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SOY LECITHIN-BASED ADJUVANTS (LECI-TECH®)

THE BEST ADJUVANT TECHNOLOGY:

TO THE PLANT, ON THE PLANT AND IN THE PLANT

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For more information on our full product line please visit
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‡ This product is not approved in California or intended to be used in California with a pesticide product or pesticide spray mixture, and cannot be used as a spray adjuvant.

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; and (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.

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.

THE FOLLOWING POINTS REGARDING ADJUVANT PRODUCTS ARE IMPORTANT AND SHOULD BE CONSIDERED WHEN 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 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.

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 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 agri-chemicals.

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

B. Penetrating surfactants:

1. Soybean oil derivatives:

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

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 80 to 84% petroleum based oil.

Herbimax®	Maximizer®
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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, imidazilinone, 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®
Choice® Trio	‡Strike Force
Flame®	Weather Gard Complete

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

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®
Franchise®	‡Strike Force®
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®
Gunsmoke®	Vader®

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 are 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®	WaterMaxx® 2
‡Infuse®	

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®
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M. Miscellaneous:*1. Tank decontaminating agents / Tank cleansers*

All Clear®	Tank & Equipment Cleaner
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2. Emulsified vegetable oils

Amigo®	
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3. Foam markers

Trekker Trax®	Tuff Trax®
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ADJUVANT FUNCTIONALITY AND EFFECT

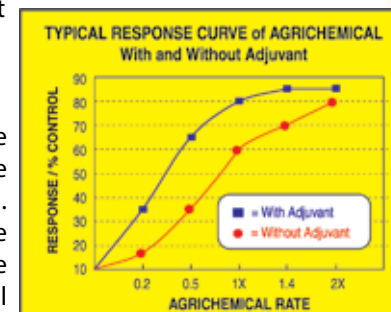
Adjuvant formulations are designed to possess certain properties, which affect the functionality of an adjuvant. Functionality can be specifically determined by (1) the chemistry of the components, (2) the proportions of the components, and (3) the dose or quantity used.

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

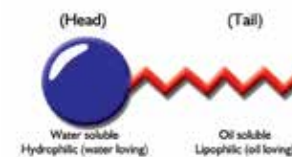
The graph on the right represents the dose responsive nature of the pesticide and pesticide/adjuvant combination. The point should be observed that the adjuvant effect is inversely related to the pesticide dose. That is, a greater effect will be observed at lower rates. The effect of the adjuvant can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



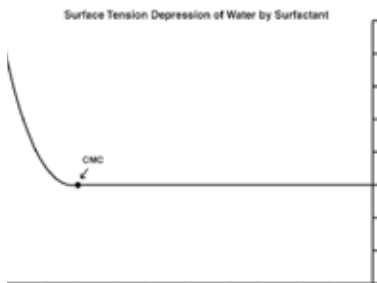
A numerical scale has been established to express the relative effect of the individual portions (hydrophilic and lipophilic) of a surfactant on the overall physical and chemical properties of the molecules. **The scale is called the HLB and represents the Hydrophilic Lipophilic Balance for a single 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 are 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.

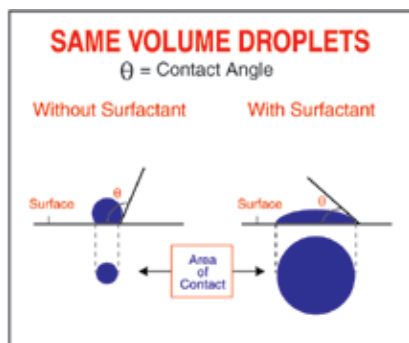
As illustrated in the graph on the right, there will be a concentration point for every surfactant at which maximum surface tension depression is achieved. Surfactant added above this concentration will not depress the surface tension further, and will be represented by the beginning of the flat portion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

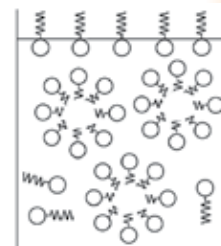
As illustrated, surfactants will cause droplets to collapse under their own weight and increase dramatically the area of contact. This is one of the main reasons surfactants are used with pesticidal materials; that is, to improve physical coverage over the surface of the intended target.



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.

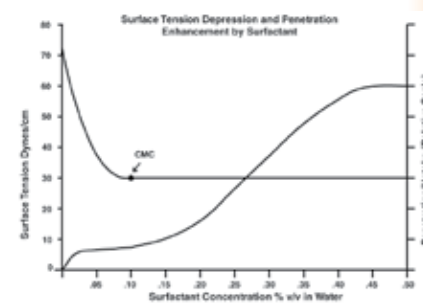
SURFACTANT MOLECULAR BEHAVIOR IN WATER

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 30 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 20s. **This means 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.



To the plant, On the plant, In the plant.

Now that's performance made easy.

A spray adjuvant with Leci-Tech "To-On-In" gives you more of what you want on the inside.

Make pesticides and foliar nutrients more effective by adding one of the many Leci-Tech adjuvants by Loveland Products. The exclusive technology of Leci-Tech suppresses spray drift and produces more performance-sized droplets for better coverage. Leci-Tech is also formulated to ensure maximum adhesion and leaf penetration. That's performance for superior results.

www.lovelandproducts.com

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Watch Leci-Tech get
To your plants, On your plants
and In your plants, easy.



SOY LECITHIN-BASED ADJUVANTS

**THE BEST ADJUVANT TECHNOLOGY: TO THE PLANT,
ON THE PLANT & IN THE PLANT**



Lecithin derivatives are obtained from the hydrogenation/hydroxylation of natural soy 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 has worked with lecithin for decades and have developed numerous applications that provide benefits above any current technology. Products containing **Leci-Tech®** technology 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, **Leci-Tech** technology allows for lower use rates and crop safety, is biodegradable and is the best adjuvant technology



To The Plant — Drift Reduction with Performance-Sized Droplets

TO



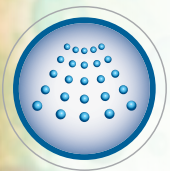
On The Plant — Droplet Retention by Adhesion & Spreading

ON



In The Plant — Increased Penetration Without Cuticle Disruption

IN



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 technology provides drift reduction without increasing the viscosity of the spray solution.

TO

Leci-Tech technology 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.



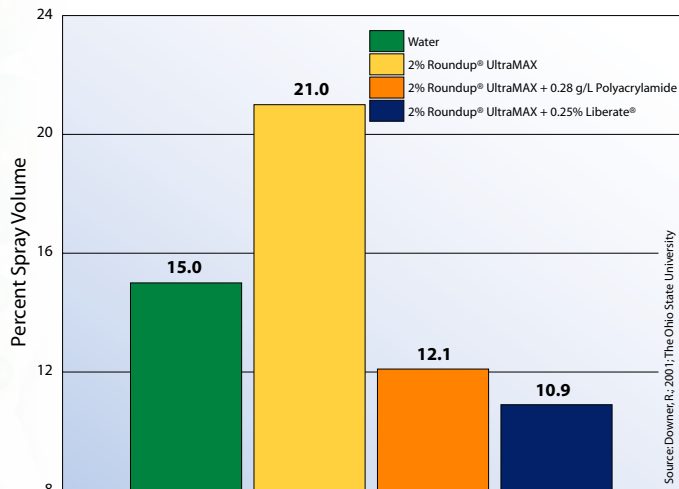
Demonstrates in simulated wind, coarse droplets of: water alone (left), water with glyphosate (center), and water with glyphosate and Leci-Tech (right).

Leci-Tech Products Reduce Driftable Droplets

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



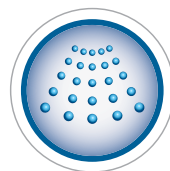
TO



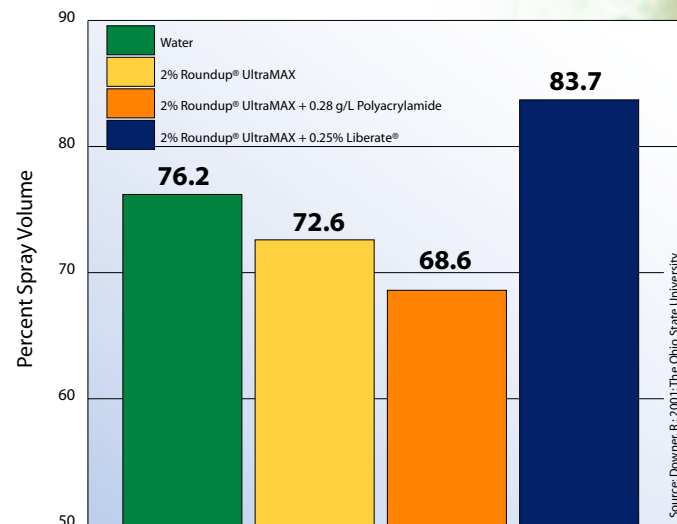
Driftable droplets can be lost to evaporation or drift to off-target sites. Either way, it's product that isn't being delivered to the field it's supposed to go on!

Leci-Tech Produces More "Performance-Sized" Droplets

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



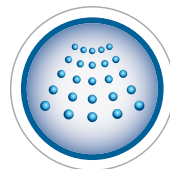
TO



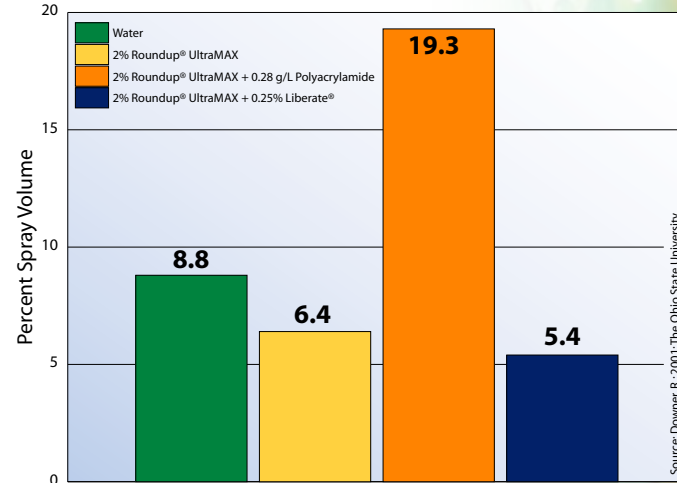
Performance-sized droplets provide optimum coverage for post-emergence products. This ensures that the maximum amount of product gets where it's supposed to go AND stays there!

Leci-Tech Products Do Not Produce "Too Large" Droplets

Droplets greater than 500 microns are "too large" to remain on the leaf surface



TO



"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?

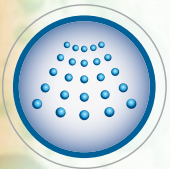
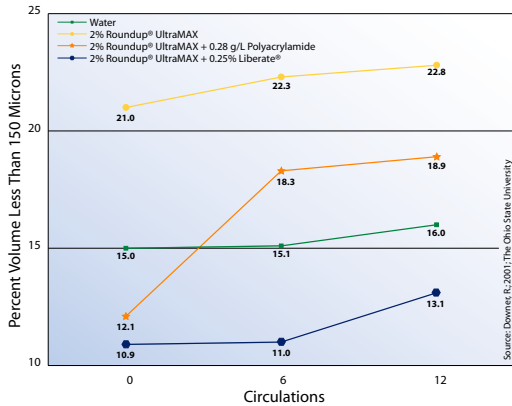
Leci-Tech Products Are Not Affected by Pump Shear

"Too small" droplets (<150 microns) are susceptible to drift



TO

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



TO

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 polyacrylamides 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 technology are not chain-forming molecules. This allows for more "performance-sized" spray droplets that are more likely to reach the desired target as well as optimizing nozzle performance.

Comparison of Fan Angle Distortion

All treatments include 2% loaded glyphosate



9 lbs starch-based drift reduction agent/100 gallons



0.125% Leci-Tech containing product/100 gallons



17 lbs AMS/100 gallons



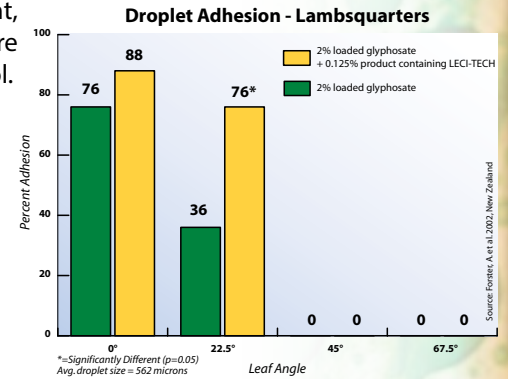
0.5% of 1% polyacrylamide product/100 gallons



ON

DROPLET ADHESION

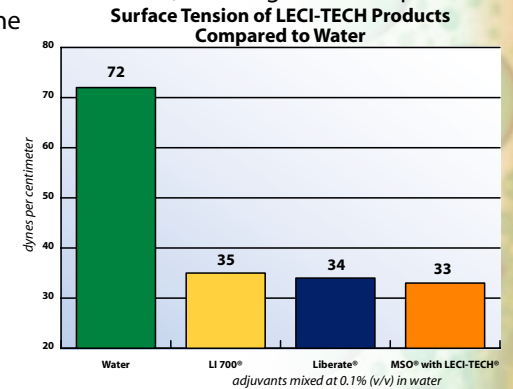
Adhesion is improved with products containing Leci-Tech technology by reducing bounce and shatter of the spray droplets upon contact with the plant leaf surface. Droplets will stay on the plant, providing more consistent control.



ON

EXCELLENT SPREADING PROPERTIES

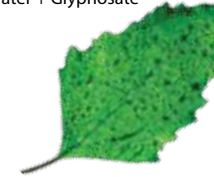
With many pesticides, coverage is the primary objective for optimum performance. The Leci-Tech technology will aid in the reduction of surface tension, allowing for better pesticide dispersion on the plant surface.



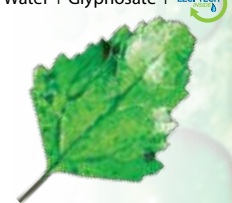
Water Alone



Water + Glyphosate



Water + Glyphosate + LECI-TECH



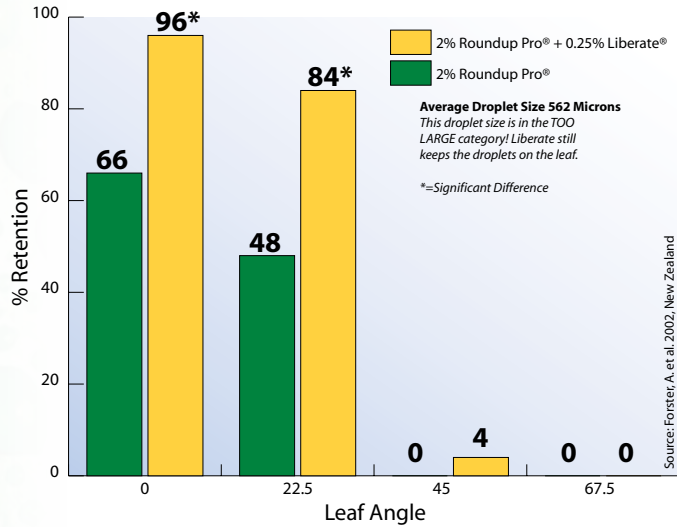
These photos demonstrate the positive benefits of Leci-Tech technology to aide in coverage with fine droplets on the waxy leaf surface of common lambsquarters. Blue dye was used for a visual indicator.

Leci-Tech Products Help Retain Droplets On The Leaf Surface

Percent retention on waxy lambsquarters leaf surface



ON



As leaf angle changes, Leci-Tech containing adjuvants keep even large droplets on the leaf surface. This is an important part of consistent performance of post-emergence herbicides. However, Leci-Tech containing adjuvants produce more droplets in the PERFORMANCE SIZE range for the best possible coverage.



IN

SUPERIOR PENETRATION

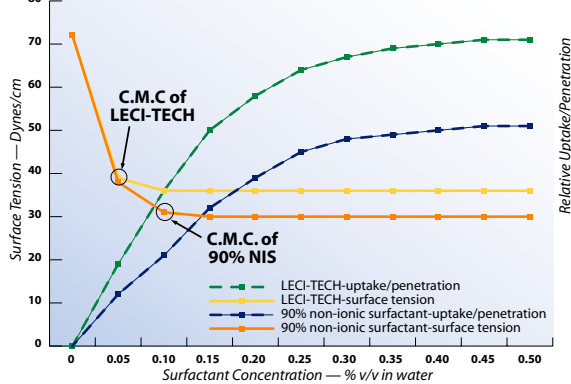
To maximize performance of both systemic and contact pesticides, it is critical to ensure penetration through the leaf cuticle. This is especially important when plants are under environmental stresses.

The Leci-Tech

technology 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 technology will also reduce evaporation, allowing for greater solubility and uptake.

Properties Comparison of LECI-TECH and 90% non-ionic surfactant

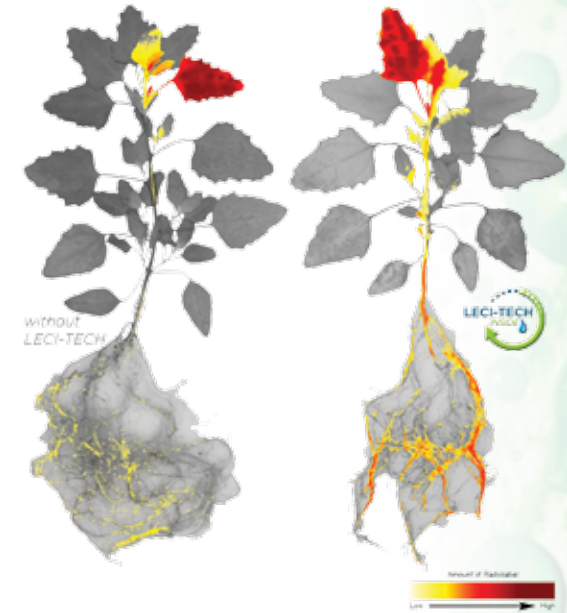
Note: Leci-TECH reaches C.M.C. at a lower concentration and starts forming micelles, therefore providing uptake.



INCREASED PENETRATION



IN



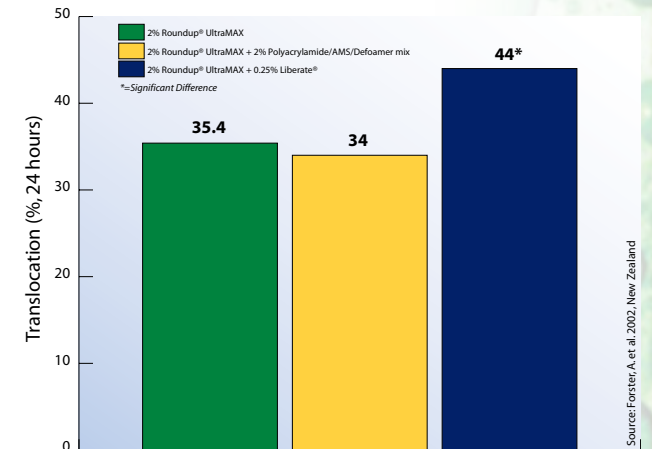
Demonstrates the effect of Leci-Tech chemistry on penetration and translocation of glyphosate into and throughout the Common Lambsquarters plant.

Leci-Tech Products Increase Translocation

"Loaded" glyphosate on common lambsquarters (4 weeks growth stage)



IN



Once the glyphosate is in the leaf, Leci-Tech containing adjuvants actually increase the amount of translocated active within the plant. This can contribute to more consistent performance.



Deposition Aid, Drift Control Agent, Antifoaming/Defoaming Agent

PRINCIPAL FUNCTIONING AGENTS

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

Compadre® is a non-ionic, non-foaming, and shear tolerant drift control agent containing suspended antifoam-defoamer. Compadre may be used as a drift control adjuvant to enhance deposition, retention and control spray droplet size of agricultural and industrial chemicals.



TO ON IN

Benefits

- **TO:** Drift reduction with performance-sized droplets
- **ON:** Droplet retention by adhesion and spreading
- **IN:** Increased penetration without cuticle disruption
- Contains an antifoam/defoam system
- Low use rates make Compadre cost-effective

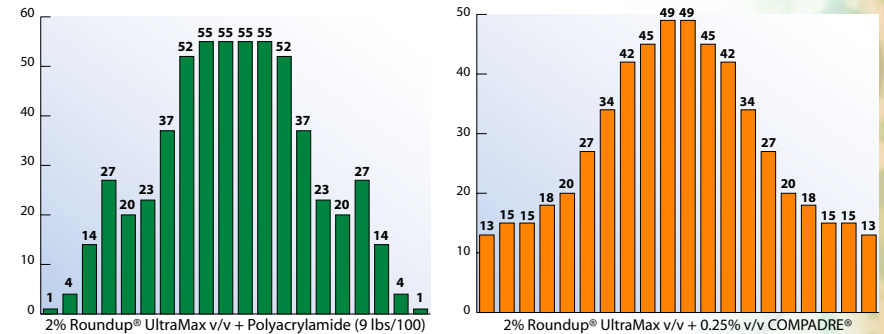
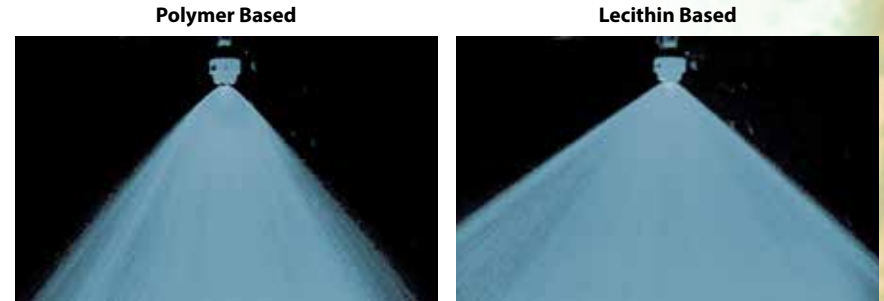
General Use Rates*

Use 1 pint of Compadre per 100 gallons of spray mixture (1 fluid ounce per 5 gallons of spray mixture)

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.

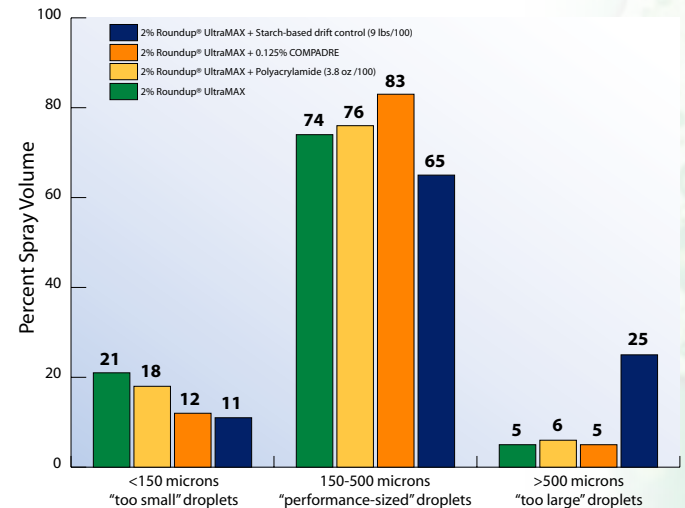


Adjuvant Effects on Fan Angle Patternator Results



Droplet Size Classes as Affected by Drift Additives

All treatments contain 17 lbs AMS/100 gallons



Teetje® XR8003VS @ 40 psi, Aerometrics Phase Doppler Particle



Penetrant, Wetting Agent For use with Strobilurin Fungicides

PRINCIPAL FUNCTIONING AGENTS

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

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 specifically formulated for use with strobilurin chemistries.



TO ON IN

Benefits

- **TO:** Drift reduction with performance-sized droplets
- **ON:** Droplet retention by adhesion and spreading
- **IN:** Increased penetration without cuticle disruption
- Consistently contributes to strobilurin performance and minimizes variability
- Proprietary formula which is particularly helpful if target plant is experiencing stress

General Use Rates*

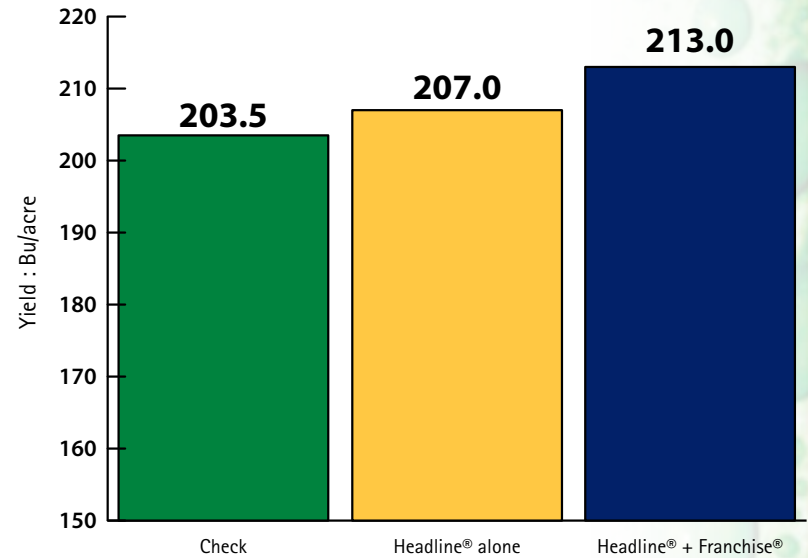
1 to 2 quarts per 100 gallons of spray mixture, or
Aerial: 1 to 2 ounces per acre; Ground: 3 to 4 ounces per acre

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



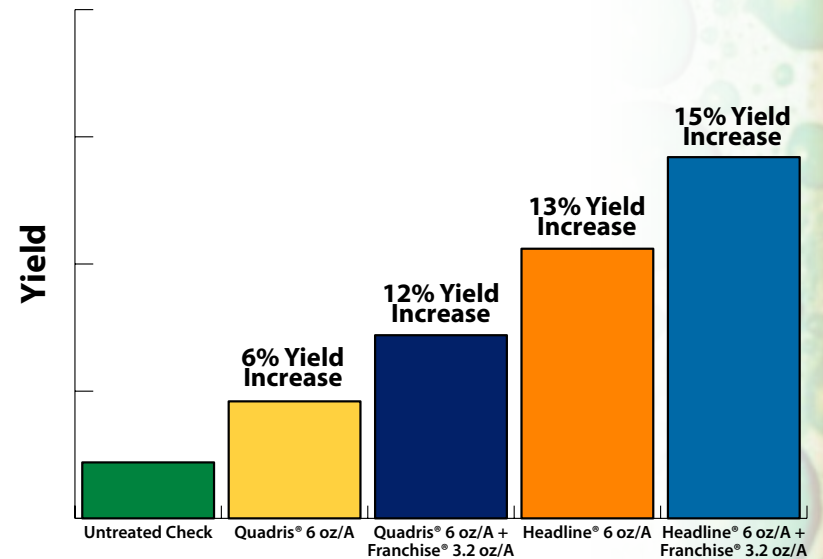
FRANCHISE Location Replicated Trials: Corn

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



FRANCHISE Soybean Yield Trials

Stoneville R&D, Mississippi, 2009



LI 700®



Penetrant, Acidifier, Deposition Aid, Drift Control Agent

PRINCIPAL FUNCTIONING AGENTS

Phosphatidylcholine, methylacetic acid and alkyl polyoxyethylene ether	80%
Constituents ineffective as Spray Adjuvant	20%

LI 700® is a 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.



TO ON IN

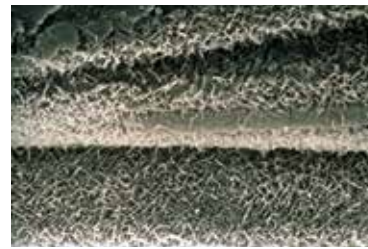
Benefits

- **TO:** Drift reduction with performance-sized droplets
- **ON:** Droplet retention by adhesion and spreading
- **IN:** Increased penetration without cuticle disruption
- Acidification properties reducing spray solution pH, preventing pesticide degradation and maximizing performance
- LI 700 is a low-foaming surfactant and will not cause foam problems in the spray tank

General Use Rates*

Acidifying Agent: water pH 8 or higher - 8 to 16 ounces per 100 gallons; water pH 6.5 to 8 - 4 to 8 ounces per 100 gallons. **General Use:** Herbicides, Defoliants, Desiccants - 1 to 4 pints per 100 gallons; Insecticides, Fungicides, Acaricides, Plant Growth Regulators, Foliar Nutrients - 0.5 to 2 pints per 100 gallons. **Drift Reduction:** 1 to 2 quarts per 100 gallons.

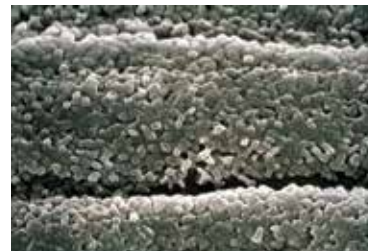
*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



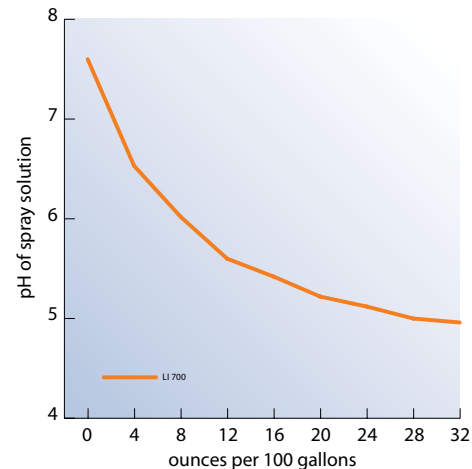
This is a normal leaf surface. The wax structure is tightly packed together. This is the normal, protective barrier of the leaf.



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 2 pH units for every 12 ounces added to the spray mixture until the pH 5 level is reached, as shown in the graph on the left.

Liberate®



Penetrant, Deposition Aid, Drift Control Agent

PRINCIPAL FUNCTIONING AGENTS

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

Liberate® is an uptake enhancing surfactant blend. Liberate is designed for use with pesticides that recommend a non-ionic surfactant, and works especially well with systemic chemistry, reducing driftable fines.



TO ON IN

Benefits

- **TO:** Drift reduction with performance-sized droplets
- **ON:** Droplet retention by adhesion and spreading
- **IN:** Increased penetration without cuticle disruption
- Neutral pH - ideally used with sulfonyl urea herbicides and other pesticides that require a pH 7 (neutral) or higher
- Contains an antifoam/defoam component and will not cause foaming problems in the spray tank
- 100% active and odorless

General Use Rates*

General: *Herbicides, Defoliants, Desiccants* - 1 to 4 pints per 100 gallons; *Insecticides, Fungicides, Acaracides, Plant Growth Regulators, Foliar Nutrients* - 0.5 to 2 pints per 100 gallons. **Drift Reduction:** 1 to 2 quarts per 100 gallons

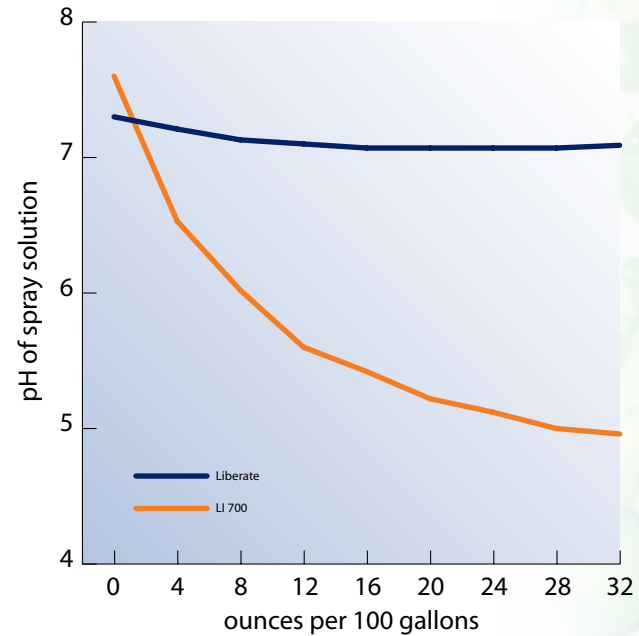
NOTE: Do not use on pears

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



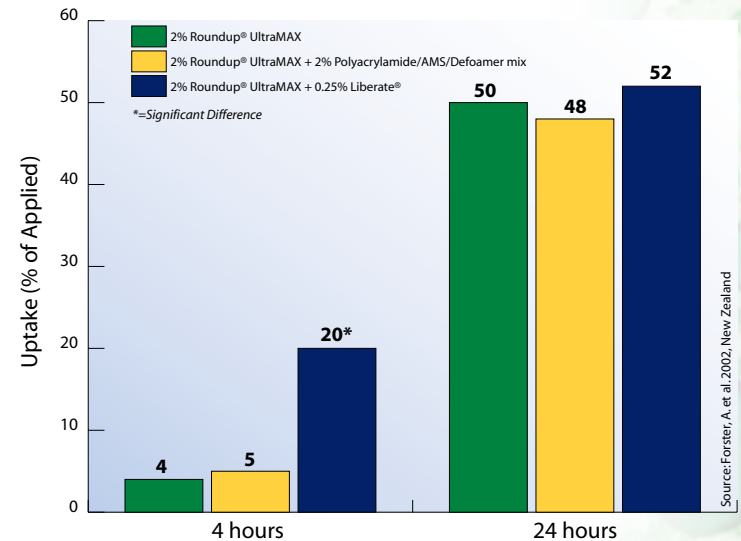
pH neutral

Liberate will not acidify the spray mixture as shown in the graph below



Increases initial uptake of "loaded" glyphosate

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



MISO[®] CONCENTRATE

with LECI-TECH[®]



Modified Vegetable Oil and Surfactant Blend

PRINCIPAL FUNCTIONING AGENTS

Methylated vegetable oil, alcohol ethoxylate, phosphatidylcholine..... 100%

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



TO ON IN

Benefits

- **TO:** Drift reduction with performance-sized droplets
- **ON:** Droplet retention by adhesion and spreading
- **IN:** Increased penetration without cuticle disruption
- MISO Concentrate with Leci-Tech provides increased plant uptake vs. standard methylated seed oil formulations
- MISO Concentrate with Leci-Tech provides improved crop safety vs. standard methylated seed oil formulations

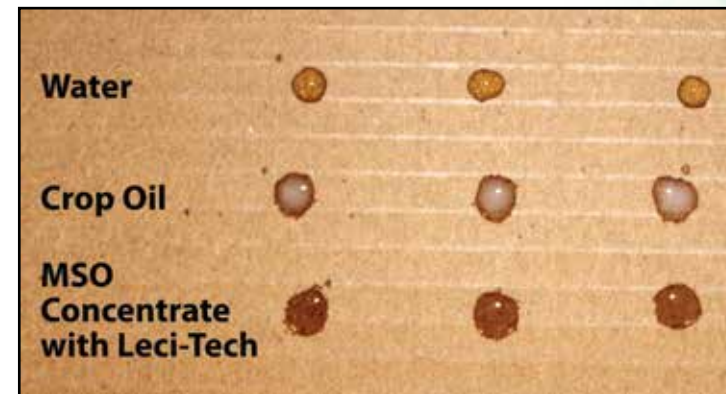
General Use Rates*

1 to 2 pints per acre

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



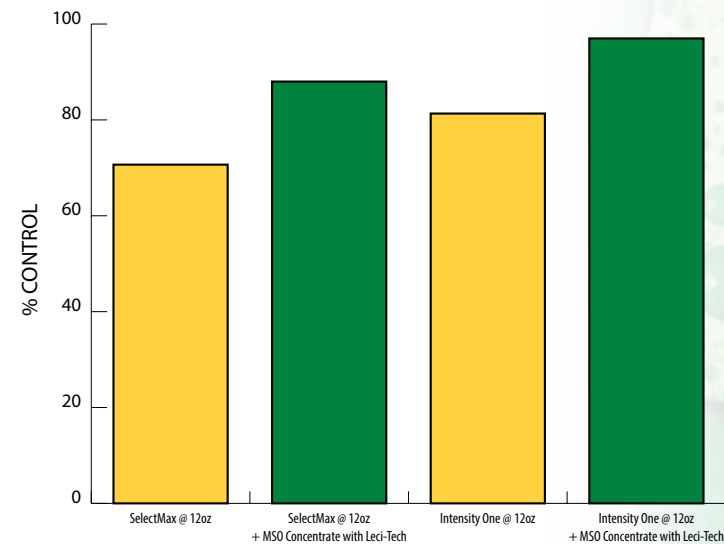
Superior Cuticle Penetration



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 MISO Concentrate with Leci-Tech. The ability of methylated seed oils to solubilize a waxy cuticle is shown in the chart below.

Clethodim Trial on Barnyardgrass

Colorado State University; 2006.





Deposition Aid, Drift Control Agent, Penetrant, Antifoaming & Defoaming Agent, Water Conditioning Agent

PRINCIPAL FUNCTIONING AGENTS

Lecithin, Lactic acid and derivatives, polyethoxylated esters and alcohols	88%
Constituents ineffective as Spray Adjuvant	12%

Strike Force® is a proprietary adjuvant specifically researched and developed for D-treated (dicamba and 2,4-D tolerant crops) acre. Containing patented technology, Strike Force is designed to maximize performance.



TO ON IN

Benefits

- **TO:** Drift reduction with performance-sized droplets
- **ON:** Droplet retention by adhesion and spreading
- **IN:** Increased penetration without cuticle disruption
- Water conditioning without AMS
- Bulk handling capabilities

General Use Rates*

2 quarts per 100 gallons in a minimum 10 GPA spray solution

* Strike Force is not approved in California or intended to be used in California with a pesticide product or pesticide spray mixture, and cannot be used as a spray adjuvant.

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



Loveland University was created to provide information on unique products offered by Loveland Products. Use these QR codes to access the available videos on the Loveland Products YouTube channel and subscribe to get automated notifications as we add more videos.



Vader®



Penetrant, Acidifier and Deposition Aid

PRINCIPAL FUNCTIONING AGENTS

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

Vader® is a unique, proprietary adjuvant designed to aid in the delivery and deposition of insecticidal sprays. The premium formulation, including acidifying agents, helps provide a spray solution environment that protects the integrity of insecticides sensitive to high pH (alkaline) solutions.



TO ON IN

Benefits

- **TO:** Drift reduction with performance-sized droplets
- **ON:** Droplet retention by adhesion and spreading
- **IN:** Increased penetration without cuticle disruption
- Acidification properties reduce spray solution pH, preventing pesticide degradation and maximizing performance
- 90% active and low odor formulation
- Maximizes performance of neonicotinoid insecticides

General Use Rates*

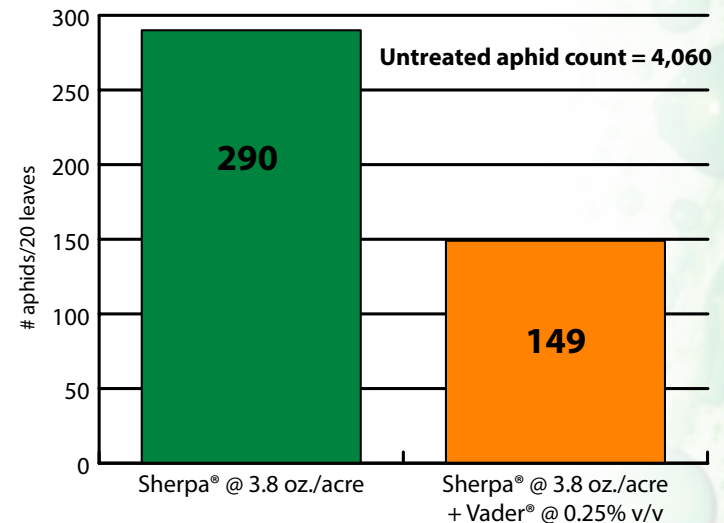
0.25% to 0.50% of the finished spray volume; 32 to 64 ounces per 100 gallons

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



Performance of Imidacloprid Formulations and Adjuvant on Cotton Aphid

Dr. M. McCarty, Carolina Ag Research, Elko, SC - 2007





Deposition Aid, Drift Control Agent, Penetrant, Antifoaming & Defoaming Agent, Water Conditioning Agent

PRINCIPAL FUNCTIONING AGENTS

Lecithin, alkylphenol ethoxylate phosphate ester, methyl soyate, dimethylpolysiloxane..... 100%

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.



TO ON IN

Benefits

- **TO:** Drift reduction with performance-sized droplets
- **ON:** Droplet retention by adhesion and spreading
- **IN:** Increased penetration without cuticle disruption
- Water conditioning component minimizes the effect of hard water ions that interfere with herbicide performance
- Antifoam/defoam component stops foam from building or can eliminate it after the fact, for quicker and easier spray tank filling
- 100% active

General Use Rates*

1 to 2 quarts per 100 gallons (1.6 to 3.2 fluid ounces per 5 gallons of spray mixture)

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



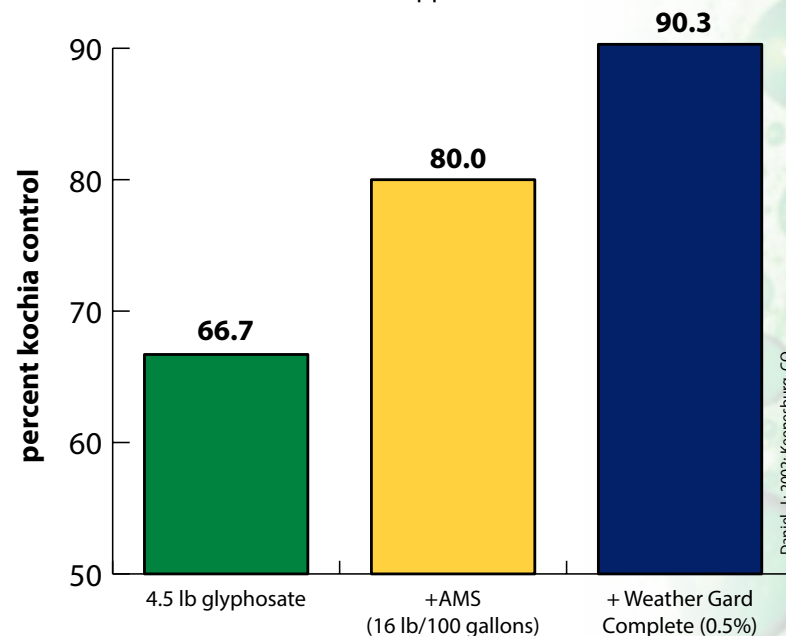
Which Would You Rather Use?



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.

Extreme Conditions

Weather Gard Complete helps control kochia in bloom in dry conditions and when tank mixes are applied in hard water



ACTIVATOR 90

90% Non-ionic Surfactant, Penetrant, Antifoaming Agent

PRINCIPAL FUNCTIONING AGENTS

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

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.

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.

General Use Rates*

1 to 4 pints per 100 gallons

NOTE: Do not use on roses

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



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.

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.
- For use with chemistries designed for over the top use of 2,4-D and/or dicamba tolerant crops, please refer to pesticide label for specific tank and equipment cleanout instructions.

General Use Rates*

General purpose cleansing (0.25% v/v) - 1 quart (32 fluid ounces) per 100 gallons (1 tablespoon per gallon); **Decontamination** (0.50% v/v) - 2 quarts (64 fluid ounces) per 100 gallons (2 tablespoons per gallon)

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Amaze Gold®

Water Conditioning Agent Deposition Aid

PRINCIPAL FUNCTIONING AGENTS

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

Amaze Gold® 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.

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 from AMS enhances the uptake and performance of the herbicide.
- More convenient liquid formulation versus conventional, soluble dry AMS products.

General Use Rates*

Glyphosate and other tank mixes: 2.5 gallons per 100 gallons for 8.5 pounds of AMS per 100 gallons; 5 gallons per 100 gallons for 17 pounds AMS per 100 gallons

* Amaze Gold is not approved in California or intended to be used in California with a pesticide product or pesticide spray mixture, and cannot be used as a spray adjuvant.

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Amigo®

Vegetable Oil Concentrate Surfactant

PRINCIPAL FUNCTIONING AGENTS

Vegetable oil.....	93%
Constituents ineffective as spray adjuvant.....	7%

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

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.

General Use Rates*

Ultra-Low Volume Applications (ULV) - Use 1 quart per acre. No water is necessary; **Low Volume Applications (2 gallons of water or less per acre)** - 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** - Use 3 to 5 pints per acre; **For CDA with water** - Use 15% of the total liquid. Do not exceed 2 quarts per acre.

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Attach®

Spreader-Sticker

PRINCIPAL FUNCTIONING AGENTS

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

Attach® 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.

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.

General Use Rates*

Ground Application: *Fungicides, Insecticides, Plant Growth Regulators* - 4 to 16 ounces per 100 gallons; *Herbicides* - 4 to 16 ounces per 100 gallons

Air Application: 4 to 16 ounces per acre

Soil Applied Pesticides: 1 to 2 pints per acre



*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Attach: Citrus



Herbicide +
Attach @ 2 pts/A

Herbicide
alone

Photo taken 3 months after treatment

Attach: Tomato



Herbicide +
Attach @ 2 pts/A



Herbicide
alone

Photos taken 11 weeks after treatment

BOND max[®]

Spreader Sticker/Deposition Aid

PRINCIPAL FUNCTIONING AGENTS

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

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.

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.

General Use Rates*

Field and row crops: 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

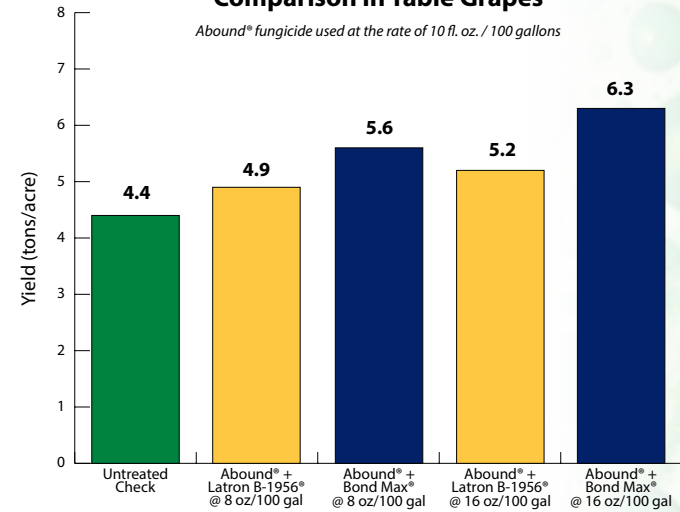
**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



Bond Max Crop Safety

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

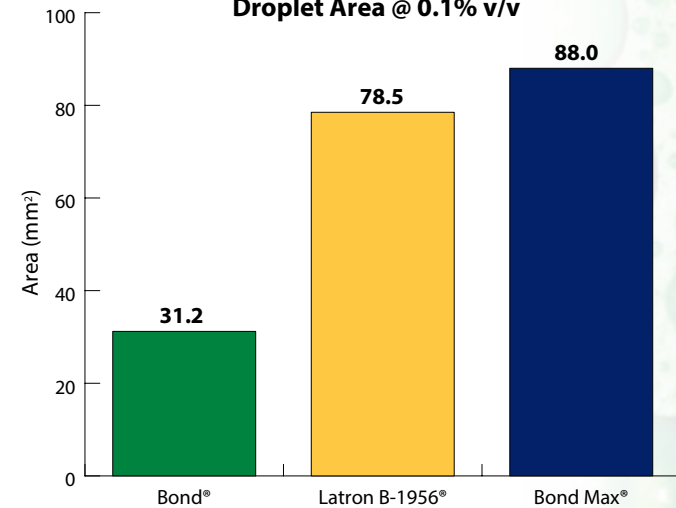
Abound[®] fungicide used at the rate of 10 fl. oz. / 100 gallons



Source: Research 4 Hire; Porterville, CA; 2008

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

Droplet Area @ 0.1% v/v





Water Conditioning Agent

PRINCIPAL FUNCTIONING AGENTS

Propionic acid ammonium salt, alkylphenol ethoxylate phosphate ester, 2-hydroxy-1,2,3-propanetricarboxylic acid, ammonium sulfate, acrylic acid polymer sodium salt..... 50%
 Constituents ineffective as spray adjuvant..... 50%

Choice® 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.

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 complexing 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.

General Use Rates*

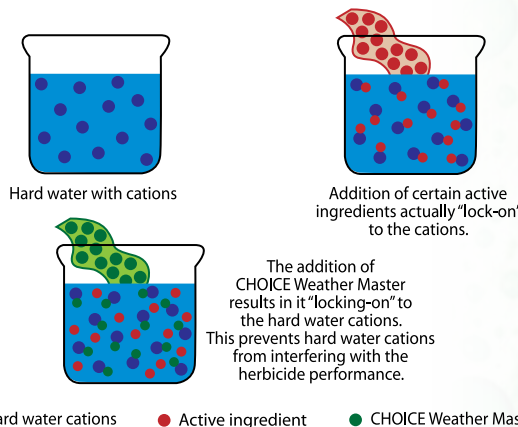
2 to 4 pints per 100 gallons

NOTE: Always add Choice Weather Master to the spray tank BEFORE adding pesticides

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Action of Choice Weather Master in Hard Water



Simplified Solubility Chart: Anions							
	F ⁻	Cl ⁻	HCO ₃ ⁻	NO ₃ ⁻	CO ₃ ²⁻	SO ₄ ²⁻	PO ₄ ³⁻
Na ⁺	S	S	S	S	S	S	S
K ⁺	S	S	S	S	S	S	S
NH ₄ ⁺	S	S	S	S	S	S	S
Ca ²⁺	I	S	SS	S	I	VSS	I
Mg ²⁺	VSS	S	S	S	VSS	S	I
Zn ²⁺	S	S	VSS	S	I	S	I
Fe ²⁺	SS	S	SS	S	VSS	S	I
Fe ³⁺	SS	S	I	S	I	S	I
Al ³⁺	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

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.)

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



Water Conditioning Agent

PRINCIPAL FUNCTIONING AGENTS

(Poly(oxy-1,2-ethanediyl), alpha-(nonylphenyl)-omega-hydroxy-phosphate),	
2-hydroxy-1,2,3-propanetricarboxylic acid.....	55.7%
Constituents ineffective as spray adjuvant.....	44.3%

Choice® Trio is a non-AMS liquid water conditioner designed to aid in the performance of herbicides susceptible to the negative effects of hard water. Choice Trio performs via three modes of action: sequestering, chelating and complexing of all hard water cations.

Benefits

- Reduces the effects of hard water on herbicide performance via:
 - Sequestering
 - Synthetic Chelating
 - Complexing
- Effective on all hard water cations.
- Non-AMS formulation can be used in applications where AMS is not recommended but water conditioning is required

General Use Rates*

1 to 2 quarts per 100 gallons (0.25 to 0.50% v/v)

NOTE: Always add Choice Trio to the spray tank BEFORE adding pesticides



3 Modes 2 Modes 1 Mode

Lab Demo visualizing negative effects of hard water on susceptible herbicides, such as Glyphosate. The sample treated with **Choice Trio** shows no visual signs of hard water cation antagonism of the salt molecule.

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



Non-Ionic Surfactant, Water Conditioning Agent

PRINCIPAL FUNCTIONING AGENTS

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

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.

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.

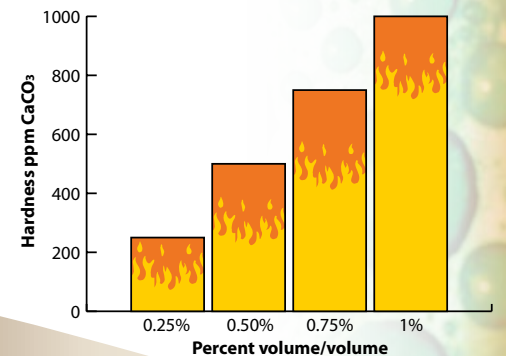
General Use Rates*

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



**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*

General Use Rates for FLAME®



Freeway®

Organosilicone Super Wetter

Organosilicone Surfactant Blend Wetter/Spreader/Penetrant

PRINCIPAL FUNCTIONING AGENTS

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

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

Benefits

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

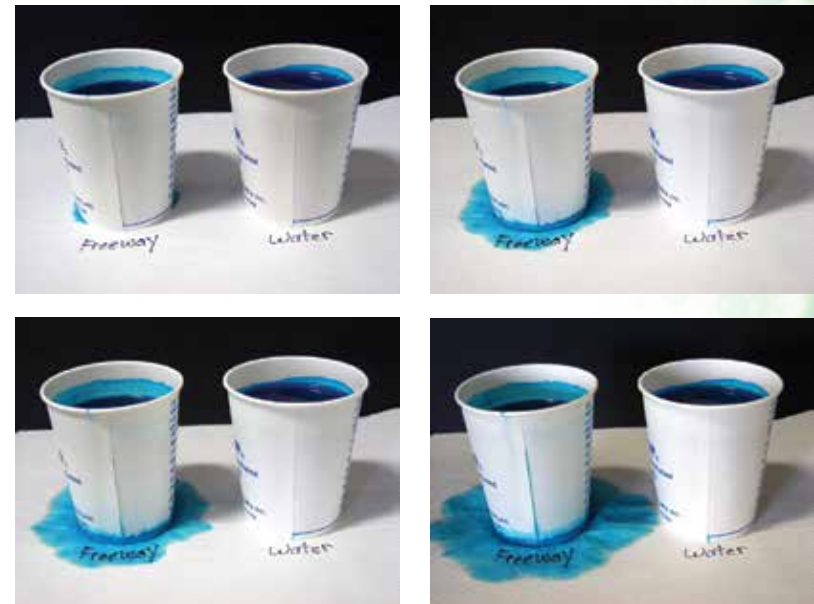
General Use Rates*

Herbicides, Desiccants, Defoliants - 12 to 64 ounces per 100 gallons;
Brush and woody species herbicides - 16 to 64 ounces per 100 gallons;
Insecticides, Fungicides, Acaracides - 6 to 16 ounces per 100 gallons;
Plant Growth Regulators, Foliar Nutrients - 10 to 32 ounces per 100 gallons;
General Wetting/Spreading - 6 to 12 ounces per 100 gallons

*Always read and follow the label directions attached to the product container.
Scan QR code with your mobile device for current specimen label and SDS information.

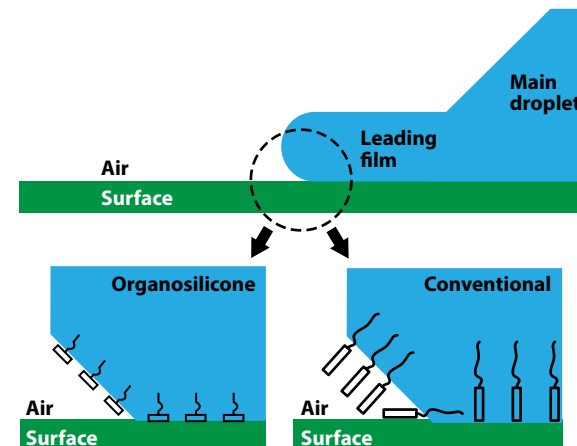


Making Water "Wetter"



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 Acidifier / Activator

PRINCIPAL FUNCTIONING AGENTS

Monocarbamide dihydrogen sulfate, alkyl amine ethoxylate, 1,2,3-trihydroxypropane..... 80%
 Constituents ineffective as spray adjuvant..... 20%

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

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.

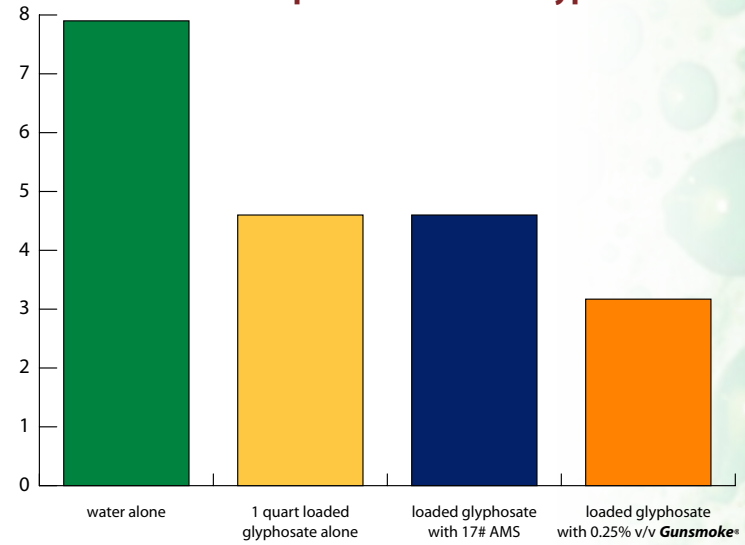
General Use Rates*

1 quart to 3 quarts per 100 gallons

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.

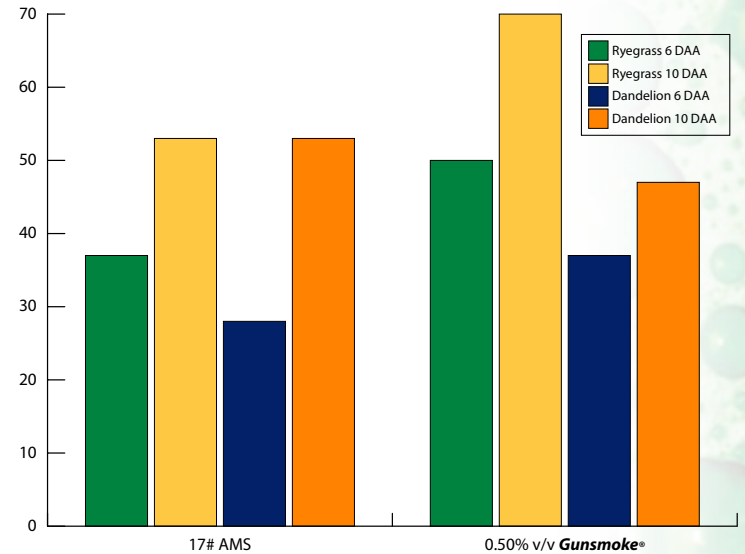


Effect on Water pH with Loaded Glyphosate



Source: Adjuvants Unlimited

Control of Winter Weeds Pre-Plant Burndown Application 17# AMS vs. 0.5% Gunsmoke® with loaded glyphosate



Loaded glyphosate rate: 16 fl. oz./acre; AMS used at 17#/100 gallons; Gunsmoke used at 0.50% v/v (2 quarts/100 gallons)
 Source: Biological Research Service; Dr. Ray Smith; Clay, Texas; 2009.

HERBIMAX[®]

Petroleum Oil-Surfactant Adjuvant

PRINCIPAL FUNCTIONING AGENTS

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	

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

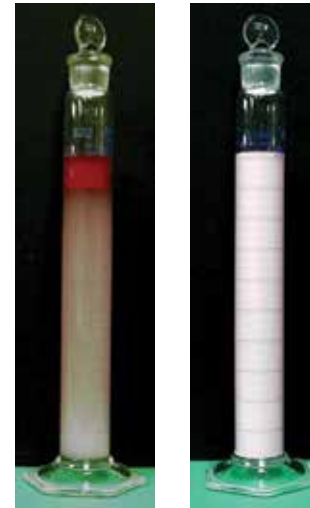
Benefits

- 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.

General Use Rates*

1 to 4 pints per acre

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



Emulsion Stability

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.



Silicone Surfactant, Spreader

PRINCIPAL FUNCTIONING AGENTS

Polydimethylsiloxane polyether copolymer, alcohol ethoxylate, polyoxyethylene-polyoxypropylene copolymer100%

Hi-Wett® is a new generation organosilicone blend, specifically designed for deposition and coverage.

Benefits

- Potential use of less water or improved performance of low-volume applications.
- Less residue.
- Improved nutrient uptake and control of diseases and insects.

General Use Rates*

Crop Type	Hi-Wett Use Rate (ounces/acre)								
	pints and pounds of formulated chemical in spray mix per acre								
	1	2	3	4	5	6	7	8	9
	ounces of Hi-Wett per acre								
--Hard to wet field crops--	3.5		4.0	5.0	6.0	7.5	8.0	9.0	9.5
--Moderate to wet field crops--	2.5		3.5		4.0		5.0		5.5
--Easy to wet field crops--	1.5	2.0	3.0	4.0	5.0	5.5		6.0	6.5
Grape leaves, berryfruit leaves	2.5		3.5		4.0		5.0		5.5
Grapes and other berry fruit	6.5			7.5	8.0	9.0		9.5	
Dense canopy trees* (e.g. citrus)	3.5				4.0		5.0		5.5
Open canopy trees (e.g. apple)	3.5				4.0		5.0		5.5

Instructions: Add up the pints and pounds of formulated chemical in the spray mix on a per acre basis and find that number in the top row of the above chart. Use that column to determine the appropriate use rate **per acre** for the crop you are spraying.

* Citrus and Avocados - if using over 85 gpa add an extra 2.0 ounces of Hi-Wett for every 10 gpa over 85 gpa

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



Grape Comparison

42 GPA without Hi-Wett



21 GPA with Hi-Wett



Apple Comparison

100 GPA without Hi-Wett



40 GPA with Hi-Wett



INFUSE®

Spray Application Deposition Aid

PRINCIPAL FUNCTIONING AGENTS

Modified vegetable oil, esters, fatty acids and ethoxylated derivatives..... 99%
 Constituents ineffective as spray adjuvant..... 1%

Infuse® is a proprietary vegetable-based soil adjuvant designed to hold soil applied chemistry in the targeted areas longer allowing for more consistent weed control.

Benefits

- Extends residual control of soil chemistries
- Vegetable based soil surfactant - crop safe
- Easily tank-mixed with various soil applied chemistries

General Use Rates*

Ground Applications - 1 to 4 pints per acre in 5 to 30 gallons of spray; *Aerial Applications* - 6 to 16 ounces per acre

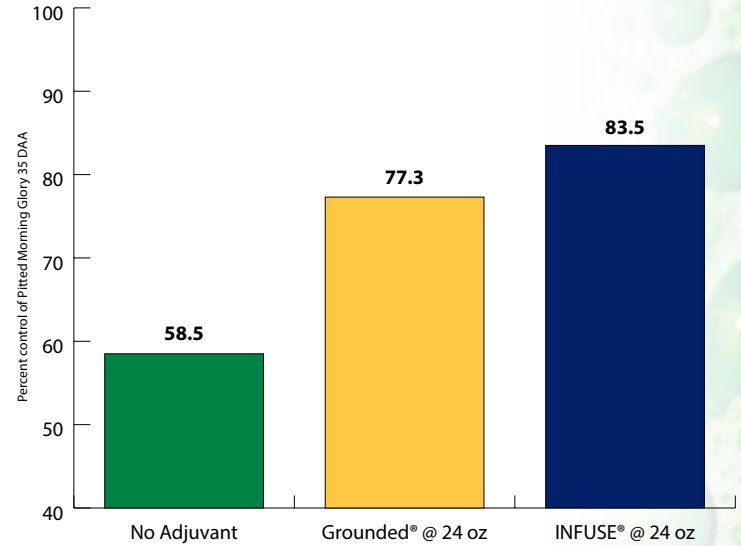
* Infuse is not approved in California or intended to be used in California with a pesticide product or pesticide spray mixture, and cannot be used as a spray adjuvant.



*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.

Evaluation of the Performance of Intimidator® Herbicide with Soil Applied Adjuvants

West Carroll Parish, LA; 5/5/2012



Evaluation of Glyphosate with Infuse® and Intimidator® Herbicide

Dr. Richard Costello, Pioneer, LA - 2013



Tank Mix with Infuse®



Tank Mix WITHOUT Infuse®

MAXIMIZER®

CROP OIL CONCENTRATE

PRINCIPAL FUNCTIONING AGENTS

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

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

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.

General Use Rates*

1 to 8 pints per acre

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



PHASE®

Surfactant, Antifoaming Agent

PRINCIPAL FUNCTIONING AGENTS

Methylated esters of fatty acids, alcohol ethoxylate, and polyether modified polysiloxane	100%
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Phase® is a high performance proprietary formula that provides spreading and coverage of a non-ionic surfactant and the penetration of a methylated seed oil.

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 non-ionic 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.

General Use Rates*

1 to 4 pints per 100 gallons

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



PHASE[®] II

Surfactant, Deposition Aid

PRINCIPAL FUNCTIONING AGENTS

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

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.

Benefits

- Methylated seed and crop oil performance with non-ionic 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 MSOs are recommended.
- Maximizes coverage and penetration for quick, complete control.
- Can be used with a variety of insecticides, herbicides and fungicides.

General Use Rate*

4 quarts per 100 gallons or 1% by volume

‡ Phase II is not approved in California or intended to be used in California with a pesticide product or pesticide spray mixture, and cannot be used as a spray adjuvant.

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Quad 7[™]

Spray Adjuvant

Non-Ionic Surfactant

PRINCIPAL FUNCTIONING AGENTS

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

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

Benefits

- Increases herbicidal activity by increasing spray solution pH thereby increasing sulfonylurea 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.

General Use Rates*

General Use: 1% v/v; 1 gallon per 100 gallons; *pesticide spray mixtures at 5 gpa or less* - 2% v/v; *sugar beet micro rates* - 1% v/v + 1% v/v MSO[®] Concentrate with Leci-Tech[®]

‡ Quad 7 is not approved in California or intended to be used in California with a pesticide product or pesticide spray mixture, and cannot be used as a spray adjuvant.

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Reign®



Deposition Aid, Drift Control Agent

PRINCIPAL FUNCTIONING AGENTS

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

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

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.

General Use Rates*

Aerial Applied - 2 to 5 quarts per 100 gallons; *Ground Applied* - 1 to 10 quarts per 100 gallons

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Reign® LC



Deposition Aid, Drift Control Agent

PRINCIPAL FUNCTIONING AGENTS

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

Reign® LC is an easy mixing polyacrylamide concentrate that decreases driftable fines and improves deposition.

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.

General Use Rates*

Ground and Aerial Application: *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 the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Scanner®

Non-ionic Surfactant, Antifoaming Agent

PRINCIPAL FUNCTIONING AGENTS

3-oxapentane-1,5-diol, propane-1,2,3-triol, alkylphenol ethoxylate, polydimethylsiloxane.....	80%
Constituents ineffective as spray adjuvant.....	20%

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

Benefits

- Manufactured with an 80/20 non-ionic formulation that is biodegradable and non-flammable.
- Mild odor
- 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.

General Use Rates*

1 to 4 pints per 100 gallons

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Surfate®

SPRAY ADJUVANT

Water Conditioning Agent, Non-Ionic Surfactant Blend

PRINCIPAL FUNCTIONING AGENTS

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

Surfate® 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.

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.

General Use Rates*

1 gallon per 100 gallons (1% v/v)

†Surfate is not approved in California or intended to be used in California with a pesticide product or pesticide spray mixture, and cannot be used as a spray adjuvant.

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



TACTIC™

Sticker, Surfactant, Deposition Aid

PRINCIPAL FUNCTIONING AGENTS

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

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.

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.

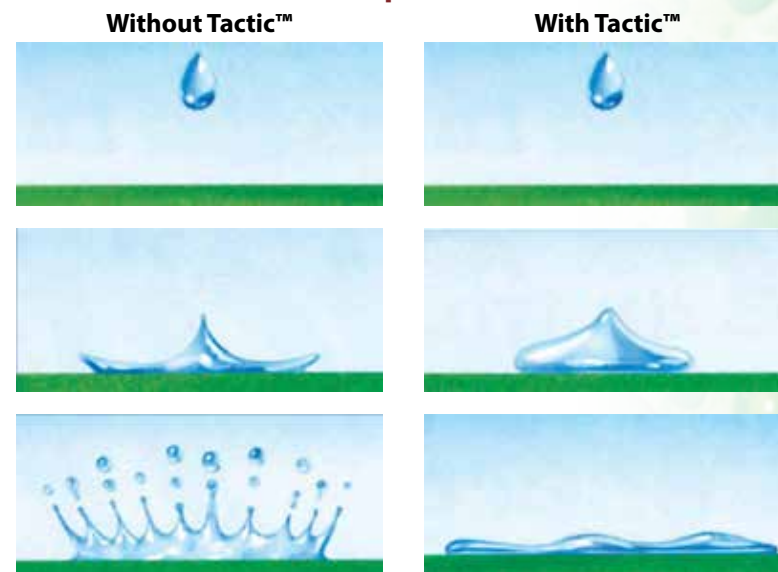
General Use Rates*

Ground and Aerial 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

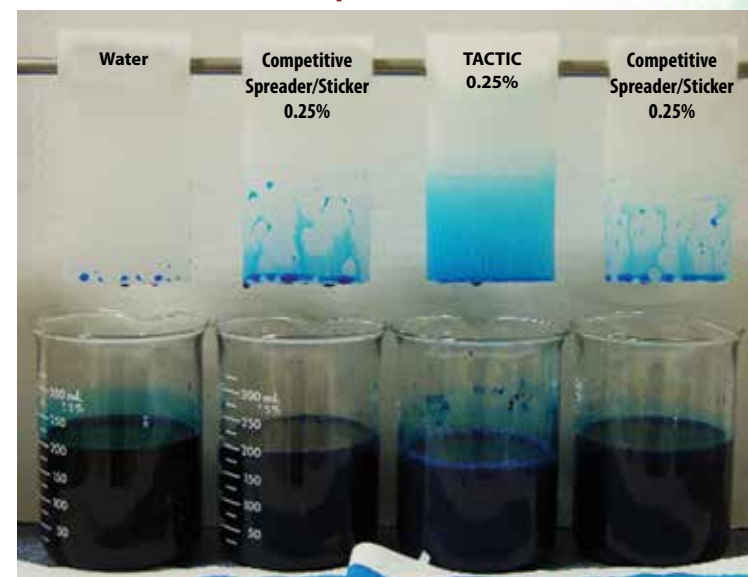
*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



The Droplet Effect



Effectiveness of Sticker/Spreaders on Paraffin Wax Blocks



TREKKER TRAX®

Superior Foam Marker

PRINCIPAL FUNCTIONING AGENTS

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

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.

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.

General Use Rates*

Soft water - 2 to 3 pints per 30 to 40 gallons water; *Medium and hard water* - 3 to 4 pints per 30 to 40 gallons water

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



TUFF TRAX®

FOAM CONCENTRATE

Highly Concentrated Foam Marker with Water Conditioner

PRINCIPAL FUNCTIONING AGENTS

Alkyl sulfonate 4-methyl-2, 4-pentane-diol	100%
--	------

TuffTrax® 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.

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.

General Use Rates*

2 to 3 pints in 30 to 40 gallons water

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Unfoamer®

Antifoaming/Defoaming Agent

PRINCIPAL FUNCTIONING AGENTS

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

Unfoamer® 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.

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.

General Use Rates*

1 to 6 ounces per 100 gallons



**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*

WaterMaxx® 2

Powered By
Aquatrols
Surfactant Technologies

Agricultural Soil Surfactant

GUARANTEED ANALYSIS

Active Ingredients	
Alkoxylated polyols	10%
Glucosethers.....	7%
Other Ingredients	
Water	83%

CONTAINS NON-PLANT FOOD INGREDIENTS

WaterMaxx® 2 agricultural soil surfactant helps growers use water more efficiently and maintain crop productivity by improving the way water moves through soils.

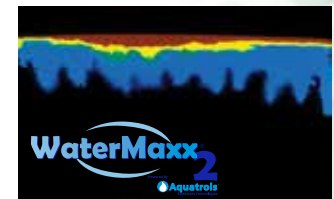
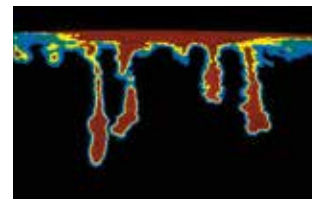
Benefits

- **INFILTRATION:** Improves infiltration so that water and nutrients move into the rootzone quickly and evenly
- **DISTRIBUTION:** Improves the lateral movement of water, increasing the horizontal reach of water
- **RETENTION:** Improves the availability of water and nutrients to the plant, increasing crop productivity
- Reduces water use and makes EVERY DROP COUNT

General Use Rates*

1 to 4 quarts per acre

Soil Profile: Maximize Your Water



Better Infiltration, Distribution and Retention of Water

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*



WIDESPREAD[®] max

POWERED BY
BREATHRU[®]

Technology for Agriculture

Silicone Surfactant

PRINCIPAL FUNCTIONING AGENTS

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

Widespread[®] 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.

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.

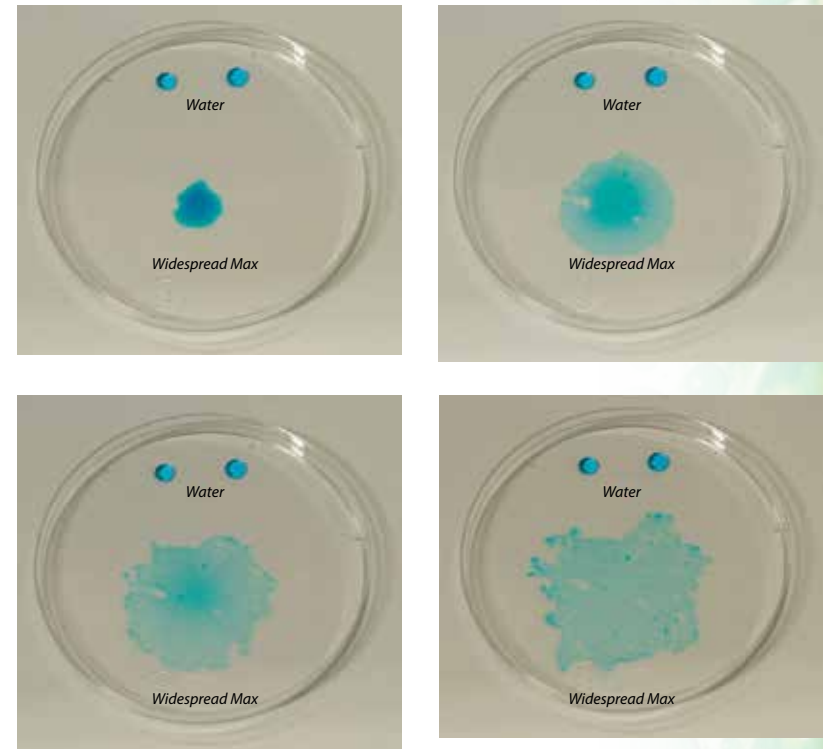
General Use Rates*

Ground Application: *Herbicides, Dessicants, Defoliants* - 6 to 13 fluid ounces per 100 gallons; *Insecticides, Fungicides, Plant Growth Regulators, Foliar Nutrients, Acaricides* - 4 to 8 fluid ounces per 100 gallons; **Aerial Application:** 12 to 16 fluid ounces per 100 gallons

*Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.



Superior Spreading Ability

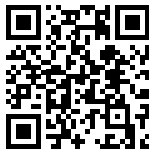


With many pesticides, coverage is a primary objective for optimum performance. A great way to provide coverage is to enable droplets to spread to a greater degree. Organosilicones are the best spreaders in the industry. Widespread Max is 100% organosilicone. The demonstration shown here is a good example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

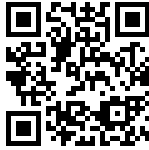
Spreadability of Organosilicone Surfactant



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.



‡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.



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



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.



‡Thrust® 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.



Leaf Life® Widespread® Organic is a new generation, highly effective organic non-ionic wetting, spreading, penetrating surfactant. Leaf Life Widespread Organic will promote uniform spreading at very low concentrations.



‡ These products are not approved in California or intended to be used in California with a pesticide product or pesticide spray mixture, and cannot be used as a spray adjuvant.

**Always read and follow the label directions attached to the product container. Scan QR code with your mobile device for current specimen label and SDS information.*

PROPER TANK MIXING PROCEDURES

Every year when application season rolls around, the number of customer calls concerning tank mix compatibility problems increases. In most cases these issues can be traced to simple product management practices that will eliminate most concerns. The most common issues are:

- Incorrect product mixing order.
- Incomplete mixing of product prior to adding a second product.
- Lack of agitation of product: inadequate bulk storage tank or mini-bulk tank recirculation before use, package product not shaken well, no agitation action in spray tank.
- Spray tank contamination or not clean.
- Product sitting overnight in the spray tank.

Other factors that can make mixing more difficult are cold temperatures of the carrier (water, liquid fertilizer) that is common during early spring seasons. Under these conditions, it is important to maintain adequate agitation to ensure proper suspension of the product. Lack of carrier volume may cause problems while mixing products.

OTHER TANK MIX GUIDELINES

- If a known product compatibility issue exists or the water or fertilizer carrier is cold, a compatibility agent may be used to help with mixing problems. COMP-AIDE or E-Z Mix work well.
- UNFOAMER® may be used if excessive foam is a problem. Surfactant loaded glyphosate products or organo-silicone surfactant products may cause excessive foaming.

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 or glufosinate (Liberty®) is to be mixed, a water conditioning agent should be added to the spray tank first, such as WeatherGard Complete or Choice® Trio.

- DF – Dry Flowable
- EC – Emulsifiable Concentrate
- EW – Emulsion in Water
- F – Flowable liquid
- ME – Micro-encapsulated
- OD – Oil Dispersion
- S – Solution
- SC – Suspension Concentrate
- SG – Soluble Granule
- SP – Soluble Powder
- WDG – Water Dispersible Granule
- WSP – Water Soluble Packet

LOVELAND PRODUCTS MIXING ORDER EXAMPLES

EXAMPLE: Crop – Corn
APPLICATION TIMING: Post-emerge @ V5
PRODUCTS OF CHOICE: Makaze Yield Pro®, Satori®, Black Label® ZN, WeatherGard Complete

MIXING ORDER:

1. Fill spray tank ¼ to ½ full of carrier
2. Add WeatherGard Complete
3. Use proper agitation
4. Add Makaze Yield Pro® glyphosate
5. Add Satori® fungicide
6. Add Black Label® ZN last
7. Fill remainder of spray tank with remainder of needed carrier and continue agitation.
8. Spray field

EXAMPLE: Crop – Soybean
APPLICATION TIMING: Post emerge @ R3
PRODUCTS OF CHOICE: Satori®, Swagger®, Re-nforce® K, Black Label® ZN, Franchise®

MIXING ORDER:

1. Fill spray tank ¼ to ½ full of carrier
2. Use proper agitation
3. Add Satori® fungicide
4. Add Swagger® insecticide
5. Add Franchise® adjuvant
6. Add Black Label® ZN
7. Add Reinforce® K
8. Fill remainder of spray tank with remainder of needed carrier and continue agitation.
9. Spray field

EXAMPLE: Crop – Wheat
APPLICATION TIMING: Post-emerge @ 4 leaf to tillering
PRODUCTS OF CHOICE: Hat Trick®, Fitness®, Tombstone™ Helios®/Warhawk®, LI 700®

MIXING ORDER:

1. Fill spray tank ¼ to ½ full of carrier
2. Use proper agitation
3. Add Hat Trick® herbicide
4. Add Fitness® fungicide
5. Add Tombstone™ Helios®/Warhawk®
6. Add LI 700®
7. Fill remainder of spray tank with remainder of needed carrier and continue agitation.
8. Spray field

WALES/DALES

MIXING ORDER FOR CHEMICAL FORMULATIONS

Pesticides should be added to the tank using the WALES or DALES method to help avoid mixing issues.

- Fill spray tank $\frac{1}{4}$ to $\frac{1}{2}$ full with carrier. Be sure agitation system is in working order.
- Add water conditioner and any compatibility agents if needed.

W or D

Dry formulations should be added to the tank first such as: wettable powders (WP/W), water dispersible granules (WDG), water soluble packets (WSP), dry flowable (DF). Be sure dry products are thoroughly dissolved prior to adding other products.

A

Agitation should be continuous and provide enough action to “roll” the surface of the carrier.

L

Add liquid (L), flowable (F), soluble concentrate (SC), formulations next.

E

Emulsifiable Concentrates (EC) should be added next. Micro-encapsulated (ME) formulations should be added after the EC product.

S

Add surfactants and other adjuvants last. This would include NIS, crop oils, MSO, drift control agents, etc. Final step is to fill the tank with the remainder of the needed carrier and continue agitation.

- When adding a nutritional product, add to the tank last.
- Always do a jar test if there are any concerns about product mixes.

NOZZLE OUTPUTS

(20-INCH NOZZLE SPACING*)

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

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 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 ($2 \times 10 = 20$). If 7.5 pounds of dry material is to be applied per acre, the unit should be calibrated to dispense 75 pounds per minute ($10 \times 7.5 = 75$).

The basic formula for calculating acres per minute is:

$$\text{swath width} \times 2 \times \text{miles per hour}$$

$$1,000$$

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.

NOTES