation and loss of function following circulation through typical spraying machinery. Additionally, it is recognized that polymers can negatively alter the functionality of spray nozzles, especially in the area of flow rate and nozzle pattern angle. Loveland Products discovered that the phospholipid/lecithin-based chemistry, being used in several of their adjuvant products, did not produce attendant losses of function.

Loveland Products' lecithin adjuvant products have consistently shown outstanding results in field crop and patternator (spray equipment) trials. These products possess properties capable of managing droplet size. Ideally, an adjuvant helps provide a spray particle distribution that contains fewer small (<150 microns) and large (>500 microns) droplets. Lecithin-based products actually improve the spray pattern and reduce drift by maintaining the proper (uniform) spray pattern as designed by the nozzle manufacturer.

**Compadre®**

**MSO® with LECI-TECH®**

**LI 700®**

**Vader®**

**Liberate®**

**Weather Gard Complete**

## I. Acidification agents:

Products that are added to spray solutions for the purpose of lowering the pH are called acidification agents. Lowering the pH of spray mixtures will improve the stability of certain pesticides and can also prevent certain incompatibilities.

**AcidipHactant**

**LI 700®**

**E-Z Mix**

**Vader®**

**Gunsmoke®**

**Weather Gard Complete**

## J. Compatibility agents:

These products have utility when tank mix combinations of pesticides or pesticides and fertilizers are prepared. Problems with compatibility usually result in non-homogenous mixtures or non-applicable mixtures. Compatibility agents, which are generally heavy-duty emulsifier blends, can assist mixture problems in two ways: (1) Their use may allow mixtures to be made that otherwise would be incompatible, and (2) their use may allow some ability to salvage mixtures already incompatible into sprayable condition. The best advice is to prevent incompatibility problems by pre-testing the combination.

**E-Z Mix**

## K. Soil Surfactants:

Soil surfactants designed to reduce crop and turf physiological stresses found in inherently droughty soils by positively affecting the wetting, rewetting and infiltration rates of soils treated.

**Freeway®**

**Respond® 3**

**Mizer®**

**WaterMaxx® 2**

**Neptune®**

## L. Antifoam/defoaming agents:

Antifoam and defoam agents are products that are typically siloxane emulsions. They will have dual functionality in that they can be utilized to eliminate foam that has already developed (defoam) or to prevent foam under conditions where a history of foaming is known (antifoam). The presence of foam in spray mixtures can seriously impact mixing and also affect calibration of spray equipment.

**Compadre®**

**Unfoamer®**

## M. Miscellaneous:

### 1. *Tank decontaminating agents / Tank cleansers*

**All Clear®**

**Tank & Equipment Cleaner**

### 2. *Emulsified vegetable oils*

**Amigo®**

### 3. *Colorants*

**Aquamark®**

**Warm-Up®**

**Turf Trax®**

### 4. *Foam markers*

**Trekker Trax®**

**Tuff Trax®**

## ADJUVANT FUNCTIONALITY AND EFFECT

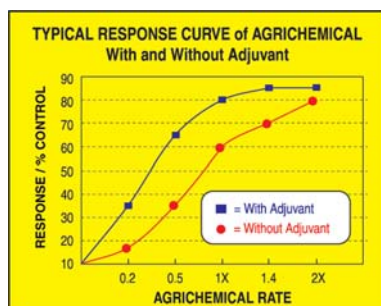
Adjuvant formulations are designed to possess certain properties, which affect the functionality of an adjuvant. Functionality can be specifically determined by (1) the chemistry of the components, (2) the proportions of the components and, (3) the dose or quantity used.

As adjuvant products are considered management tools, it will be important for users to know what properties are needed in an adjuvant and what particular adjuvant can provide those properties. Users should also be aware that, in certain situations, the addition of adjuvant properties may not produce an effect.

Obtaining an effect from the use of an adjuvant with an agri-chemical will depend on the following:

- adjuvant property added and in what amount
- pesticide used and in what amount
- intended target
- application efficacy
- environmental conditions

The graph on the right represents the dose responsive nature of the pesticide and pesticide/adjuvant combination. The point should be observed that the adjuvant effect is inversely related to the pesticide dose. That is, a greater effect will be observed at lower rates. The effect of the adjuvant can be represented by the difference between the two lines.

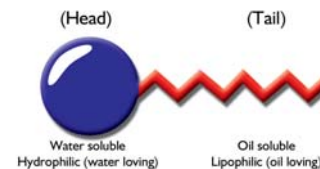


## SURFACTANT PROPERTIES AND BEHAVIOR

While it is recognized that not all adjuvants are surfactants, it is well accepted that the contribution surfactants make to the functionality of many adjuvants is extremely important. Because of this fact, the following section will be a bit larger and in more detail than other categories of adjuvant products.

The single most unique feature of a surfactant is not its chemistry but its two-part structure. Every surfactant molecule will have a distinct portion that is, to some degree, water-soluble and a portion that is, to some degree, oil soluble. It is this dual set of diverse properties that will

determine its behavior and functionality. General pictorial representations of surfactant molecules are usually as follows:



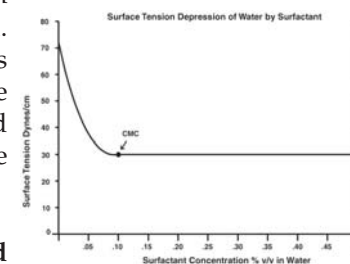
A numerical scale has been established to express the relative effect of the individual portions (hydrophilic and lipophilic) of a surfactant on the overall physical and chemical properties of the molecules. The scale is called the HLB and represents the Hydrophilic Lipophilic Balance for a single surfactant molecule. The scale runs from 1 to 20 with 1 being the most lipophilic and 20 being the most hydrophilic. By knowing the molecular weights of the two portions of the molecule, the HLB can be mathematically calculated.

The limitations of the usefulness of an HLB rating is as follows:

1. Applicable to non-ionic surfactants only
2. Accurate only for single surfactant molecules
3. Not useful for mixtures of surfactants
4. Not useful for use when surfactants are used above the critical micelle concentration

The most obvious and familiar property imparted to aqueous solutions by surfactants is that of surface tension reduction. Surface tension is a phenomenon caused by an unbalanced force of attraction due to cohesion. Surface tension of liquids manifests itself by phenomena such as the curved shape of liquids in containers (the meniscus) and the fact that a liquid will draw itself into a spherical shape on a non-wettable surface. Surface tension is also responsible for the "elastic-like" nature of the liquid surface.

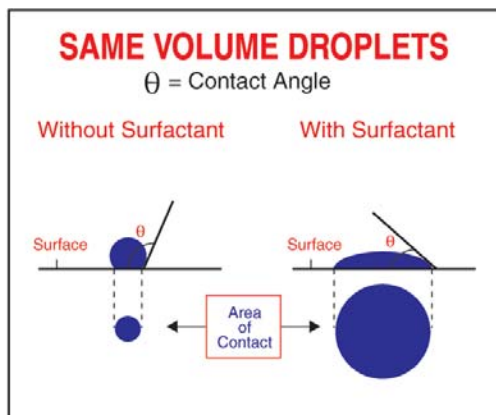
As illustrated in the graph on the right, there will be a concentration point for every surfactant at which maximum surface tension depression is achieved. Surfactant added above this concentration will not depress the surface tension further, and will be represented by the beginning of the flat portion of the graph.



The point described previously is called the Critical Micelle Concentration or CMC. When surfactants are mixed with water, the "head" portion

attaches itself to water molecules due to the polar nature of both the “head” and the water molecule. Surface tension of water is reduced and is dependent on concentration of surfactant. Reduction will be non-linear until a maximum depression is achieved. Beyond this point, the addition of more surfactant does not result in further surface tension depression.

To illustrate the effect that surfactant surface tension reduction has on spray droplets, the following is used:

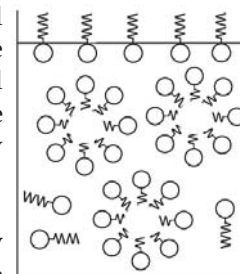


As illustrated, surfactants will cause droplets to collapse under their own weight and increase dramatically the area of contact. This is one of the main reasons surfactants are used with pesticidal materials; that is, to improve physical coverage over the surface of the intended target.

Indicated earlier in this section was the fact that surfactants exhibit a point at which no further surface tension depression is experienced. This point is simply the limit of aqueous solubility of the surfactant. **This point is marked by another phenomena known as micelle formation.** This means that the surfactant molecules no longer function and behave as monomers (single molecules). At this point, surfactant molecules clump together to form aggregate units called micelles. If the micelles are in water, they will orient themselves with their hydrophilic portion outward and their lipophilic portions inward.

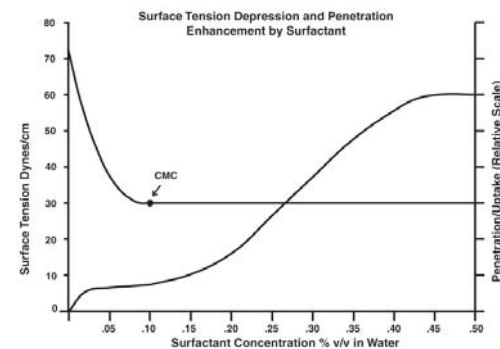
## SURFACTANT MOLECULAR BEHAVIOR IN WATER

When a solution reaches/exceeds its Critical Micelle Concentration (CMC), the surface of the liquid can no longer accommodate additional surfactant molecules. At this concentration, the excess surfactant molecules will migrate away from the surface and aggregate to form micelles.



Micelles may have impact on pesticide activity by providing increased uptake into the target. The exact mechanism may be linked to solubilization of the waxy layer of leaves by micelles. This will be dependent on the number of micelles present and the HLB of the surfactant monomers. **Other actions that may be attributable to micelles are: pesticide concentration effect, partitioning of the pesticide and the maintenance of a hydrated state of the target surface.**

The following idealized graph illustrates the relationship of micelles to penetration enhancement by surfactants.



As illustrated, no significant surfactant enhancement of penetration occurs until after CMC is reached. Further shown is the relationship of increased dosage (beyond CMC) on uptake. With this information, it becomes clear that surface tension reduction alone does not significantly do anything beyond spreading or coverage enhancement. As CMC for virtually all surfactants is at or below a dose of 0.1% v/v (12.8 oz/100 gallons), it also becomes apparent as to why doses of 0.25 to 0.50% v/v are commonly recommended on many herbicide labels. **These are the doses that are sufficient to accomplish penetration improvement.** This fact might also lead one to ask why some adjuvant manufacturers recommend doses of surfactant significantly below CMC for products that must be taken into plants.

All of the discussion thus far has been typical of conventional surfactant chemistry. In the past thirty years, research has been ongoing into the attributes and functionality of a special group of surfactants called organosilicones. This chemistry brings to surfactant behavior some unique occurrences such as ultra-low surface tension. Conventional surfactants will produce surface tensions down to 28-29 dynes/cm while organosilicones such as *Widespread® Max*, considered to be a “super wetter”, can reach down to the lower 20’s. **What this means is that extreme spreading of droplets can be achieved.** Spread factors of over 20 times that of conventional surfactants are common with organosilicones at the same use rate. Another unique result of sprays applied at very low surface tension is the phenomena known as stomatal entry. Simply stated, the spray solution is capable of entering leaves through naturally occurring openings called stomata.

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## CONCLUSION

The book, *Fate of Pesticides in the Environment* (Dr. Julius J. Menn), outlines seven aspects of agri-chemical trends. In reviewing these trends, it becomes apparent that the use of adjuvants, as a class of agri-chemical products, fit extremely well into the trends for pesticide use in the future. The following is a brief synopsis of those trends with comments on adjuvant use:

1. *New agri-chemicals are trending toward more active molecules delivered in very concentrated formulations.* Generally, they will be more expensive and will use smaller quantities than conventional pesticides. Adjuvants will fit into the scheme of more effective application (deposition and retention) as the margin for application error becomes smaller.
2. *Agri-chemical rate reduction.* Through general practice as well as through regulation, the main goal will be to reduce the environmental load of agri-chemicals. Adjuvants have a historical base in rate sparing and many attempts at reduction have been successful only with the addition of adjuvants.
3. *Changing agronomic practices and improvement in pesticide delivery system.* Programs such as CRP along with minimum- and no- till regimes necessitate the use of more post-emergence pesticidal products. Adjuvants have an excellent base of performance enhancement for post-emergence agri-chemicals.

4. *Management of pest resistance.* The recognition and management of resistance to agri-chemicals by various strategies will be a huge challenge. One strategy is to insure better initial control of pests, which can slow down resistance development. Improved performance consistency of pesticides by use of adjuvants will be an integral part of this strategy.
5. *Impact of IPM program on pesticide use patterns.* The overall effect may be to reduce the amount and frequency of use of pesticidal materials. In either case, it will be important to do everything possible to insure the highest level of performance, i.e., adjuvant utilization.
6. *The effect of federal and state regulatory activities on types of pesticides marketed.* Trends will be toward more selective, “softer” pesticides with less persistence and rapid biodegradability. As in section 5 above, all efforts should be made to insure the most efficient level of performance such as incorporation of adjuvants.

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## SOURCES OF INFORMATION ON ADJUVANT USE

The first and foremost source of information is the pesticide label itself. Increasingly, pesticide manufacturers include information on recommended adjuvant type, ionic classification, rate, minimum percent activity, as well as general use cautions. The internet is another source of information. Basic manufacturers, agri-chemical marketing companies, publishers of farm publications and journals, universities, etc. have websites, which post everything from specific product information to research results. Adjuvant formulators and university extension services often have brochures and other literature pieces on adjuvants available.

## SOY LECITHIN-BASED ADJUVANTS



### SURFACTANCY, ADHESION, PENETRATION, ATOMIZATION CONTROL, INCREASED DEPOSITION

Lecithin derivatives are obtained from the hydrogenation/hydroxylation of natural soya lecithin and refined using special techniques. Biochemically, it is a lipid material belonging to the phospholipid class and is a component of all living cells. Most performance benefits of lecithin come from the unique surface-active properties of phospholipids. As molecules, phospholipids contain hydrophobic and hydrophilic elements. The hydrophobic portion has an affinity for fats and oils and the hydrophilic portion has an affinity for water. Because of this affinity, these products work well with oil-soluble and water-soluble-herbicides. They are very safe biosurfactants with superior heat and oxidation stability. The products based on this chemistry are not subject to the issues of pump shear degradation (loss of drift reduction function of spray solution following pump circulation), reduction of nozzle fan angle and compatibility problems with most pesticide formulations.

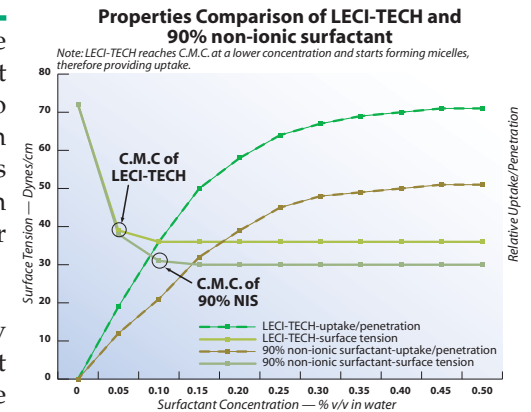
Loveland Products, Inc. has worked with lecithin technology for over 20 years and has developed numerous applications that provide benefits above any current technology. Products containing *Leci-Tech*® provide a unique chemistry that works in a variety of row crop, vegetable, small grain, turf and ornamental and non-crop applications. While supporting the American soybean grower, the *Leci-Tech* chemistry allows for lower use rates, crop safety and is biodegradable.

### SUPERIOR PENETRATION

To maximize performance of both systemic and contact pesticides it is critical to ensure penetration through the leaf cuticle. This is especially important when plants are under environmental stresses.

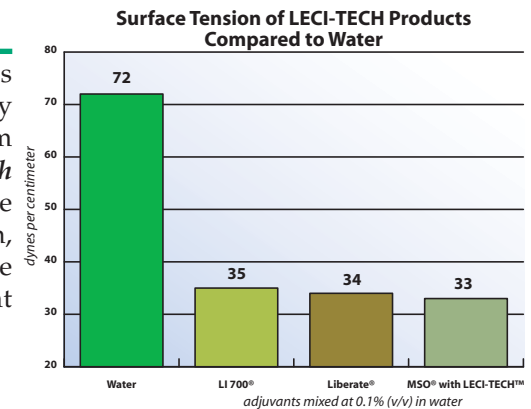
The *Leci-Tech* chemistry allows for the spray droplet to reach the critical micelle concentration (CMC) at a lower concentration, providing quicker uptake versus conventional non-ionic surfactants.

*Leci-Tech* chemistry will also reduce evaporation, allowing for greater solubility and uptake.



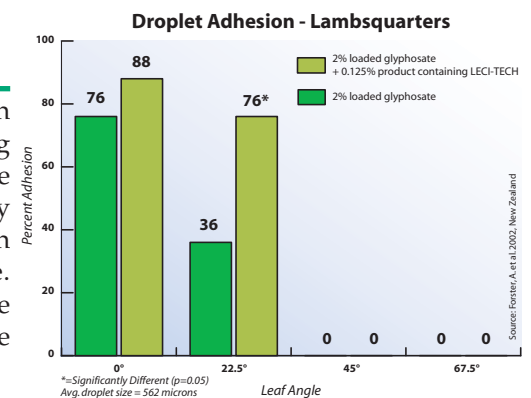
### EXCELLENT SPREADING PROPERTIES

With many pesticides coverage is the primary objective for optimum performance. The *Leci-Tech* chemistry will aid in the reduction of surface tension, allowing for better pesticide dispersion on the plant surface.



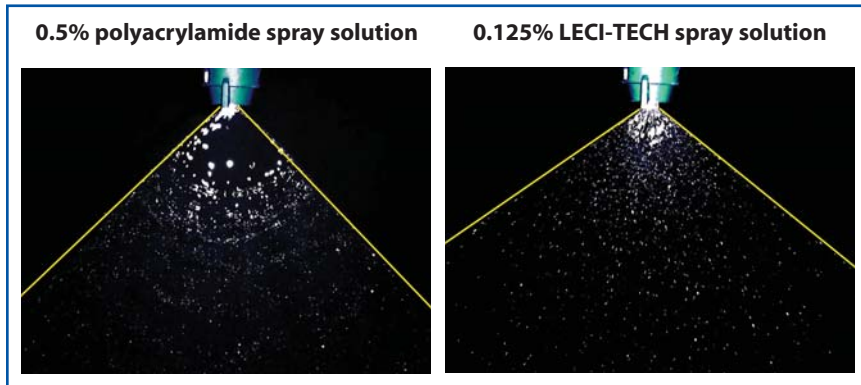
### DROPLET ADHESION

Adhesion is improved with *Leci-Tech* containing product by reducing bounce and shatter of the spray droplets upon contact with the plant leaf surface. Droplets will stay on the plant, providing more consistent control.



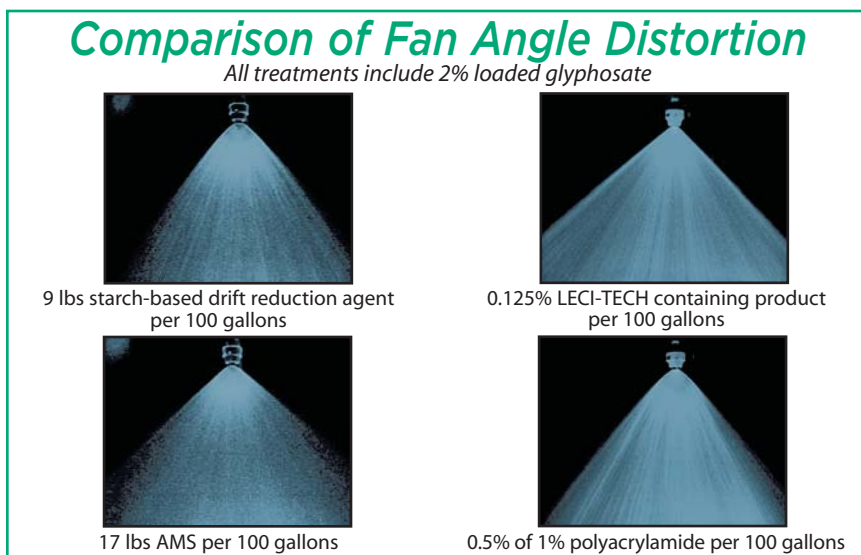
## DRIFT MANAGEMENT

Drift reduction is critical when spraying certain pesticide formulations. Many polymer-based drift agents will increase the droplet size to reduce the potential for losses and off-target applications. Polymer-based drift agents increase the viscosity of the spray solution and in doing so, negatively affect nozzle performance, as described below. *Leci-Tech* chemistry provides drift reduction without increasing the viscosity of the spray solution. *Leci-Tech* chemistry contains phospholipids, that produce less stress on the droplet allowing for more uniform droplet size. A more uniform droplet size will aid in reducing drift, as well as more consistent coverage on the desired target.



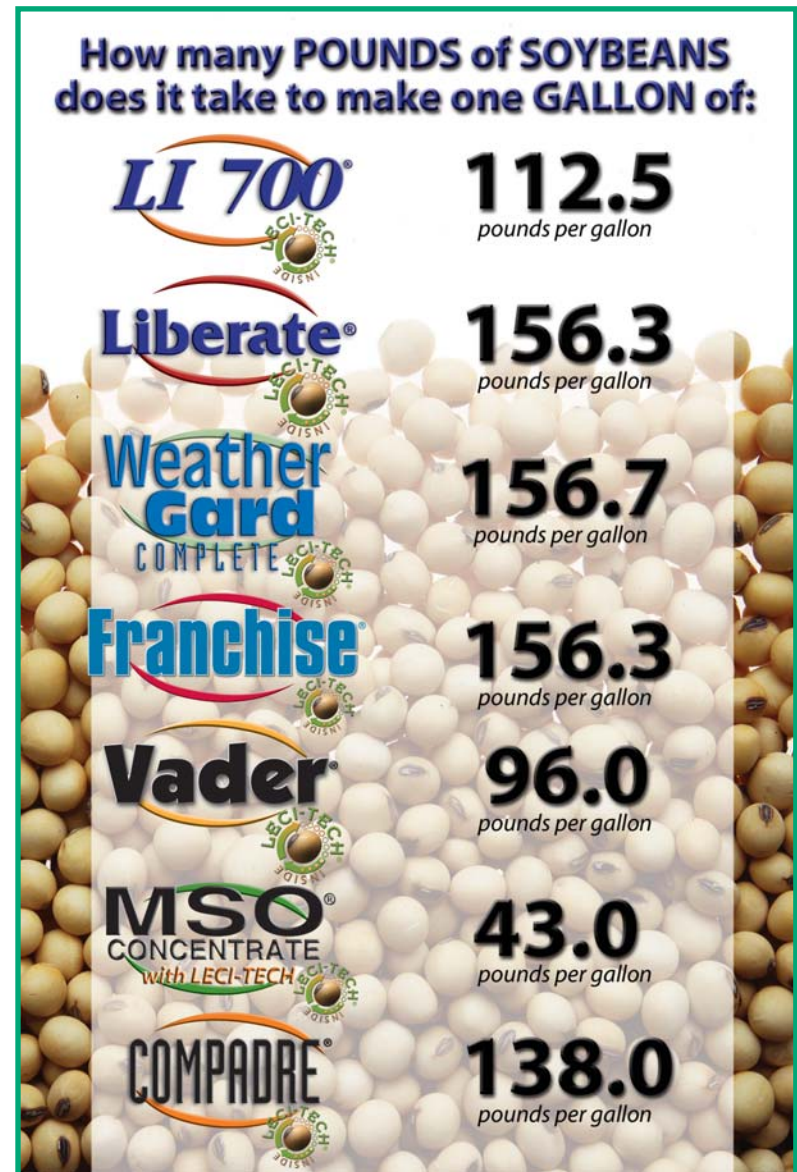
## INCREASED DEPOSITION

As drift reduction agents are added to the spray mix it is important that not only drift is managed, but the spray pattern and droplet size remain consistent. Chain-forming drift agents like polyacrilamides can “pinch”



fan angle as well as increase droplet sizes causing an over-abundance of droplet bounce and shatter when deposited on the target. The spray solution will become broken-up as it exits the nozzle.

The phospholipids provided in the *Leci-Tech* chemistry are not chain-forming molecules. This allows for more “right sized” spray droplets, that are more likely to reach the desired target as well as optimizing nozzle performance.





## Deposition Aid, Drift Control Agent, Antifoam/Defoamer

Compadre® is a non-ionic adjuvant with drift control agents and an integrated antifoam/defoamer formulated for loaded glyphosate compounds. Compadre is designed specifically to enhance deposition, control droplet size and defoam spray solutions.

### Formulation

Lecithin, alcohol ethoxylate, methyl esters of fatty acid, 2,2'-dihydroxydiethyl ether, polydimethylsiloxane .....100%

### Benefits

- Does not compromise spray nozzle performance.
- Increases droplet adhesion and improves deposition.
- Contains an antifoam/defoam system.
- Provides the most effective atomization (drift) control available for glyphosate formulations.
- Low use rates make *Compadre* cost-effective.
- User-friendly, liquid formulation that is compatible in all spray solutions.

### Application Information\*

1 pint per 100 gallons of spray mixture

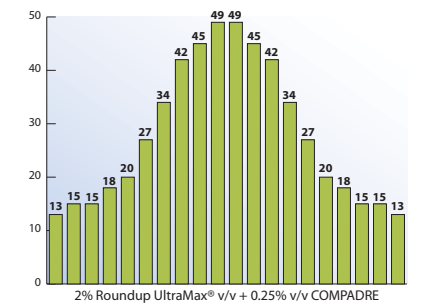
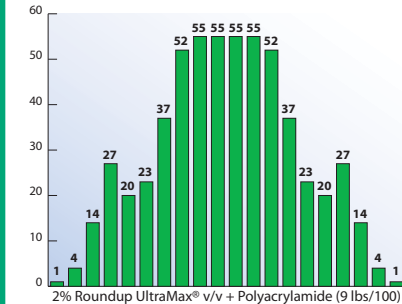
Target Chemistries: Loaded glyphosate formulations

## Adjuvant Effects on Fan Angle Patternator Results

Polymer Based

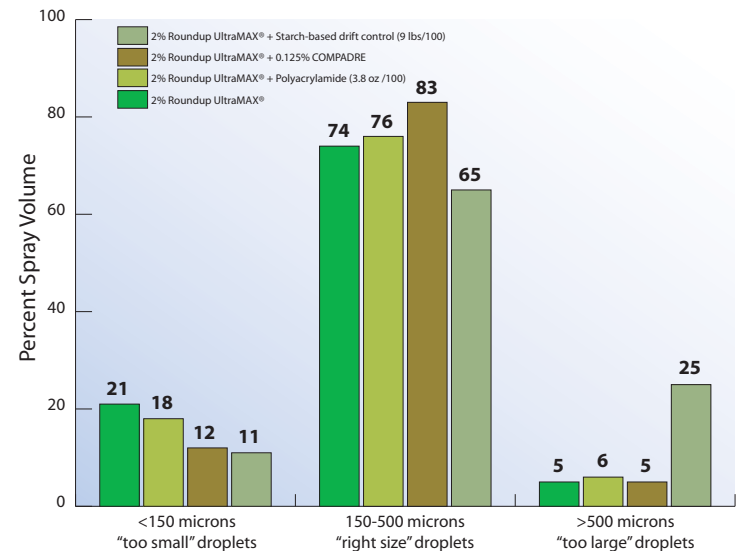


Lecithin Based



## Droplet Size Classes as Affected by Drift Additives

All treatments contain 17 lbs AMS/100



Teejet® XR8003VS @ 40 psi, Aeometrics Phase Doppler Particle

\*Always read and follow product label directions and recommendations.



## Penetrant, Wetting Agent For use with Strobilurin Fungicides

For growers or custom applicators who want to minimize the variability in performance of strobilurin fungicides, *Franchise*® is specially formulated for use when spraying fungicides on crops that are experiencing stress. Unlike traditional surfactants, *Franchise* is specially formulated for use with strobilurin chemistries.

### Formulation

Lecithin, methyl esters of fatty acids, and alcohol ethoxylate . . . .100%

### Benefits

- Consistently contributes to strobilurin performance.
- Minimizes variability of strobilurin sprays.
- Provides enhanced uptake, spreading and coverage of sprays.
- Proprietary formula which is particularly helpful if target plant is experiencing stress.

### Application Information\*

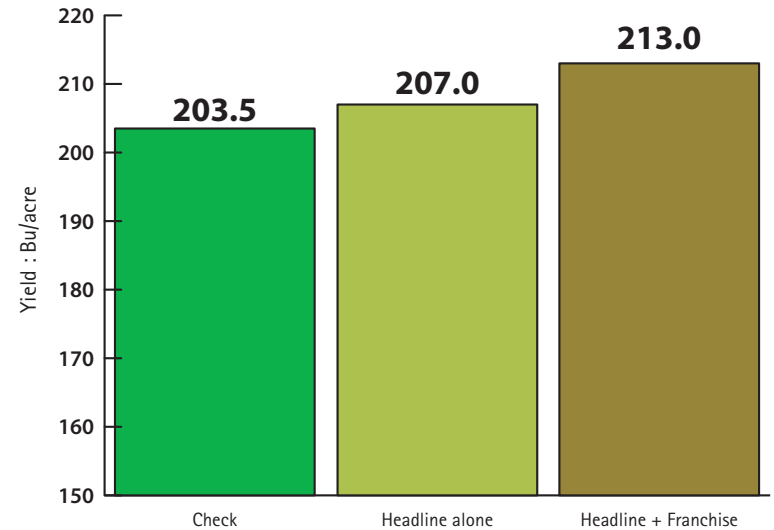
Can be applied aerial or ground

- **General Use Rate:** 1 to 2 quarts/100 gallons spray mixture
- *or*
- *Aerial:* 1 to 2 ounces/acre
- *Ground:* 3 to 4 ounces/acre

**Target Chemistries: Strobilurin Fungicide chemistries**

## Franchise Location Replicated Trials : Corn

Average of four Ohio trials (Urbana, Ottawa, Phillipsburg, DeGraff), 2008  
Headline® fungicide used at 6 fl. oz./acre; Franchise used at 0.25% v/v



\*Always read and follow product label directions and recommendations.



## Penetrant, Acidifier, Deposition Aid, Drift Control Agent

*LI 700*® is a soy-oil derived, non-ionic penetrating surfactant, that reduces off-target spray drift, and reduces spray water pH. Unique formulation technology and quality ingredients separate *LI 700* from the imitators. The addition of d-limonene provides a more user-friendly formulation.

### Formulation

Phosphatidylcholine, methylacetic acid and alkyl polyoxyethylene ether .....80%  
 Constituents ineffective as spray adjuvant .....20%

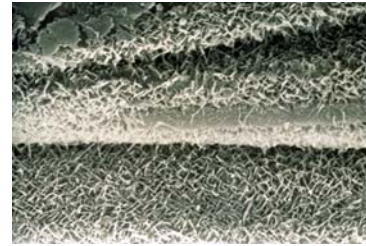
### Benefits

- Surfactant properties improve spray droplet deposition, adhesion and coverage of spray material on leaf surfaces.
- Penetrant properties maximize the effectiveness of systemic herbicides, insecticides, fungicides, miticides, PGRs and foliar applied nutrients.
- Acidification properties prevent degradation of pesticide caused by high pH water.
- Drift reduction properties of *LI 700* lower potential for off-target spray and improves deposition of spray droplets.
- Soy-oil derived components in *LI 700* provide excellent crop safety and replaces petroleum-based components with farm-grown components.
- *LI 700* is a low-foaming surfactant and will not cause foam problems in the spray tank.

### Application Information\*

**When used as a Surfactant:** 1 to 4 pints per 100 gallons  
**When used as a Penetrant:** 1 to 4 pints per 100 gallons  
**When used as an Acidifying Agent:** 8 oz. to 1 pint per 100 gallons  
**When used as a Drift Reduction Agent:** 1 to 2 quarts per 100 gallons  
**Target Chemistries:** Weak acid herbicides (i.e. glyphosate, 2,4-D, dicamba, etc.), insecticides, defoliant

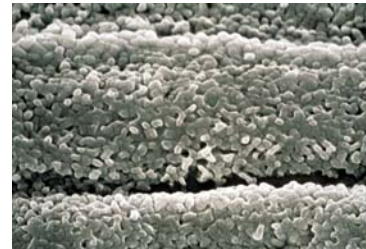
\*Always read and follow product label directions and recommendations.



This is a normal leaf surface. The wax structure is tightly packed together. This is the normal, protective barrier of the leaf.

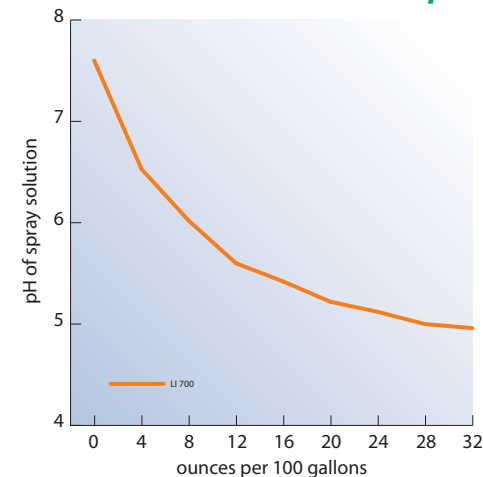


After the addition of *LI 700*, the wax structure is intact, but stands more erect. *LI 700* enhances penetration by temporarily relaxing the wax structure.



After the addition of an oil surfactant, severe distortion of the wax structure can be seen. Breakdown of the waxy barrier may result in injury to desirable plants.

### Effect of LI 700 on pH



Generally speaking, *LI 700* will lower two pH units for every 12 ounces added to the spray mixture until the pH 5 level is reached.



**This Land is Loveland,  
Get Growing with LI 700®.**



Maximize the effectiveness of systemic herbicides, insecticides, fungicides, miticides, PGRs and foliar applied nutrients with a superior soy-oil derived, non-ionic surfactant LI 700®. Its' enhanced Leci-Tech® formulation reduces off-target spray drift, and reduces spray water pH.

Give your crops the best, with LI 700 from your local Crop Production Services representative.



## 100% Active, Non-Ionic Surfactant, Defoamer

*Liberate*® is an uptake enhancing surfactant blend. *Liberate* is designed for use with pesticides that recommend a non-ionic surfactant and contains soybean-based components that work especially well with systemic chemistry, reducing driftable fines. *Liberate* provides uniform droplets allowing complete coverage and excellent control. Additional defoaming properties make *Liberate* very user-friendly.

### Formulation

Lecithin, methyl esters of fatty acids and alcohol ethoxylate . . . .100%

### Benefits

- 100% active spreader/penetrant contains soy oil derivative.
- Odorless, low-foaming, neutral pH formulation.
- Provides drift reduction, increased droplet adhesion, excellent penetration and deposition and is user friendly.



### Application Information\*



When used with Herbicides (Terrestrial or Aquatic), Defoliants, Desiccants: 1 to 4 pints per 100 gallons  
 When used with Insecticides, Fungicides, Acaricides, Plant Growth Regulators, Foliar Nutrients: ½ to 2 pints per 100 gallons of spray mixture

When used for Drift Reduction: 1 to 2 quarts per 100 gallons

When used on Non-Crop Sites: 1 to 8 pints per 100 gallons

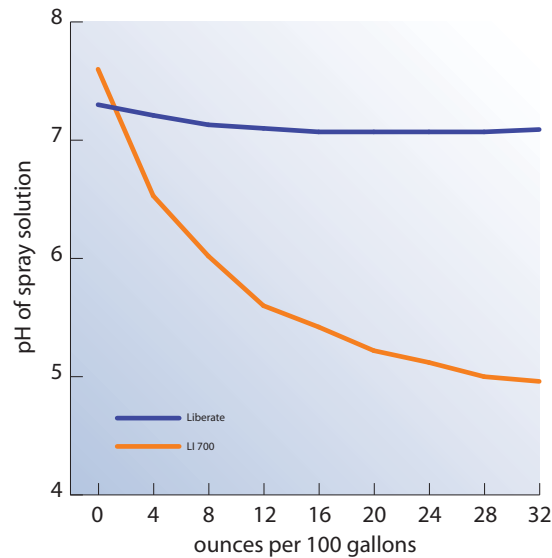
When used on Turf & Ornamentals: ½ to 2 pints per 100 gallons

**NOTE: Do not use *Liberate* on grape foliage.**

**Target Chemistries: Sulfonyl urea (SU) herbicides, fungicides and those chemistries requiring a neutral pH**

\*Always read and follow product label directions and recommendations.

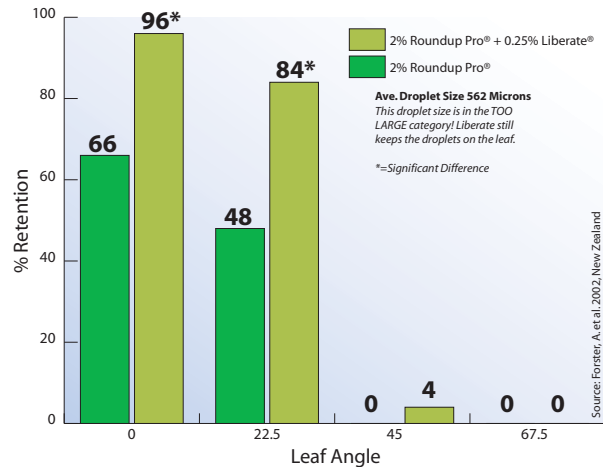
## pH neutral



*Liberate* will not acidify the spray mixture.

## Helps retain droplets on the leaf surface

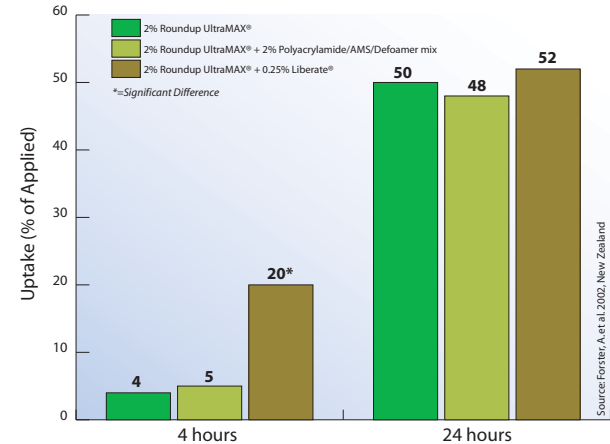
Even on waxy leaf surfaces like lambsquarters, *Liberate* helps retain droplets that are too large for the best coverage.



As leaf angle changes, *Liberate* keeps even large droplets on the leaf surface. This is an important part of consistent performance of post-emergence herbicides. However, *Liberate* produces more droplets in the *RIGHT SIZE* for the best possible coverage.

## Increases initial uptake of "loaded" glyphosate

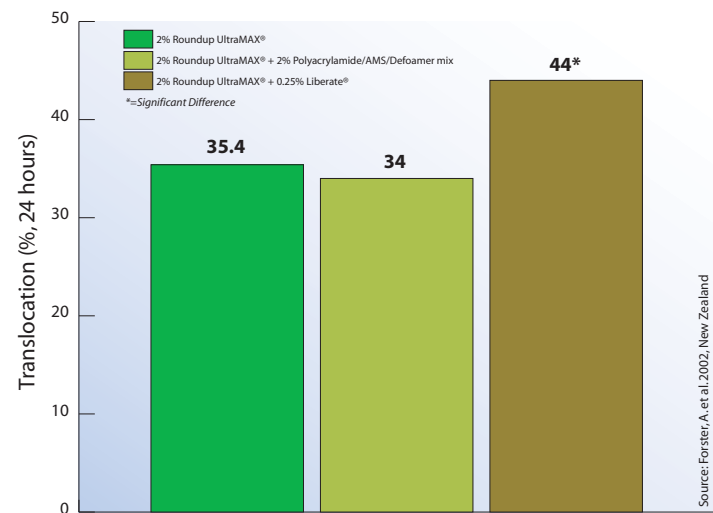
Effect of *Liberate* on uptake of c-glyphosate in lambsquarters leaves  
Common lambsquarters (4 weeks growth stage)



Once the droplet is on the leaf, the penetrant activity of *Liberate* takes over. *Liberate* increases initial uptake of Roundup UltraMAX® by 5X in the first 4 hours. This can mean improved rainfast times and more consistent performance.

## Increases translocation of "loaded" glyphosate

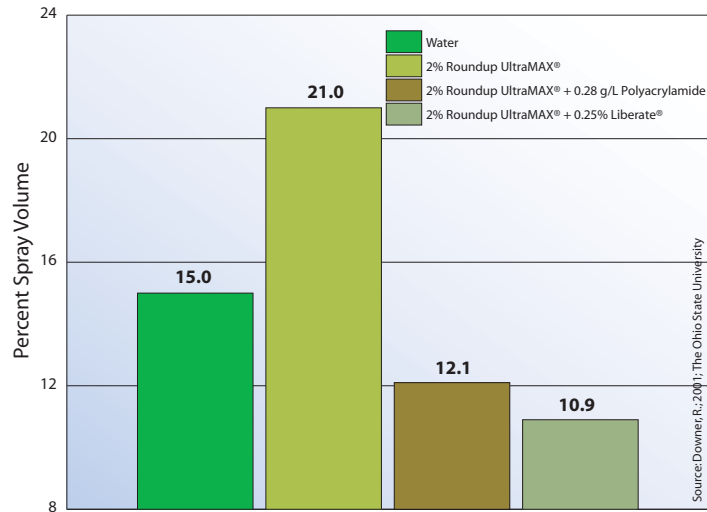
Common lambsquarters (4 weeks growth stage)



*Liberate* isn't finished yet. Once the glyphosate is in the leaf, *Liberate* actually increases the amount translocated within the plant. This can contribute to more consistent performance.

## Reduces driftable droplets as well as standard drift control products

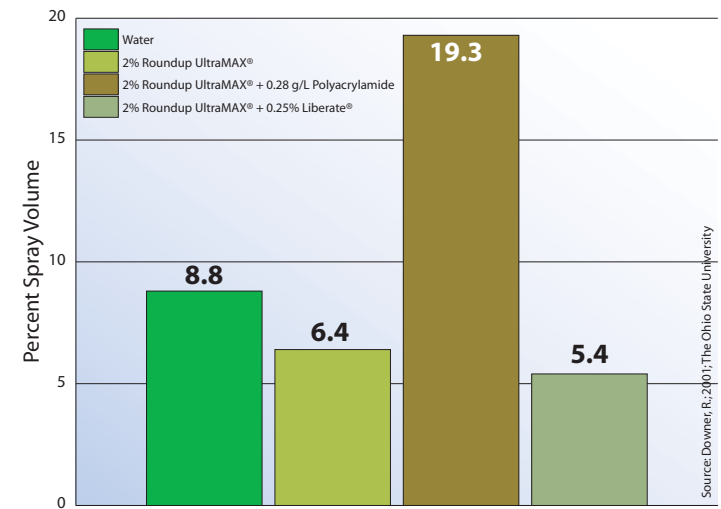
Driftable droplet size class (0-150 microns) as affected by drift additives



Driftable droplets can be lost to evaporation or drift to off-target sites. Either way, it's product that isn't being delivered to the field it's supposed to go on!

## Does not produce "too large" droplets

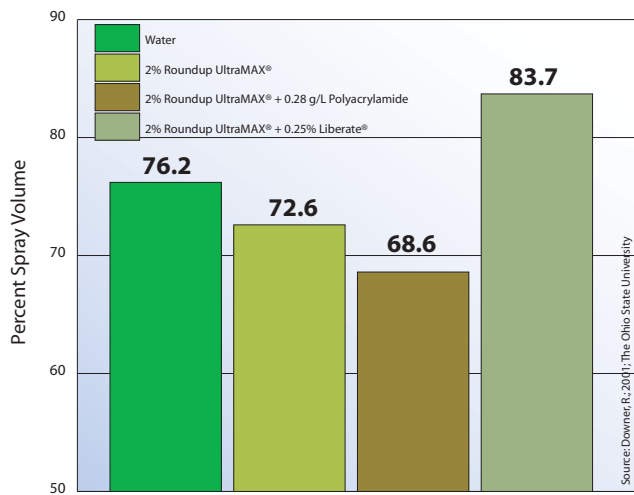
"Too large" droplets are >500 microns



Too large droplets can be lost to bounce, shatter and/or runoff especially on waxy leaf surfaces. Too many large droplets might look good for drift reduction, but if they don't stick to anything what good do they do?

## Produces more "right size" droplets for coverage

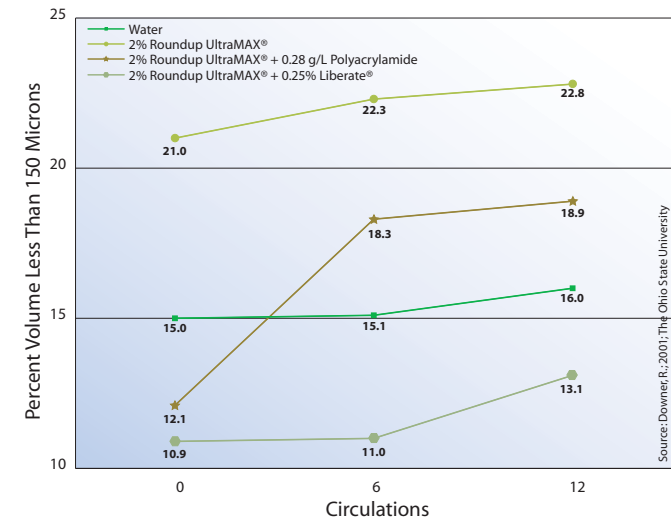
Droplets that are important for coverage with post-emergence herbicides are from 150 to 500 microns in size



Right sized droplets provide optimum coverage for post emergence products. This ensures that the maximum amount of product gets where it's supposed to go AND stays there!

## Not affected by pump shear

"Too small" droplets are <150 microns and are susceptible to drift



Pump shear can reduce the effectiveness of drift control products. Most drift control products contain a type of polyacrylamide, most of these are susceptible to shearing in a pump after 1 or 2 circulations. This results in more driftable size droplets.



## Modified Vegetable Oil and Surfactant Blend

MSO® Concentrate with LECI-TECH® is a methylated seed oil containing the highest quality components available. The premium emulsifiers along with Leci-Tech chemistry will provide uniform mixing for excellent performance as well as drift reduction, enhanced penetration and droplet adhesion. MSO Concentrate with LECI-TECH is designed for use with post-emergent herbicides and has consistently demonstrated increased penetration over conventional crop oil concentrates.

### Formulation

Methylated vegetable oil, alcohol ethoxylate, tall oil fatty acid . . .100%

### Benefits

- Premium emulsifiers provide easy mixing.
- Use of the highest quality methyl esters available produce a product with a lower freezing point than others on the market and increased herbicide absorption for optimum weed control.
- MSO Concentrate with LECI-TECH will provide increased plant uptake vs. standard methylated seed oil formulations.

### Application Information\*

1 to 2 pints per acre or product label recommendation.  
Add MSO Concentrate with LECI-TECH after pesticides are thoroughly mixed.

**Target Chemistries:**  
Micro rate applications, sulfonyl urea (SU) herbicides

\*Always read and follow product label directions and recommendations.

## Superior Cuticle Penetration



Methylated Seed Oils (MSOs) are utilized when superior cuticle penetration is needed. Methylated seed oils are often used with herbicides during hot, dry conditions. During these stressful environmental conditions, plants will develop thick waxy cuticles in an effort to conserve moisture. The demonstration above compares the differences in activity of water, crop oil and MSO Concentrate with LECI-TECH. The ability of methylated seed oils to solubilize a waxy cuticle is shown in the chart below.

## Penetrating Ability of Methylated Seed Oil Green Foxtail Wax Solubility

	Exposure interval (min)					
	0	5	10	20	40	24 hrs
Distilled Water	0	0	0	0	0	0
Petroleum Oil	0	0	0	2.5	2.5	9
Sunflower Oil	0	0	0	0	2.5	6
Methylated Seed Oil	2.5	5	6.5	9	10	10

Evaluation scale: 0=no solubility; 10=totally dissolved

Manthey, F.A. and J.D. Nalewaja; NDSU, Fargo, ND; 1992



## Penetrant, Drift Control and Deposition Agent, Acidifier

*Vader*<sup>®</sup> is a unique, proprietary adjuvant designed to aid in the delivery and deposition of insecticidal sprays. The enhanced *Vader* formulation powered by *Leci-Tech*<sup>®</sup> chemistry aids in penetration, uptake, translocation and translaminar movement of foliar insecticidal applications such as that of Loveland Products' *Sherpa*<sup>®</sup> Insecticide. The premium *Leci-Tech* formulation, including acidifying agents, helps provide a spray solution environment that protects the integrity of insecticides sensitive to high pH (alkaline) solutions. The premium properties of *Vader* enhance spray drift control and delivery of a more uniform pattern of insecticidal sprays.

### Formulation

Phosphatidylcholine, methylated vegetable oil,  
 alcohol ethoxylate .....90%  
 Constituents ineffective as spray adjuvant .....10%

### Benefits

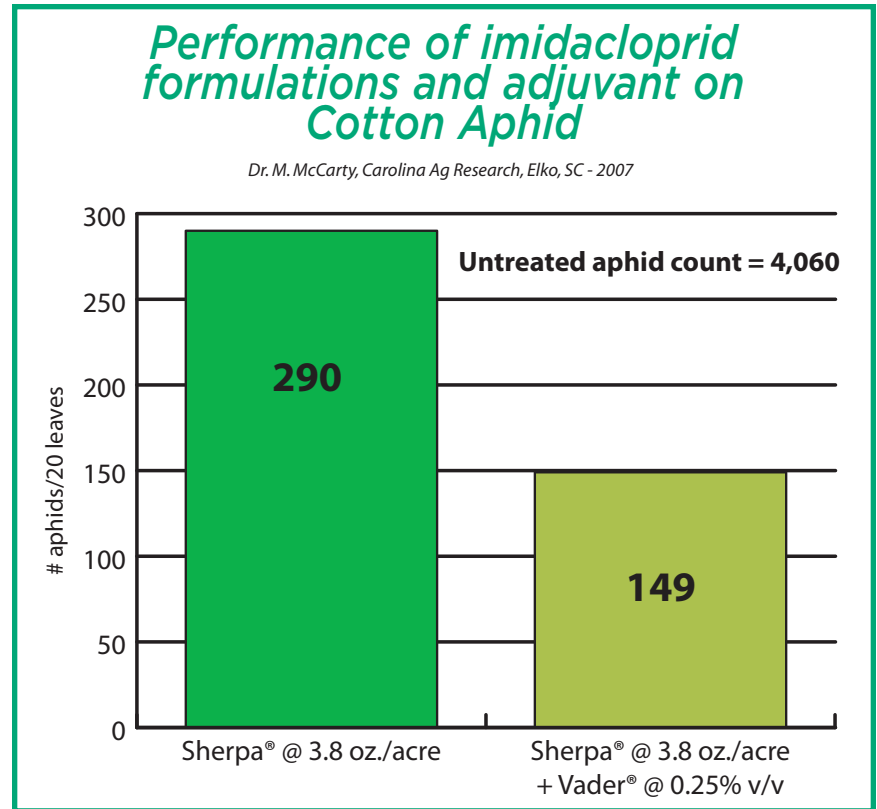
- 90% active spreader/penetrant containing soy oil derivative.
- Provides drift reduction, increased droplet adhesion, excellent penetration and deposition.
- Decreases spray solution pH to protect integrity of insecticides and prevent their degradation.
- Low odor.

### Application Information\*



**With Sherpa:** Add *Vader* at 0.125 to 0.25% of the finished spray volume;  
 16 to 32 ounces/100 gallons  
**With other neonicotinoid insecticides:** Add *Vader* at 0.25% to 0.50% of the finished spray volume; 32 to 64 ounces/100 gallons

\*Always read and follow product label directions and recommendations.





## Deposition Aid, Drift Control Agent, Water Conditioner, Antifoam/Defoamer, Penetrant

*Weather Gard Complete* is a proprietary crop-based formulation containing a drift reduction agent, antifoam/defoamer, penetrant and water conditioner in one easy-to-use liquid formulation. Formulated and approved for use with all potassium salt-based glyphosate products.

### Formulation

Lecithin, phosphate ester, methyl esters of fatty acid  
and polydimethylsiloxane .....100%

### Benefits



- *Weather Gard Complete* contains *Leci-Tech*<sup>®</sup> chemistry, eliminating pump shear which can negatively affect drift management.
- *Weather Gard Complete* maintains the droplet spectrum at the optimal size to control drift and improve coverage.
- The water conditioning component reduces the effects of hard water ions that interfere with herbicide performance.
- Antifoam/defoam component stops foam from building or eliminates it after the fact, for quicker and easier spray tank filling.
- 100% active formulation includes added penetrants allowing for enhanced uptake.

### Application Information\*



1 to 2 quarts per 100 gallons  
**SHAKE WELL BEFORE USING!** *Weather Gard Complete* should be added to the spray tank before adding pesticides to prevent foaming and reduce the effects of hard water ions.

**Target Chemistries: Partial or unloaded glyphosate formulations**

\*Always read and follow product label directions and recommendations.

## Which Would You Rather Use?



**Tired of handling AMS?** One 2.5 gallon container of *Weather Gard Complete* replaces 170 pounds of AMS and *Weather Gard Complete* also contains a drift control agent, penetrant and defoamer. Both of the photos above treat 1,000 gallons of water.

## Weather Gard Complete Performance



# ACTIVATOR 90

## 90% Non-ionic Premium Surfactant

*Activator 90* is the premier non-ionic surfactant available on the market today. This high quality, high concentration, low-foaming formulation allows the product to increase the performance of a wide range of chemicals.

### Formulation

Alkylphenol ethoxylate, alcohol ethoxylate,  
and tall oil fatty acid .....90%  
Constituents ineffective as spray adjuvant .....10%

### Benefits



- 90% active, non-ionic formulation that is biodegradable and non-flammable.
- Exceeds chemical manufacturers' recommendations.
- The high HLB level of *Activator 90* is highly water soluble and won't gel in your spray tank.
- The unique blend of ingredients in *Activator 90* break through natural barriers that affect pesticide performance.

### Application Information\*

1 to 4 pints per 100 gallons



**Application Timing:** Wettable powders and water soluble materials: Add *Activator 90* in water before pesticide is added.  
**Emulsifiable products:** Add *Activator 90* after a good emulsion is formed.

\*Always read and follow product label directions and recommendations.

# ALL CLEAR®

## Spray Tank Decontaminator

*All Clear®* is a highly effective all-purpose tank cleaner that is specifically formulated to remove pesticide deposits and other debris, including sticky and oily substances from tanks, hoses, booms and nozzles.

### Formulation

Ammonia-free Liquid Concentrated Detergent Formulation

### Benefits

- Removes phenoxy herbicides and trace element precipitates.
- Cleans emulsifiable concentrates, morpholine fungicides and residual herbicides.
- Can be used in all types of spray rig decontamination in the following markets: agriculture, horticulture, turf and ornamental, industrial and forestry.



### Application Information\*



One (1) to two (2) quarts per 100 gallons  
(250 to 500 mL per 100 L)

\*Always read and follow product label directions and recommendations.



## Water Conditioning Agent/ Deposition Aid

*Amaze Gold*<sup>®</sup> is an ammonium sulfate-based (AMS) liquid adjuvant plus deposition aid designed to maximize the performance of glyphosate, glufosinate, and other non-selective herbicides that are adversely affected by hard water calcium cations.

### Formulation

Ammonium sulfate, polyacrylamide and dimethylpolysiloxane	34%
Constituents ineffective as spray adjuvant	66%

### Benefits



- *Amaze Gold* contains AMS to counteract the antagonistic effects of hard water cations (ex. calcium) on the efficacy of various herbicides including glyphosate, glufosinate and others.
- *Amaze Gold* also contains PAM (a thickening agent) to increase the viscosity of the pesticidal spray solution to aid deposition.
- The nitrogen component derived also from AMS enhances the uptake and performance of the herbicide.
- More convenient liquid formulation versus conventional, soluble dry AMS products.

### Application Information\*



**Glyphosate and other tank mixes—use at a rate of:**  
 2.5% (2.5 gals./100 gals. solution) for 8.5 lbs. AMS/100 gals.  
 5% (5 gals./100 gals. solution) for 17 lbs. AMS/100 gals.

\*Always read and follow product label directions and recommendations.  
40



## Emulsified Vegetable Oil Surfactant

*Amigo*<sup>®</sup> was developed to maximize the performance of pesticides by increasing the deposition and coverage of chemicals on the target crop.

### Formulation

Vegetable oil	93%
Constituents ineffective as spray adjuvant	7%

### Benefits



- *Amigo* increases coverage of the spray solution on the plant surface.
- This product is compatible with a wide variety of chemicals, including: herbicides, insecticides, fungicides, plant growth regulators and foliar nutrients.
- The high quality vegetable oil contained in *Amigo* reduces evaporation of the spray mixture.

### Application Information\*



**Ultra-low volume applications (ULV):** Use 1 quart per acre; no water necessary.  
**Low volume applications (2 gallons water or less):** Use 1 quart per acre.  
**Normal volume applications (5 to 20 gallons water per acre):** Use 2 quarts per acre.  
**Citrus sprays (100 to 500 gallons per acre):** Use 1% of the total amount of water.  
**Dormant orchard sprays (100 to 500 gallons per acre):** Use 1 to 2% of the total amount of water.  
**For controlled droplet applications (CDA) where no water is added:** The use of 2 to 5 pints per acre is recommended.  
**For CDA with water:** Use 15% of the total liquid. Do not exceed 2 quarts per acre.

\*Always read and follow product label directions and recommendations.

# Attach<sup>®</sup>

## Non-Ionic Spreader Sticker

*Attach*<sup>®</sup> is a non-ionic spreader sticker for use in two types of spray applications. *Attach* can be used with many soil-applied herbicides to reduce the effects of volatility, leaching and photodegradation. *Attach* can also be applied with foliar sprays to increase initial deposition and to delay photodegradation.

### Formulation

Pinene (terpene) polymers, petrolatum,  
a-(p-dodecylphenyl)-omega-hydroxypoly (oxyethylene) . . . .100%

### Benefits



- *Attach*'s unique pinene chemistry reduces photodegradation, leaching and volatility.
- *Attach* reduces leaching dissipation of many soil applied herbicides.
- *Attach* increases contact, wetting and adhesion.

### Application Information\*

**Foliar Application:** 4 to 16 ounces / 100 gallons spray solution

**Soil Application:** 1 to 2 pints / acre



**Application Timing:** For best results, apply spray mixture containing *Attach* at least 1/2 hour, during daylight, before anticipated rain.

\*Always read and follow product label directions and recommendations.

## ATTACH : Citrus



Herbicide  
+  
ATTACH @ 2 pt/A

Herbicide  
alone

Photo taken 3 months after treatment

## Attach : Tomato



Herbicide  
+  
ATTACH @ 2 pt/A

Herbicide  
alone

Photo taken 11 weeks after treatment



## Spreader Sticker/Deposition Aid

*Bond Max*® combines the adherence ability of a latex polymer with super coverage of non-ionic surfactants. *Bond Max* promotes rapid spreading for a uniform protective film across the plant surface, thereby enhancing the effectiveness of pesticide sprays.

### Formulation

Synthetic latex, 1,2-propanediol and alcohol ethoxylate .....57.5%  
 Constituents ineffective as spray adjuvant .....42.5%

### Benefits



- *Bond Max* enhances droplet deposition and rainfastness in minutes, thereby reducing the risk of pesticide runoff from the plant surface.
- *Bond Max* increases the effectiveness of fungicidal and insecticidal sprays.

### Application Information\*

Suggested use rates - ground and air application

Above 50 GPA .....12 to 24 fluid ounces per 100 gallons  
 10 to 50 GPA .....20 to 32 fluid ounces per 100 gallons  
 Below 10 GPA .....28 to 40 fluid ounces per 100 gallons



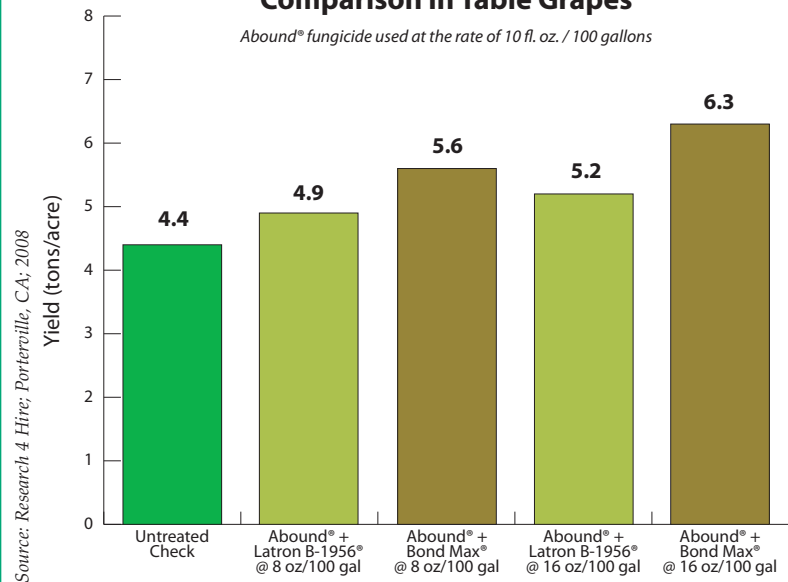
Apply sprays containing *Bond Max* at least 30 minutes before an anticipated rain or overhead irrigation event.

\*Always read and follow product label directions and recommendations.

## Bond Max Crop Safety

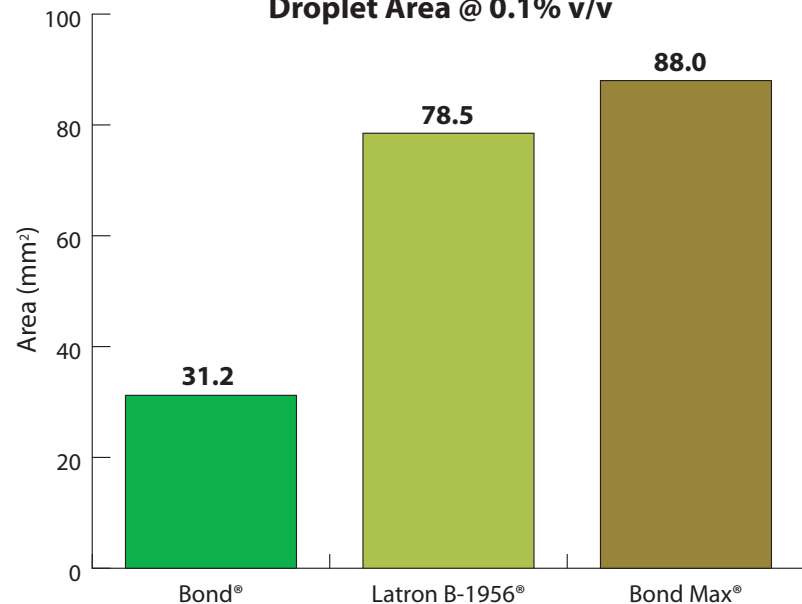
### Bond Max® and Latron B-1956® Crop Safety Comparison in Table Grapes

*Abound*® fungicide used at the rate of 10 fl. oz. / 100 gallons



## Spreading Ability of Bond Max vs. Bond® and Latron B-1956®

### Droplet Area @ 0.1% v/v





## Water Conditioner

*Choice*<sup>®</sup> *Weather Master* is a water conditioning agent for use with agricultural chemicals. Designed for hard water conditions, this liquid formulation locks up hard water cations allowing maximum herbicide performance. Compatible with all formulations of glyphosate, including the newer K-salts.

### Formulation

Salts of polyacrylic, hydroxy carboxylic, propionic acids,  
 phosphate ester and ammonium sulfate .....50%  
 Constituents ineffective as spray adjuvants .....50%

### Benefits



- *Choice Weather Master* reduces the effects of hard water on herbicide performance. When certain herbicide chemistries are added to water the negative charges in the herbicide molecules attract the positive ions (cations) in the water. The herbicide and these cations form a strong complex which can prevent or hinder uptake of the herbicide into the plant, effectively reducing herbicide performance.
- Multiple sequestering and chelating agents bind multiple hard water cations, such as calcium, manganese, magnesium, and potassium.
- Liquid formulation provides convenience of treating 1000 gallons with 2½ to 5 gallons of liquid instead of 100 to 200 pounds of dry product.

### Application Information\*

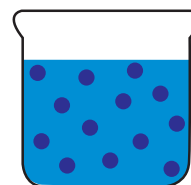
2 to 4 pints (based on water hardness) per 100 gallons of water



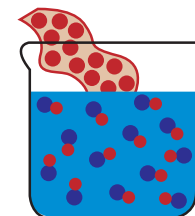
Add desired rate of *Choice Weather Master* to water before adding pesticides.

\*Always read and follow product label directions and recommendations.

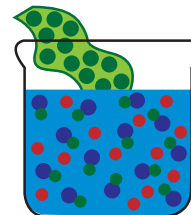
## ACTION OF CHOICE WEATHER MASTER IN HARD WATER



Hard water with cations



Addition of certain active ingredients actually "lock-on" to the cations.



The addition of *CHOICE Weather Master* results in it "locking-on" to the hard water cations. This prevents hard water cations from interfering with the herbicide performance.

● Hard water cations    ● Active ingredient    ● *CHOICE Weather Master*

### Simplified Solubility Chart : Anions

	F <sup>-</sup>	Cl <sup>-</sup>	HCO <sub>3</sub> <sup>-</sup>	NO <sub>3</sub> <sup>-</sup>	CO <sub>3</sub> <sup>2-</sup>	SO <sub>4</sub> <sup>2-</sup>	PO <sub>4</sub> <sup>3-</sup>
Na <sup>+</sup>	S	S	S	S	S	S	S
K <sup>+</sup>	S	S	S	S	S	S	S
NH <sub>4</sub> <sup>+</sup>	S	S	S	S	S	S	S
Ca <sup>2+</sup>	I	S	SS	S	I	VSS	I
Mg <sup>2+</sup>	VSS	S	S	S	VSS	S	I
Zn <sup>2+</sup>	S	S	VSS	S	I	S	I
Fe <sup>2+</sup>	SS	S	SS	S	VSS	S	I
Fe <sup>3+</sup>	SS	S	I	S	I	S	I
Al <sup>3+</sup>	S	S	X	S	X	S	I

S=Soluble (over 5,000 mg/L); SS=Slightly soluble (2,000 - 5,000 mg/L);  
 VSS=Very Slightly Soluble (20 - 2,000 mg/L); I=Insoluble (less than 20 mg/L); X=Not a compound

From: "Water: The Universal Solvent" - Nalco Chemical Co.

*Choice Weather Master* is a sequesterant and keeps ALL types of hard water cations from bonding with glyphosate. **AMS only handles calcium.** Ammonium Sulfate: Hard water cations (Ca, Mg, Fe, Na, etc.) have a negative effect on glyphosate molecules. The addition of AMS allows the sulfate to bond with calcium and forms "Very Slightly Soluble" calcium sulfate, and once formed it is not likely to disassociate; however, all other cations form bonds that are "soluble" thereby allowing for disassociation and further interference with the glyphosate molecule. (Refer to chart.)

# Effective

## Premium Oil Surfactant with Water Conditioners

*Effective* is a blend of premium oil surfactant and water conditioning components to reduce interference of hard water ions with herbicide performance.

### Formulation

Premium oil surfactant plus water conditioners .....99%  
 Constituents ineffective as spray adjuvant .....1%

### Benefits



- Contains water conditioners to reduce adverse effects of hard water on herbicide performance.
- Effective penetrating adjuvant for most herbicides.
- Provides excellent weed control and superior crop safety.

### Application Information\*

2.5 pints per acre



\*Always read and follow product label directions and recommendations.



## Spray Adjuvant

*Flame*® is a unique blend of wetting agents, ammonium sulphate and penetrators in an easy-to-mix and stable formulation. This combination will reduce surface tension, reduce hard water antagonism, and provide superior penetration even in tough conditions.

### Formulation

Blend of paraffinic oil, ammonium sulphate  
 and alkyl polyglucoside .....52.7%  
 Constituents ineffective as spray adjuvant .....47.3%

### Benefits



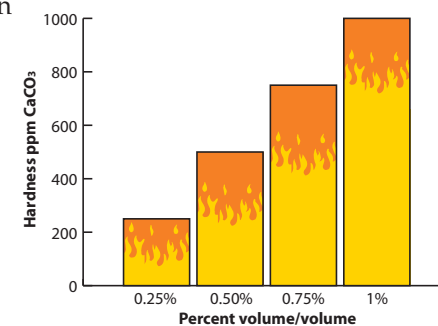
- Wetting agents will reduce droplet bounce, aid in droplet retention and reduce surface tension.
- Ammonium sulphate will protect from deactivation due to hard water.
- Increased penetration allows for an increased level of pesticide into the leaf surface for optimum performance.
- Ammonium ions stimulate pesticide uptake for increased performance.
- Neutral pH allows for cross-utility amongst chemistries.

### Application Information\*

1 quart to 1 gallon per  
 100 gallons of solution  
 (see chart)



General Use Rates for FLAME®





## Organosilicone Surfactant Blend Wetter/Spreader/Penetrant

Freeway® is a non-ionic surfactant blend containing organosilicone designed to decrease surface tension of spray solution below conventional surfactants resulting in better coverage.

### Formulation

Alcohol ethoxylates, silicone-polyether copolymer,  
propylene glycol and dimethylpolysiloxane .....100%

### Benefits



- Decreases surface tension resulting in better coverage.
- Excellent crop safety.
- Increases absorption of pesticides and micronutrients.
- Low use rates versus conventional surfactants.

### Application Information\*

Lower spray volumes generally require higher rates for best results.



**When used with Herbicides, Desiccants, Defoliants:** 12 to 64 ounces per 100 gallons

**Brush and woody species Herbicides:** 16 to 64 ounces per 100 gallons

**When used with Insecticides, Fungicides, Acaracides:** 6 to 16 ounces per 100 gallons

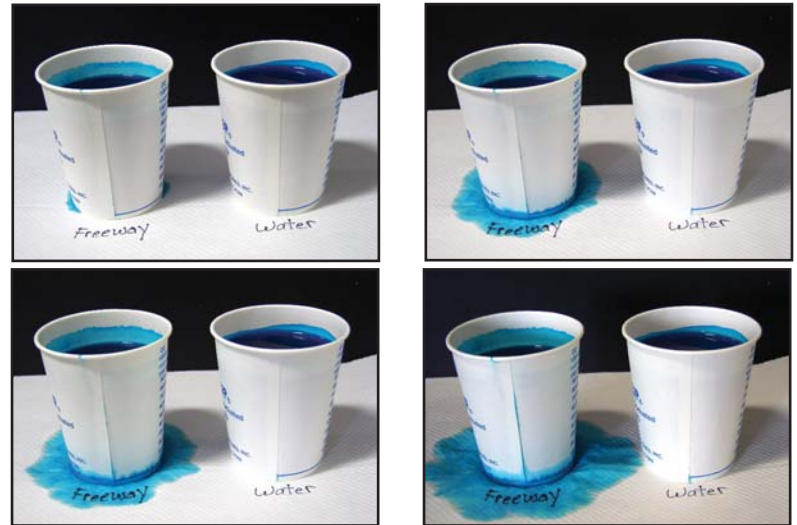
**When used with Plant Growth Regulators, Foliar Nutrients:** 10 to 32 ounces per 100 gallons

**When used for Soil Wetting:** 12 to 32 ounces per 100 gallons

**When used for General Wetting/Spreading:** 6 to 12 ounces per 100 gallons

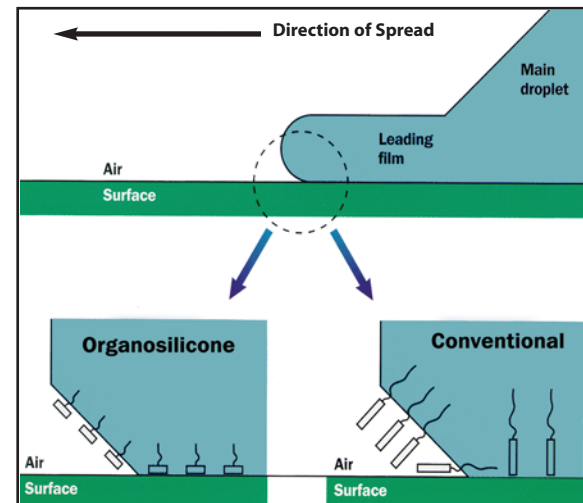
\*Always read and follow product label directions and recommendations.

## Making Water "Wetter"



A surfactant, or surface active agent, makes water more efficient by making water "wetter". Organosilicones are referred to as "Super Wetters". In the demonstration above, paper cups have been filled with water and dyed blue. In the cup on the left, Freeway has been added. When Freeway is added, the cup quickly reaches its saturation point and can no longer contain the water.

## Effect of the surfactant "tail" on spreading



Which hydrophobic "tail" would offer the most resistance to the movement in the direction of spread?



## Water Conditioning Agent, pH Adjuster

*Gunsmoke*® is a premium-grade activator, water conditioner and acidifier designed to improve performance and speed of control of glyphosate.

### Formulation

Monocarbamide dihydrogen sulfate, alkyl amine ethoxylate,  
 1,2,3-trihydroxypropane .....80%  
 Constituents ineffective as spray adjuvant .....20%  
 All ingredients exempt from requirements of a tolerance under 40 CFR 180

### Benefits

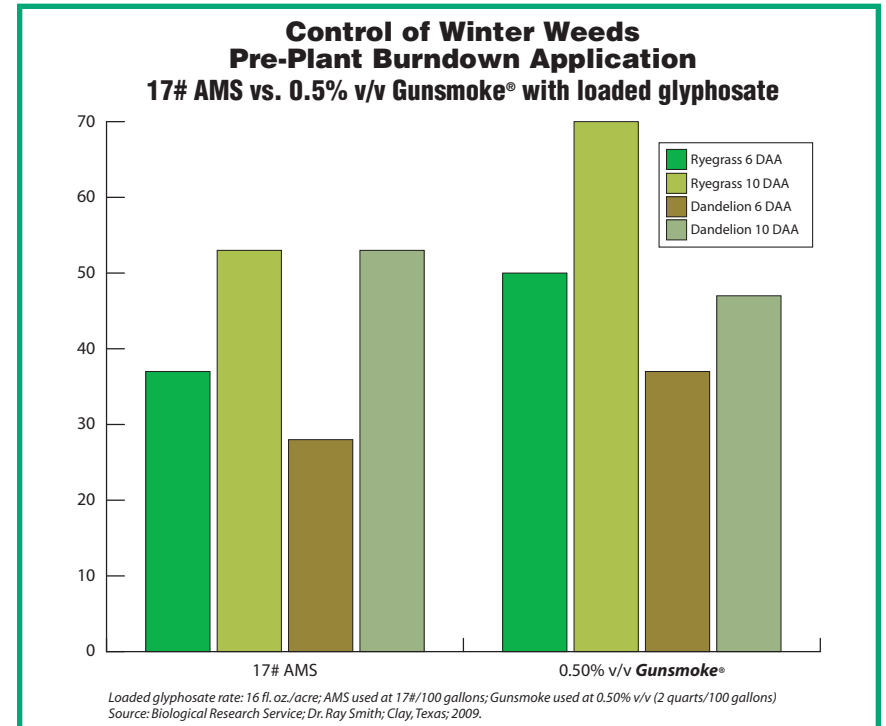
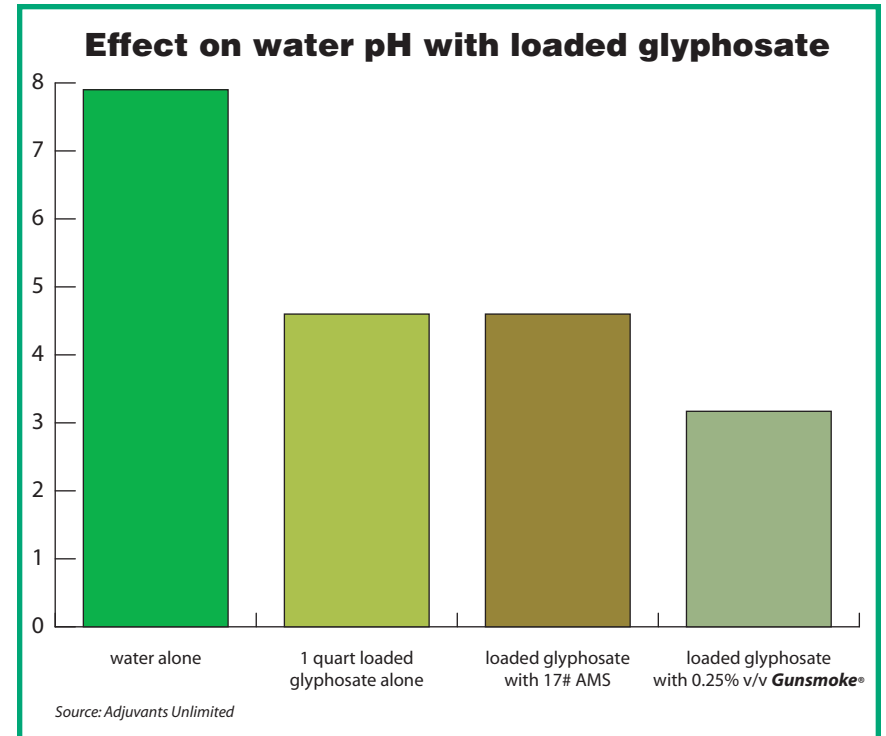
- *Gunsmoke* will greatly accelerate weed control in glyphosate tank mixes
- *Gunsmoke* is more convenient than dry AMS and provides similar to or better control than AMS
- *Gunsmoke* contains a surfactant, an acidifier *and* a water conditioner

### Application Information\*

Use *Gunsmoke* at 1 quart per 100 gallons water under normal growing conditions with small, actively growing weeds and good water quality.

Use *Gunsmoke* at 2 quarts per 100 gallons water when environmental conditions, water quality and/or weed sizes will make weed control difficult.

\*Always read and follow product label directions and recommendations.





## Premium Crop Oil Concentrate

*Herbimax*® is a premium oil/surfactant that increases penetration and the activity of post-emergence herbicides.

### Formulation

Petroleum hydrocarbons (light paraffinic distillate, odorless aliphatic petroleum solvent) . . . . .	83.00%
Alkylphenol ethoxylate, tall oil fatty acid . . . . .	16.32%
Constituents ineffective as spray adjuvant . . . . .	0.68%
Contains petroleum distillates	

### Benefits



- Premium multi-component oil/surfactant system.
- Premium, fertilizer-compatible emulsifier stabilizes solution in the spray tank.
- Increases herbicide activity and penetration of the plant surface.
- Easy to use, non-foaming formulation allows easy mixing of chemicals and complete clean out of the spray tank.
- Can be applied by ground or air.

### Application Information\*

General Use Rate: 1 to 4 pints per acre



\*Always read and follow product label directions and recommendations.

## Emulsion Stability

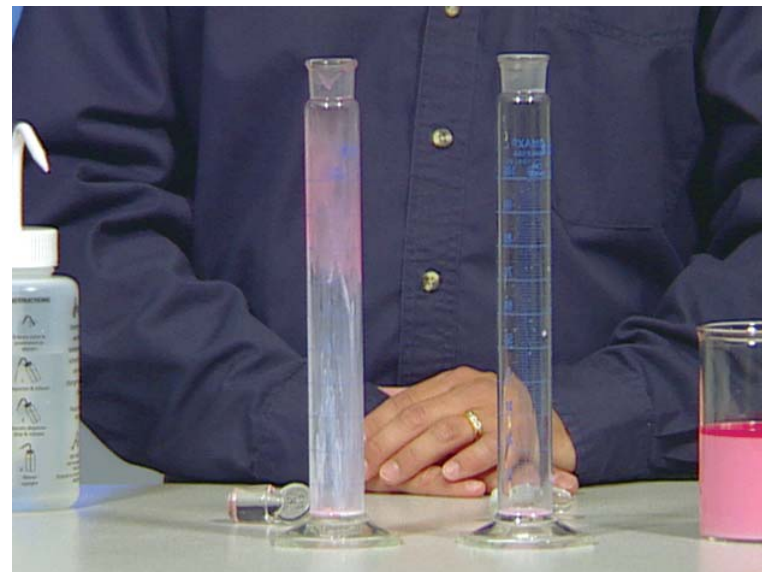


Crop Oil + 2% AMS



Herbimax + 2% AMS

After sitting for 10 minutes, *Herbimax*, on the right, holds a spray mixture together; competitive product's emulsion, left, broke down.



*Herbimax* won't leave sticky residues in the spray tank. *Herbimax* cleans out much easier than standard Crop Oil Concentrates. Easy clean-out alleviates worries about crop injury when switching from one crop application to another.



## Deposition Aid, Spreader

HiWett® is a new generation organosilicone blend super-spreader, specifically designed for deposition and coverage.

### Formulation

Polysiloxane polyether copolymer, alcohol ethoxylate,  
Polyoxyethylene-polyoxypropylene copolymer .....100%

### Benefits

- Specifically designed for deposition and coverage.
- Potential use of less water or improved performance of low-volume applications.
  - Less residues.
  - Improved nutrient uptake.
  - Improved control of diseases and insects.



## Application Information\*

### Ground and Air Application Rates

CROP	SPRAYER TYPE	WATER GALS/A <sup>1</sup>	Total pounds or pints of chemicals being applied per acre								
			1	2	3	4	5	6	7	8	9
Vegetables such as Bulb, Brassica, Leafy and Strawberries (hard to wet leaves)	Ground Boom Sprayer or Aerial Application	15-20	Rate of HiWett Adjuvant in fluid ounces per acre								
			3.2	3.2	4.0	4.8	6.0	7.2	8.0	8.8	9.6
Potatoes and other Fruiting Vegetables, Cotton (easy to wet leaves)		5-10	1.6	2.0	3.0	4.0	4.8	5.2	5.6	6.0	6.4
Grapes - Foliage	Ground	10-25	2.4	2.4	3.2	3.2	4.0	4.0	4.8	4.8	5.6
Grapes - Bunches	Air Assist	20-25	6.4	6.4	6.4	7.2	8.0	8.0	8.8	8.8	9.6

<sup>1</sup>Use the lower water volumes when crop canopy is small or light. Use the higher water volumes on larger, dense canopies.

\*Always read and follow product label directions and recommendations.

## Grape Comparison

42 GPA without HiWett®



21 GPA with HiWett®



## Apple Comparison

100 GPA without HiWett®



40 GPA with HiWett®



Note: SURROUND® was used as a visual marker on all images.



## Crop Oil Concentrate

*Maximizer*<sup>®</sup> is a combination of superior paraffinic oil and surfactant, designed especially for use with pesticide spray programs.

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### Formulation

Paraffin base petroleum oil . . . . .	83.0%
Tall oil fatty acids, alkylphenol ethoxylate . . . . .	16.3%
Constituents ineffective as spray adjuvants . . . . .	0.7%

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### Benefits

- *Maximizer* is a proprietary crop oil concentrate (COC) formulated with crop safe, fertilizer compatible emulsifiers and premium paraffinic oil to provide enhanced pesticide efficacy.
  - *Maximizer* also has a surfactant load to aid in the spreading of the pesticide spray solution across the target plant surface.
- *Maximizer* rates are flexible and recommended on a per-acre basis for ground or air applications.
- Non-foaming, easy mix, tank friendly formulation.
- Formulation has a mild odor.



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### Application Information\*

General Use Rate: 1 to 8 pints per acre

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\*Always read and follow product label directions and recommendations.



## Proprietary Blend of Methylated Seed Oil and Organosilicone Surfactant

*Phase*<sup>®</sup> is a high performance proprietary formula that provides spreading and coverage of a non-ionic surfactant and the penetration of a methylated seed oil.

### Formulation

Methyl esters of fatty acids, alkylpolyoxyethylene ether and polyether modified polysiloxane .....100%

### Benefits



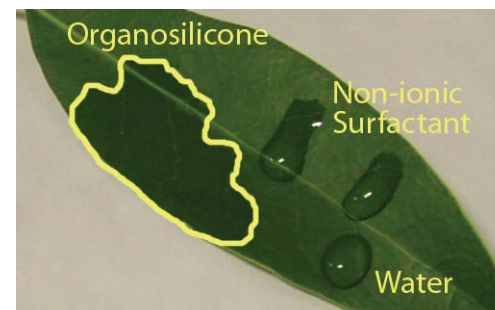
- Combined spreading ability of organosilicone surfactant with penetrating ability of a methylated seed oil makes *Phase* an ideal tank mix partner for a wide variety of pesticides.
- Methylated seed and crop oil performance with nonionic adjuvant use rates.
- Rapidly spreads across and penetrates plant tissue carrying sensitive pesticides into the plant cuticle protecting them from UV breakdown.
- Maximizes coverage and penetration for quick complete control.
- Can be used with a variety of insecticides, herbicides and fungicides.

### Application Information\*



1 to 4 pints/ 100 gallons  
Increase the rate of *Phase* as the spray volume decreases to obtain the desired coverage.

## Spreadability of Organosilicone Surfactant



## Penetrating Ability of Methylated Seed Oil Green Foxtail Wax Solubility

	Exposure interval (min)					
	0	5	10	20	40	24 hrs
Distilled Water	0	0	0	0	0	0
Petroleum Oil	0	0	0	2.5	2.5	9
Sunflower Oil	0	0	0	0	2.5	6
Methylated Seed Oil	2.5	5	6.5	9	10	10

Evaluation scale: 0=no solubility; 10=totally dissolved

Manthey, F.A. and J.D. Nalewaja; NDSU, Fargo, ND; 1992

\*Always read and follow product label directions and recommendations.



## Surfactant and Deposition Aid

*Phase® II* is a high performance proprietary formula that contains UAN solution to improve uptake, spreading and coverage of a non-ionic surfactant with the penetration of a methylated seed oil.

### Formulation

Carbamides, alcohol ethoxylates, methylated esters of fatty acids, polyether modified polysiloxane .....	.80%
Constituents ineffective as spray adjuvant .....	.20%

### Benefits

- Methylated seed and crop oil performance with nonionic adjuvant use rates.
- Rapidly spreads across and penetrates the plant tissue carrying sensitive pesticides into the plant cuticle protecting them from UV breakdown.
- Can be used when N basic blends or MSO's are recommended.
- Maximizes coverage and penetration for quick, complete control.
- Can be used with a variety of insecticides, herbicides and fungicides.



### Application Information\*

4 quarts per 100 gallons or 1% by volume



\*Always read and follow product label directions and recommendations.



## Non-Ionic Surfactant, Buffering Agent

*Quad 7* is an oil-free patented blend of non-ionic surfactant, ammonium salt, and buffering components designed to enhance the efficacy of sulfonyleurea and other herbicides. The inherent properties of *Quad 7* effectively increase the pH (alkaline) of sulfonyleurea herbicide sprays, thereby increasing their solubility in water and subsequently their chemical activity that leads to greater weed control.

### Formulation

Alcohol ethoxylate and ammonium nitrate .....	.42%
Constituents ineffective as spray adjuvant .....	.58%

### Benefits

- Increases herbicidal activity by increasing spray solution pH thereby increasing sulfonyleurea solubility and application effectiveness.
- Ammonium salts enhance herbicide uptake and performance.
- Contains non-ionic surfactant that enhances coverage of spray solution applied.
- Formulated to be utilized for micro-rate herbicide applications on sugar beets.



### Application Information\*

Use *Quad 7 Spray Adjuvant* at 1% v/v (1 gallon per 100 gallons spray mixture); use *Quad 7* at 2% v/v when applying pesticide spray mixture at 5 gpa or less.



**Sugar Beet Micro Rates:** Add *Quad 7* first to clean water in spray tank when using with sugar beet micro rates and follow specific tank filling and mixing information provided on the herbicide labels.

Use *Quad 7* at 1% v/v + 1% v/v *MSO® Concentrate with Leci-Tech®*.

\*Always read and follow product label directions and recommendations.



## Deposition Aid, Drift Control Agent

*Reign*<sup>®</sup> aids in reducing drift and improving coverage of pesticide or fertilizer solutions. *Reign* is user-friendly and effective.

### Formulation

Polyvinyl polymer (polyacrylamide) .....	1%
Constituents ineffective as spray adjuvant .....	99%

### Benefits



- *Reign* will help reduce, but not eliminate, drift and aids in deposition in all types of agricultural sprays.
- *Reign* will not settle out or separate when agitation stops and will not leave a residue in the spray tank.

### Application Information\*



**Aerial use:** 2 to 5 quarts per 100 gallons

**Ground use:** 1 to 4 quarts per 100 gallons\*\*

**\*\*Spray guns (ground use):** 3 to 10 quarts per 100 gallons

\*Always read and follow product label directions and recommendations.



## Drift Control Agent, Deposition Aid

*Reign*<sup>®</sup> LC is an easy mixing polyacrylamide concentrate that decreases driftable fines and improves deposition.

### Formulation

Polyvinyl polymer (polyacrylamide) .....	30%
Constituents ineffective as spray adjuvant .....	70%

### Benefits



- Disperses easily in spray solutions.
- Effective, low use rates.
- *Reign LC* is compatible with most herbicides, including K-salt glyphosates.
- For use with agricultural, aquatic and terrestrial products.
- Effective with most water soluble and wettable powder pesticides, desiccants and cotton defoliant.
- Apply by air or with standard ground application equipment.
- Easy-to-use squeeze and pour container provides accurate measurement.

### Application Information\*



**Below 20 psi:** 1 to 2 ounces per 100 gallons

**Below 40 psi:** 1.5 to 3 ounces per 100 gallons

**Above 40 psi:** 2 to 4 ounces per 100 gallons

\*Always read and follow product label directions and recommendations.



## Non-ionic Surfactant

*Scanner*<sup>®</sup> is an 80/20 non-ionic surfactant offering uniform leaf coverage, wetting and distribution of pesticides on plant surfaces.

### Formulation

1,2-propanediol, alkylpolyoxyethylene ethers, polydimethylsiloxane . . . . .	80%
Constituents ineffective as spray adjuvant . . . . .	20%

### Benefits



- Manufactured with an 80/20 non-ionic formulation that is biodegradable and non-flammable.
- Mild odor—carries the CAUTION signal word.
- Formulation has neutral pH of 7.1 (1% v/v solution).
- Very low use rates that provide uniform spreading and wetting of the pesticide spray solution.
- Low foaming formulation.
- Product emulsifies easily and is very user-friendly.

### Application Information\*

**Acaricides, Insecticides, Fungicides, Miticides (livestock sprays):** 3 to 8 fluid ounces per 100 gallons of water



**Herbicides, Defoliant, Desiccants, Wettable Powders:** 1 to 4 pints per 100 gallons of water

**Utility and Highway R.O.W. and in Forest Site Preparation:** 1 to 4 pints per 100 gallons of water

**Foliar Nutrients:** 1 pint per 100 gallons of water



## Surfactant Blend containing Ammonium Sulfate

*Surfate*<sup>®</sup> *Spray Adjuvant* is a multi-component, non-ionic surfactant plus liquid ammonium sulfate designed to maximize the performance of glyphosate, glufosinate, and other non-selective herbicides. *Surfate* exhibits excellent wetting and penetration properties. The addition of *Surfate* to spray solutions can overcome the antagonistic effect of hard water on glyphosate activity.

### Formulation

Ammonium sulfate, alkylpolyglycosides and dimethylpolysiloxane . . . . .	50%
Constituents ineffective as spray adjuvant . . . . .	50%

### Benefits



- Non-ionic surfactant provides enhanced wetting and penetrating properties to herbicidal sprays.
- Nitrogen component enhances the uptake and performance of glyphosate and other non-selective herbicides.
- Convenient and user friendly.

### Application Information\*

Add *Surfate* at 1% v/v (1 gallon/100 gallons) under most conditions.



\*Always read and follow product label directions and recommendations.



## Sticker, Organosilicone Surfactant, Deposition Agent

*Tactic* combines the spreading properties of organosilicone with a quality sticker for the best possible droplet retention on the leaf surface. *Tactic* sticks insecticides and fungicides to the leaf surface preventing pesticide loss due to droplet shatter or bounce, and protects from rain and irrigation wash-off.

### Formulation

Synthetic latex, 1,2-propanediol, alcohol ethoxylate,  
 silicone polyether copolymer .....63.4%  
 Constituents ineffective as spray adjuvants .....36.6%

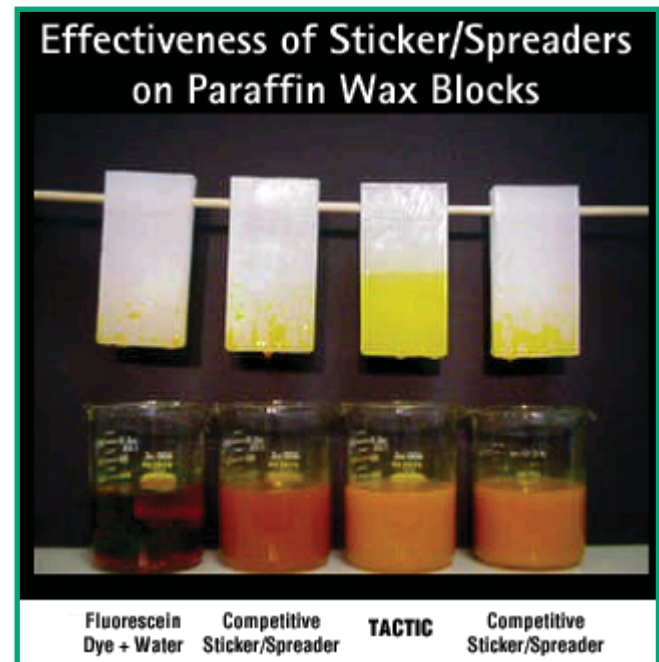
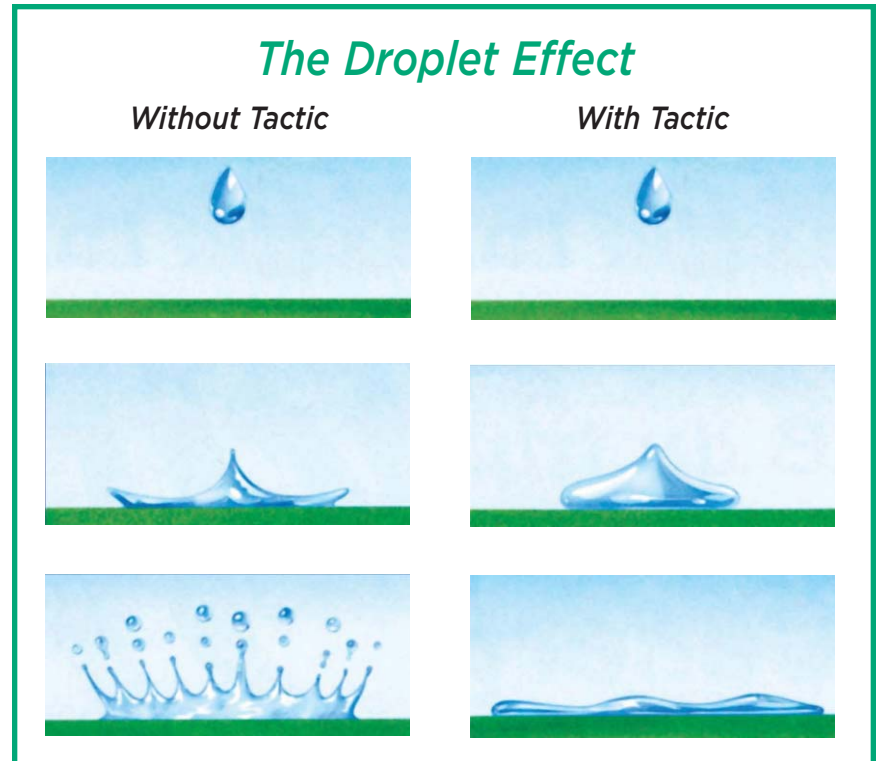
### Benefits

- *Tactic* produces excellent droplet deposition and rainfastness in minutes.
  - *Tactic* weather-proofs your spray application.
  - Works in high or low volume sprays in ground or aerial applications.
    - Resists wash-off from irrigation or rainfall.
- Covers the leaf surface with the spreading ability of an organosilicone surfactant.
- Increases the effectiveness of insecticides and fungicides.

### Application Information\*

Ground or Air Application

**Above 50 GPA:** 8 to 16 ounces per 100 gallons  
**10 to 50 GPA:** 16 to 24 ounces per 100 gallons  
**Below 10 GPA:** 24 to 32 ounces per 100 gallons



\*Always read and follow product label directions and recommendations.



## Superior Foam Marker

*Trekker Trax*® is a unique blend of ingredients that produce thick-bodied, long-lasting foam. *Trekker Trax* works in nearly all water conditions regardless of hardness and mineral content or impurities.

### Formulation

Alcohols .....	.24%
Mixed anionic and non-ionic surfactants .....	.30%
Inert diluent compounds .....	.46%

### Benefits



- Produces thick, long-lasting foam.
- Works with a wide range of water conditions in agriculture, commercial and industrial use.
- This easy-to-use product ensures accurate spray application and eliminates unnecessary field skips.

### Application Information\*

Mix with water at approximately 1% of concentration



**In soft water:** 2 to 3 pints in 30 to 40 gallons of water

**In medium and hard water:** 3 to 4 pints in 30 to 40 gallons of water

*Note: If foam consistency is poor at the 4 pint level, check for a malfunction or contamination in the foam generating system.*

\*Always read and follow product label directions and recommendations.



## Highly Concentrated Foam Marker with Water Conditioner

*Tuff Trax*® is a superior foam marker, a unique blend of ingredients for producing thick, long-lasting foam. *Tuff Trax* has been formulated to work over a wide range of water hardness, mineral content and impurities.

### Formulation

Alkyl sulfonate 4-methyl-2, 4-pentane-diol .....	.100%
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### Benefits



- Produces thick, long-lasting foam.
- Works with a wide range of water conditions in agriculture, commercial and industrial use.
- This easy-to-use product ensures accurate spray application and eliminates unnecessary field skips.

### Application Information\*

Mix with water at approximately 1% of concentration.



Rate: 2 to 3 pints in 30 to 40 gallons of water.

\*Always read and follow product label directions and recommendations.



## Antifoaming/Defoaming Agent

*Unfoamer*<sup>®</sup> *Antifoaming/Defoaming Agent* is designed to effectively control foam in water, oil, fertilizer and pesticide spray mixtures. *Unfoamer* can reduce mixing time by facilitating faster and more accurate filling. Foam can affect calibration and metering of spray mixtures. *Unfoamer* will help reduce waste and exposure to pesticides contained in foam running over the top of the tank.

### Formulation

Dimethylpolysiloxane, polypropylene glycol, and methylated silicone .....12.5%  
Constituents ineffective as spray adjuvant .....87.5%

### Benefits



- Contains a premium, high concentration, dual-component antifoam/defoamer chemistry to provide effective knockdown of foam following tank fill.
- Aids in preventing foam when added to the tank first, as additional tank additives and chemistries may inherently cause foam upon mixing.

### Application Information\*

**KEEP FROM FREEZING - SHAKE WELL BEFORE USE**

1 to 6 ounces per 100 gallons of spray mixture.



For best results, add *Unfoamer* to the water before adding the agricultural chemicals. Agitation will aid dispersion. Effectiveness of *Unfoamer* depends upon temperature, viscosity and composition of spray mixture. Decrease or increase rate until desired foam control is obtained.

\*Always read and follow product label directions and recommendations.



## Agricultural Soil Surfactant

*WaterMaxx*<sup>®</sup> 2 helps growers use water more efficiently and maintain crop productivity by improving the way water moves through soils.

### Guaranteed Analysis

Alkoxylated polyols .....10.0%  
Glucoethers .....7.0%  
Water .....83.0%

### Benefits



- Improves infiltration allowing water and nutrients to move into the rootzone quickly and evenly.
- Improves the lateral movement of water increasing the horizontal reach of water in the soil profile.
- Improves the availability of water and nutrients to the plant increasing crop productivity.
- Improves penetrability of compacted soils allowing deeper root penetration and water movement.
- Improves the distribution of chemicals and nutrients applied with water.
- Reduces crusting improving water infiltration, gas exchange, and seedling emergence.

### Application Information\*



*WaterMaxx* 2 may be applied through any type of irrigation system (except permanent earthen ditches) or by conventional spray equipment. *WaterMaxx* 2 may be applied as a one time application or in multiple applications throughout the growing season. Rates and frequency will be dependent on crop type and local growing conditions. Consult your sales representative for details.

Generally, *WaterMaxx* 2 will be used at 1 to 4 quarts per acre.

\*Always read and follow product label directions and recommendations.



## Non-Ionic Wetting Agent / Spreader / Penetrant Surfactant

*Widespread*<sup>®</sup> *Max* is a premium organosilicone adjuvant designed to reduce the surface tension of the spray solution in order to maximize pesticide and nutrient spray coverage and efficacy.

### Formulation

Polyether-polymethylsiloxane-copolymer polyether . . . . .100%

### Benefits



- 100% pure organosilicone formulation delivering maximum wetting on target surfaces and coverage of pesticidal and nutritional sprays.
- The organosilicone chemistry allows for lower spray volumes without jeopardizing spray coverage while delivering faster adhesion (rainfastness) to the target surface.
- Tank mix capable with a wide variety of chemistries including herbicides, insecticides, fungicides, plant growth regulators, defoliants and desiccants.
- Very low use rates and crop safe.
- Stable formulation with a mild odor.

### Application Information\*

#### Ground Application:

*Herbicides, Dessicants, Defoliants* .....6 to 13 oz. per 100 gallons  
*Insecticides, Fungicides, Plant Growth Regulators,*  
*Foliar Nutrients, Acaracides* .....4 to 8 oz. per 100 gallons

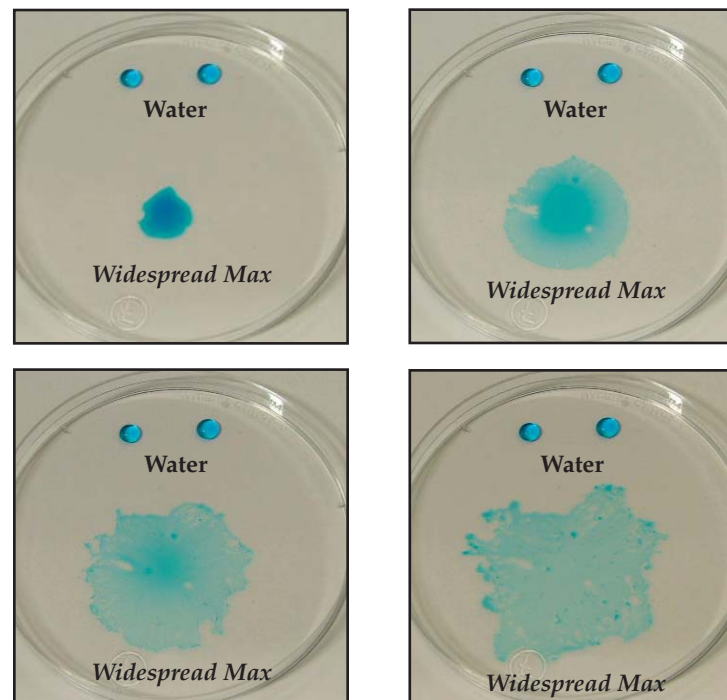
**Aerial Application:** Apply at the rate of 12 to 16 oz. per 100 gallons

**Idaho Aerial Applications:** Use 2 to 4 oz. per acre

**For use with Dormant Sprays for Walnut Blight:** Apply *Widespread Max* in a concentration of 0.5% or approximately 65 oz. per 100 gallons of spray

\*Always read and follow product label directions and recommendations.

## Superior Spreading Ability



With many pesticides, coverage is a primary objective for optimum performance. A great way to provide coverage is to enable droplets to spread to a greater degree. Organosilicones are the best spreaders in the industry. *Widespread Max* is 100% organosilicone. The demonstration shown here is a good example of how well *Widespread Max* spreads in comparison to water. The series of pictures were taken within seconds after droplets were applied.

## Spreadability of Organosilicone Surfactant



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## ACIDIPHACTANT

*AcidipHactant* acts to reduce the pH of pesticide spray solutions to a point where alkaline hydrolysis (degradation) of the pesticide will be minimized. *AcidipHactant* also serves to increase the activity and effectiveness of insecticides, herbicides, fungicides and many other agricultural chemicals.

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## E-Z MIX

*E-Z Mix* is a highly concentrated compatibility agent for direct addition to liquid fertilizers when a stable mixture of pesticides and liquid fertilizer is desired.

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## SPREADER 90

*Spreader 90* is a low-foam, non-ionic utility surfactant. It reduces surface tension in spray solutions and improves spreading and wetting characteristics.

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## Tank & Equipment Cleaner

*Tank & Equipment Cleaner* is a tough, hardworking cleaner that comes through when others fail. *Tank & Equipment Cleaner* will keep machinery working right and looking good.

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## THRUST

*Thrust*<sup>®</sup> is a highly processed, sprayable-grade ammonium sulfate/polymer adjuvant designed to improve the efficacy of post-emergence herbicides requiring ammonium sulfate. *Thrust* also contains a drift reduction/deposition aid, which reduces spray fines and improves deposition on plant vegetation.

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# Turf & Ornamental Products



## WHAT IS LAMINAR FLOW TECHNOLOGY (LFT)?

Traditional soil surfactants rely heavily on the water-moving performance of single polymer chemistries while holding claims to overcome all soil water-limiting properties, such as hydrophobicity. Single polymer soil surfactants have performance limitations in uniformly distributing water within the rootzone. *Laminar Flow Technology (LFT)* is delivered in a



proprietary blend of soil surfactants designed to reduce crop and turf physiological stresses found in inherently droughty soils by positively affecting the wetting, rewetting and infiltration rates of soils treated. The *LFT* family of soil surfactants (*Respond 3*<sup>®</sup>, *Neptune*<sup>®</sup>, and *Mizer*<sup>®</sup>) contains engineered ratios or “stacks” of proprietary surfactant chemistries independently designed to target hydrophobic causal agents that often lead to localized dry spot or hot spots. *LFT* significantly enhances the product performance of *Respond 3*<sup>®</sup>, *Neptune*<sup>®</sup>, and *Mizer*<sup>®</sup> via synergistic and complimentary affects of each polymer in the “stack”, although the ratio of each polymer by product varies. It is the parallel delivery of each polymer with each application to the soil that aids in overcoming soil water repellency and achieving uniform water distribution in the rootzone, thereby helping to eliminate physiological crop and turf stress inherent of droughty soils.

*LFT will improve these conditions:*



**Dry Patch**  
Localized Dry Spot  
(LDS)



**Drought Stress**

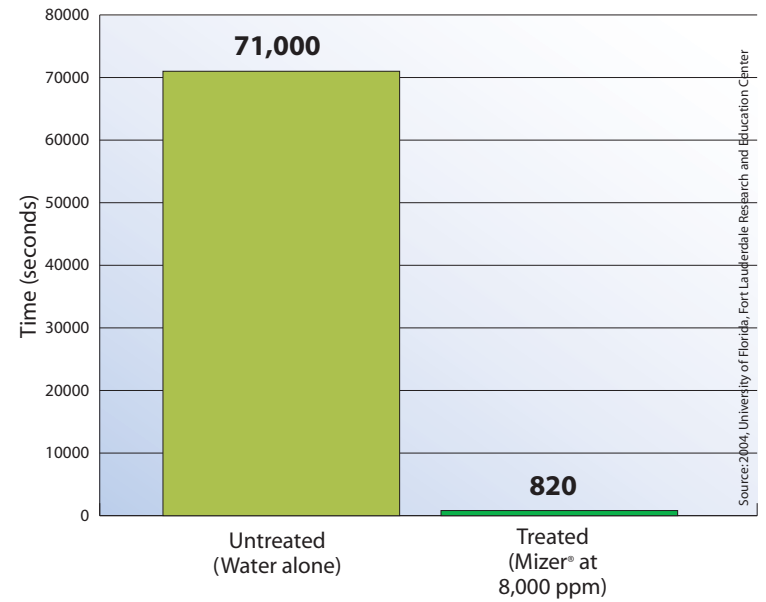


**Water Repellency**

*Potential vertical and horizontal water distribution in the soil affected by LFT.*



## Time in Seconds to Infiltrate a 6 cm Hydrophobic Soil Core



## Making Water Wetter?



Untreated  
(Water alone)

Treated



## Soil Surfactant, Penetrant

*Mizer*<sup>®</sup> is a premium, non-ionic wetting agent for improving water penetration into the soil profile, optimizing water usage and conserving water loss through evaporation. This product is specifically designed to go through irrigation systems on large turf areas and nurseries or conventional equipment on smaller areas like home lawns/landscapes.

### Formulation

Neutral blend of polyhydroxyethyl alkoxy alkylene oxides  
and alkylpolyoxyethylene .....25%

### Benefits



- *Mizer* contains all the benefits of *Laminar Flow Technology*: Superior penetration, excellent lateral movement and long residual with extreme turf safety.
- *Mizer* has 25% active ingredients meaning it can be applied at a reduced rate and cost per acre.
- The addition of a linear polyacrylamide results in *Mizer* acting as a flocculent in the soil by opening it up and increasing water and air movement. It also helps flush salts from the soil and gets soil-active pesticides deeper into the profile and distributed more uniformly.

### Application Information\*

**Maintenance Dose:** 16 to 24 ounces / acre

**Maximum Dose:** 32 ounces / acre

**Spray Application:** 0.37 to 0.73 ounces / 1,000 square feet every 21 to 30 days or as needed.



\*Always read and follow product label directions and recommendations.



## Long-term Soil Surfactant

*Neptune*<sup>®</sup> is an advanced polymer surfactant chemistry designed to support a high level of superior turf while producing laminar moisture throughout the root zone.

### Formulation

Polyglycol ether ester .....98%  
Constituents ineffective as soil wetting agent .....2%

### Benefits



- *Neptune* is recommended for use on turf grasses where superior demands are required such as golf courses, athletic fields and other highly maintained areas.
- *Neptune* will improve root zone moisture distribution in a variety of sand and non-sand based soil types and under severe stress conditions.
- *Neptune* will provide efficient irrigation use and water savings.
- When *Neptune* is applied in a program prior to the onset of hydrophobic conditions, *Neptune* will prevent their effects.
- *Neptune* will enhance rooting and overall turf vigor when used in monthly programs.

### Application Information\*

**Standard Program:** Apply six (6) fluid ounces per 1,000 sq. ft. in two (2) gallons of water (185 mL/100 m<sup>2</sup> in 8 L of water).



#### Tank Mixing

*Neptune* may be tank mixed with other commonly used turf chemicals and fertilizers at rates not to exceed six (6) ounces per 1,000 sq. ft.

\*Always read and follow product label directions and recommendations.



## Concentrated Soil Surfactant, Penetrant

*Respond*<sup>®</sup> 3 is a premium wetting agent for improving water penetration and treating localized dry spot, compaction and drought stress. For use on golf courses, sports turf, etc. Available in liquid and granular formulations.

### Formulation

Neutral blend of polyhydroxyethyl alkoxy alkylene oxides . . . . .100%

### Benefits



- *Respond 3* provides superior penetration, excellent lateral movement and long residual with extreme turf safety.
- *Respond 3* has been widely tested in Europe and at the University of Georgia.

### Application Information\*



**LIQUID—Sand-Based Mixes and Native Sandy Soils:**

**Corrective Program:** 4 oz. per 1,000 sq. ft. followed by 4 oz. per 1,000 sq. ft. every 14 days thereafter. **Maintenance Program:** 4-6 oz. per 1,000 sq. ft. every 30 days.

**LIQUID—Heavy, Non-Sandy Soils: Corrective Program:**

4 oz. per 1,000 sq. ft. followed by 4 oz. per 1,000 sq. ft. every 14 days thereafter. **Maintenance Program:** 2-4 oz. per 1,000 sq. ft. every 30 days.

**GRANULAR—Managed Application Program\*\*:** 1.5 lb. per 1,000 sq. ft.; 2 applications at 14 day intervals in early season followed by 1 lb. per 1,000 sq. ft. monthly as needed. **Intensive Split Dose Application Program\*\*:** A 3 lbs. per 1,000 sq. ft. early season application followed by 1.5-3 lbs. per 1,000 sq. ft. mid-season application. **Curative Application Program\*\*:** 1.5 lb. per 1,000 sq. ft. as necessary, repeat at 10-14 day intervals.

\*Always read and follow product label directions and recommendations.

\*\*Water in 0-18 hours after application.



## Concentrated Soil Surfactant, Penetrant

*Respond*<sup>®</sup> 3 Tablets provide a premium wetting agent for improving water penetration and treating localized dry spot, compaction and drought stress. For use on golf courses, sports turf, etc.

### Formulation

Neutral blend of polyhydroxyethyl alkoxy alkylene oxides . . . . .100%

### Benefits



- *Respond 3 Tablets* provide superior penetration, excellent lateral movement and long residual with extreme turf safety.
- 100% active provides flexible application methods (preventative program or for curative purposes/season-long control) and makes it more economical to use.

### Application Information\*



*Respond 3 Tablets* are specifically designed for spot treatment of severely affected areas through the proper hose-end applicators. The *Respond 3 Tablet* is inserted into the applicator vessel of the hose-end device and as water pours over the tablet, it slowly dissolves. Rate of dissolution will depend upon water pressure and water temperature. One tablet should be enough to cover one golf green in 20-30 minutes, or alternatively, spot treat 6 to 7 golf greens.

\*Always read and follow product label directions and recommendations.



## Lake and Pond Colorant

Aquamark® Blue Lake and Pond Colorant safely and conveniently transforms pale or off-color water into a natural appearing deep blue. Aquamark is available in both liquid and water soluble packets.

### Benefits



- For use in contained bodies of water such as: golf course water hazards, ponds, small lakes, fountains, fisheries.
- Safe/Non Toxic, treated water may be used for irrigation or swimming and recreation.
- Water soluble packets (WSP) offer greater convenience: pre-measured with easier handling and application.

### Application Information\*



**Aquamark Liquid:** Use 1 quart (0.95 L) per acre foot\* (1,234 m<sup>3</sup>) to be treated.

**Aquamark WSP:** Use 1 WSP per acre foot\* (1,234 m<sup>3</sup>) to be treated.

\*One acre foot is an area comprising 1 acre, 1 foot deep or 325,851 gallons of water.

\*Always read and follow product label directions and recommendations.



## Superior Spray Dye Indicator

Turf Trax® is a non-staining, temporary spray indicator used to show where pesticides have been applied to turf. For use in boom, handgun and spot spraying applications. Available in both blue (liquid and WSP) and green (liquid only) formulations.

### Benefits



- Mixes with water soluble pesticides and fertilizers.
- Economical marker for all spray equipment.
- Indicates skips and overlaps.
- Promotes precise applications.
- Indicates applicator contact with spray solution.
- Application verification for crew and supervisor.
- Indicates spray volume.
- Indicates spray drift.
- Can help identify equipment problems.
- Breaks down with sunlight and water.
- Safe and non-toxic.
- Washes up with soap and water.

### Application Information\*

**Turf Trax Blue or Turf Trax Green Liquid:**

*Greens & Tees:* 16-22 ounces per acre

*Fairways & Lawns:* 20-30 ounces per acre

*Roughs:* 16-36 ounces per acre

*Backpack Sprayer:* 1 ounce per gallon



**Turf Trax Blue WSP (water soluble packets)**

1-2 WSP per 50 gallons of spray solution

\*Always read and follow product label directions and recommendations.



## Turf Paint

*Warm Up*<sup>®</sup> is a super concentrated, dark green turf pigment for treating intensively managed turf where rapid soil temperature increases are desired to promote and maintain growth and color. When applied in early spring and late fall to turf, the dark hue absorbs warmth from the sun to increase (warm up) soil temperatures, thus providing earlier use and extended use of the treated turf areas.

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### Benefits



- Will not wash off.
  - Long-lasting color.
  - May be applied to all turfgrass types.
  - Improves appearance of dormant turf.
  - Raises soil temperature.
- Highly concentrated.

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### Application Information\*

#### Summer Application (discoloration):



4 to 10 ounces per gallon of spray solution. Spray at a rate of 2.5 gallons per 1,000 square feet.

#### Spring/Fall/Winter Application (dormant):

10 to 18 ounces per gallon of spray solution. Spray at a rate of 3 gallons per 1,000 square feet.

# Reference Information

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## Proper Tank Mixing Procedures

When application season rolls around, the number of customer calls concerning problems with tank mixes rises. In most cases, these problems occur with the use of dry formulations. These include formulations such as Dry Flowables (DF), Water Dispersible Granules (WDG) and Wettable Powders (WP), among others.

*Some of the products that would fall into these categories include: Atrazine 90, Savage® DS, Simazine 90WDG, Diazinon 50WP, Diuron 80WDG, Polyram® 80DF.*

The solution to most of the problems surrounding dry formulations involves patience, warmer temperatures, and proper mixing order.

Early in the spray season, carrier (water or liquid fertilizer) temperatures are commonly lower than normal. This can also occur, even on a warm day, if the water source is a deep well or is piped a great distance underground before added to the tank. Under these conditions, it will take longer for dry formulations to dissolve. It is also important to maintain adequate agitation to ensure proper suspension of the product.

Another problem that can occur is adding dry formulations in the wrong order when tank mixing various products.

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### Mixing with glyphosate or glufosinate formulations

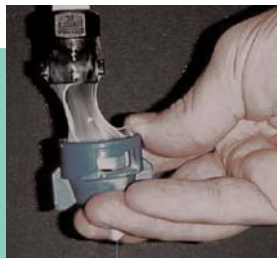
The following guidelines can be utilized throughout the season to avoid tank mixing problems:

- Fill the spray tank half full with carrier (water or fertilizer). Make sure the agitation system is engaged and working properly.
- If glyphosate (Roundup®, Touchdown®, Mirage®) or glufosinate (Liberty®) is being used, a water conditioning agent such as **Choice® Weather Master** or **Weather Gard Complete** should be added first.

*Continued on next page....*

*“An ounce of prevention is worth a pound of cure.”*

*-Benjamin Franklin*



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### WALES/DALES method

Other pesticides should be added to the tank in this order (WALES or DALES method):

**W or D** — represents the *dry formulations* (WDG, WP, DF) and should be added to the tank first.

**A** — stands for proper *agitation*, which should be continuous and provide enough action to “roll” the surface of the carrier. Confirm that the dry products are thoroughly dissolved before adding anything else to the tank.

**L** — stands for *liquids and flowables* (L, F, S) and are added next.

**E** — stands for the *emulsifiable concentrates* (EC) and should be added next. Microencapsulated formulations should be added after the EC's.

**S** — stands for *surfactants and other adjuvants*. This includes crop oils, drift control agents, etc. Some organosilicone products can cause excessive foaming, which is another reason to add them last.

The last step is to fill the tank with the remainder of the needed carrier and continue agitation, especially if using one of the dry formulations or a product that may settle out.

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### Other points to remember

If a known compatibility problem exists, a compatibility agent, such as **E-Z Mix** is generally added before the herbicides.

If excessive foam is a problem, an anti-foaming product, such as **Unfoamer®** or **Compadre®**, may be required. Although both products can be used as a curative, it is recommended to use preventative tactics when using a high foaming product.

## NOZZLE OUTPUTS (20-INCH NOZZLE SPACING\*)

Output	Ground speed, miles per hour					
	3	4	5	6	7	8
<b>5 gal per acre</b>						
Gal. per minute	.05	.067	.084	.101	.118	.135
Ounces per minute	6.4	8.6	10.8	12.9	15.1	17.2
<b>6 gal per acre</b>						
Gal. per minute	.06	.081	.101	.121	.141	.162
Ounces per minute	7.8	10.3	12.9	15.5	18.1	20.6
<b>7 gal per acre</b>						
Gal. per minute	.071	.094	.118	.141	.165	.189
Ounces per minute	9.0	12.1	15.1	18.1	21.1	24.2
<b>8 gal per acre</b>						
Gal. per minute	.081	.108	.135	.162	.189	.216
Ounces per minute	10.3	13.8	17.2	20.7	24.1	27.6
<b>9 gal per acre</b>						
Gal. per minute	.091	.121	.152	.182	.212	.242
Ounces per minute	11.6	15.5	19.4	23.3	27.1	31.0
<b>10 gal per acre</b>						
Gal. per minute	.101	.135	.168	.202	.236	.269
Ounces per minute	12.9	17.2	21.5	25.9	30.1	34.4
<b>15 gal per acre</b>						
Gal. per minute	.152	.202	.253	.303	.354	.404
Ounces per minute	19.4	25.9	32.3	38.8	45.2	51.8
<b>20 gal per acre</b>						
Gal. per minute	.202	.269	.337	.404	.472	.538
Ounces per minute	25.9	34.5	43.1	51.8	60.2	69.0

\* Data also applies if every other outlet is plugged and two nozzles are used per drop, as is often the case in post-emergence herbicide application. The table may be used to:

1. Determine gallonage per acre at given ground speed and nozzle output.
2. Select proper ground speed when operating at a given nozzle pressure and output.
3. Select new nozzles when range of gal. per acre and ground speed is known.

## AIRCRAFT CALIBRATION

	Acres covered per minute										
	Swath width in feet										
	30	35	40	45	50	75	100	200	300	500	
75	4.5	5.2	6.0	6.7	7.5	11.2	15.0	30.0	45.0	75.0	
80	4.8	5.6	6.4	7.2	8.0	12.0	16.0	32.0	48.0	80.0	
85	5.1	5.9	6.8	7.6	8.5	12.7	17.0	34.0	51.0	85.0	
90	5.4	6.3	7.2	8.1	9.0	13.5	18.0	36.0	54.0	90.0	
95	5.7	6.6	7.6	8.5	9.5	14.2	19.0	38.0	57.0	95.0	
100	6.0	7.0	8.0	9.0	10.0	15.0	20.0	40.0	60.0	100.0	
110	6.6	7.7	8.8	9.9	11.0	16.5	22.0	44.0	66.0	110.0	
120	7.2	8.4	9.6	10.8	12.0	18.0	24.0	48.0	72.0	120.0	
130	7.8	9.1	10.4	11.7	13.0	19.5	26.0	52.0	78.0	130.0	
140	8.4	9.8	11.2	12.6	14.0	21.0	28.0	56.0	84.0	140.0	
150	9.0	10.5	12.0	13.5	15.0	22.5	30.0	60.0	90.0	150.0	

The rate of application in gallons or pounds per minute is calculated by multiplying the acres per minute by the number of gallons or pounds per acre to be applied. Take for example a 100-mile-per-hour aircraft that has a 50 foot effective swath. The chart indicates that the plane has a coverage of 10.0 acres per minute. If spray is to be applied at a rate of 2 gallons per acre, the unit should be calibrated to dispense 20 gallons per minute (2 X 10 = 20). If 7.5 pounds of dry material is to be applied per acre, the unit should be calibrated to dispense 75 pounds per minute (10 X 7.5 = 75).

The basic formula for calculating acres per minute is:  

$$\frac{\text{swath width} \times 2 \times \text{miles per hour}}{1,000}$$

## COMPUTING PLANT POPULATIONS AND YIELDS

Row Width	Length of Row in 1/1000 Acre
40 inches	13-ft., 1-in.
38 inches	13-ft., 9-in.
36 inches	14-ft., 6 in.
30 inches	17-ft., 5-in.
20 inches	26-ft., 2-in.
15 inches	34-ft., 10-in.

### Determining Plant Population\*

1. Measure off 1/1000 acre row.
2. Count number of plants; then multiply by 1000 to determine plants per acre.

### Determining Yields\*

1. Harvest grain from 1/1000 acre row.
2. Weigh harvested grain then multiply by 1000 to get pounds of grain per acre.
3. Determine moisture content then divide pounds per acre by pounds per bushel for adjusted moisture.

\* Average three or more 1/1000 acre rows for more accurate estimate of field populations and yields.

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## USEFUL MEASUREMENTS

### LENGTH

1 mile = 80 chains = 8 furlongs = 1,760 yards = 5,280 ft. = 1.6 kilometers

1 chain = 22 yards = 4 rods, poles or perches = 100 links

### WEIGHT

1 lb. = 16 oz. = 454 grams = 0.454 kilograms

1 short ton = 2,000 lbs.

1 metric ton = 2,204 lbs. = 1,000 kilograms

### AREA

1 acre = 10 sq. chains = 4,840 sq. yards = 43,560 sq. ft. = 0.045 hectares

1 sq. mile = 640 acres = 2.59 kilometers

1 hectare = 2.471 acres

### VOLUME

1 fluid oz. = 2 tablespoons = 6 teaspoons = 29.57 c.c.'s

1 liter = 1,000 c.c.'s = 0.22 Imperial gal = 2.10 pts

### CAPACITIES

Cylinder-diameter<sup>2</sup>/ x depth x 0.785 = cubic feet

Rectangle-breadth x depth x length = cubic feet

Cubic Feet x 7.5 = gal

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## QUICK CONVERSIONS

1 pt. / acre = 1 fluid oz. / 302 sq. yards

1 gal. / acre = 1 pt. / 605 sq. yards

1 lb. / acre = 1 oz. / 302 sq. yards

1 cwt. / acre = 0.33 oz. / sq. yard

1 mph = 88 ft. / minute

3 mph = 1 chain / 15 sec.

1 liter / hectare = 0.089 gal. / acre

1 kilogram / hectare = 0.892 lb. / acre

1 c.c. / 100 liter = 0.16 fl. oz. / 100 gal

125 c.c. / 100 liter = 1 pt. / 100 gal

1 gm. / 100 liter = 0.16 oz. / 100 gal

A strip 3 ft. wide x 220 chains = 1 acre

A strip 4 ft. wide x 165 chains = 1 acre

A strip 5 ft. wide x 132 chains = 1 acre

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## CONVERSION TABLE

1 kilogram (kg) = 1000 grams (g) = 2.2 lbs.

1 gram (g) = 1000 milligrams (mg) = .035 ounce

1 liter = 1000 milliliters (ml) or cubic centimeters (cc)  
= 1.058 quarts

1 milliliter or cubic centimeter = .034 fluid ounce

1 milliliter or cubic centimeter of water weighs 1 gram

1 liter of water weighs 1 kilogram

1 lb. = 453.6 grams

1 ounce = 28.35 grams

1 pt. of water weighs approximately 1 lb.

1 gallon of water weighs approximately 8.34 lbs

1 gallon = 4 quarts = 3.785 liters

1 qt = 2 pts = .946 liters

1 pt = .473 liters

1 fluid ounce = 29.6 milliliters or cubic centimeters

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## QUICK CONVERSIONS

Temperature		Length		Volume	
<u>°C</u>	<u>°F</u>	<u>cm</u>	<u>inch</u>	<u>liters</u>	<u>quarts</u>
100	212	2.5	1	1	1.1
90	194	5	2	2	2.1
80	176	10	4	3	3.2
70	158	20	8	4	4.2
60	140	30	12	5	5.3
50	122	40	16	6	6.3
40	104	50	20	7	7.4
35	95	60	24	8	8.5
30	86	70	28	9	9.5
25	77	80	32		
20	68	90	36		
15	59	100	39		
10	50	200	79		
5	41		<u>feet</u>		
0	32	300	10		
-5	23	400	13		
-10	14	500	16		
-15	5	1,000	33		
-20	-4				
-25	-13				
-30	-22				
-40	-40				



# This Land is Loveland.

Out here, many successful corn growers rely on high-quality Loveland Products from Crop Production Services for the performance and value they demand. When you want crop protection, plant nutrition, adjuvants and seed treatments that really work, trust your land to Loveland.

To find your local Crop Production Services store, go to [www.lovelandproducts.com](http://www.lovelandproducts.com).





[www.lovelandproducts.com](http://www.lovelandproducts.com)