



KALO

The 411 on Adjuvants

GS Long Company

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Industry Recommendations and Adjuvant Terminology

The use of spray adjuvants, and the terminology associated with them is often misunderstood.

Terms are often used generically without thorough understanding and consideration for which types of spray adjuvants are available and best suited for the pending application.



"Sticker"

"Spreader-wetter"

"Spreader-Sticker"

"Sticker-Spreader"

"Surfactant"

"Wetter"

Industry Recommendations and Adjuvant Terminology

American Society for Testing and Materials (ASTM)

*An **ADJUVANT** is defined as:*

A product added to a spray application to improve the biological activity of the pesticide being applied; to enhance or modify the spray droplet, spray pattern or spray deposit; to improve handling characteristics of the spray solution and spray equipment performance.

Generalized Categories of Spray Adjuvants

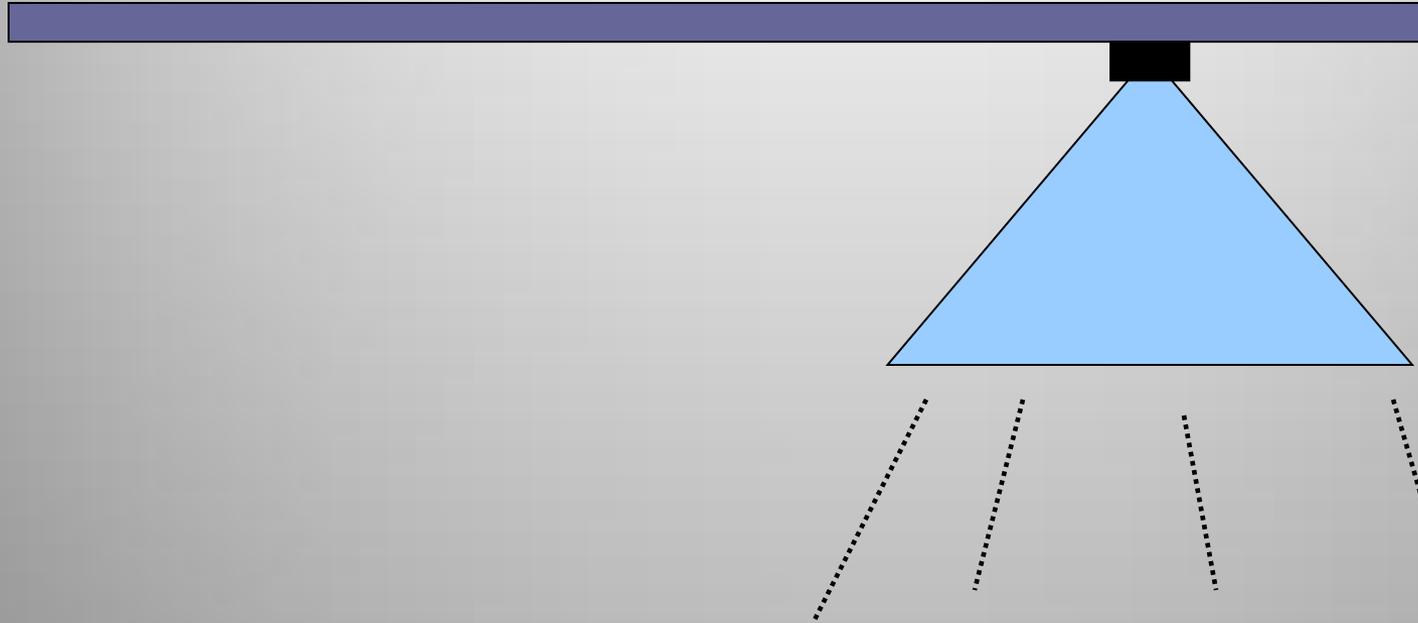
- General Purpose Wetting Agents
90/10 NIS
- Specialty Adjuvants
Organosilicone
Water Conditioning Agents
Deposition/Drift Adhesion Agents
- Oil Based Adjuvants
Seed or Petroleum Based
- Utility Agents
Anti-Foam
Tank Cleaners
Dyes





\$ The most expensive spray is the one that fails to accomplish the purpose for which it is applied.

Adjuvants Help Manage the Success and Fail Factors Associated with Spray Applications



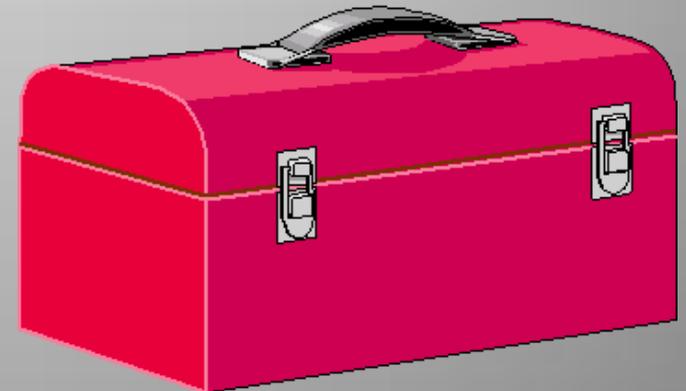
- **PESTICIDE SELECTION**
- **APPLICATION**
- **SPRAY DISRUPTORS**
- **SPRAY BARRIERS**

Tools to manage **SPRAY DISRUPTORS** and **SPRAY BARRIERS**



=

**MANAGEMENT
TOOLS**



Spray Disruptors

Things that chemically and physically disrupt spray performance.

Disruptors

Poor Spray Water Quality

Tank Residues and Incompatibility

Unwanted Tank Foam

Natural Elements such as Rainfall,
Ultra-Violet Degradation, Dew

Air Currents – Wind



68 °F / 20 °C
Mostly Cloudy

Humidity: 78%

Dew Point: 61 °F / 16 °C

Wind: 16 mph / 26 km/h / 7.2 m/s
from the SSW



Wind Gust: 23 mph / 37 km/h /
10.3 m/s

Pressure: 30.02 in / 1017 hPa

Visibility: 9.0 miles / 14.5 kilometers

UV: 3 out of 16

Clouds: Mostly Cloudy 1600 ft /
487 m
(Above
Ground
Level)

Spray Barriers

Natural plant features and characteristics that protect the plant from harm.

Barriers

Plant Structure including Leaf Angle, Hairs and Waxy Cuticle

Plant Growth Stage & Type such as Annual vs. Perennial, Dormancy vs. Active Growth

Woody Stems and Bark

Adjuvant Management

Nonionic Activator Adjuvants including:

- surfactants to improve wetting and coverage
- oil based adjuvants to improve penetration and uptake





Leaf shape and orientation





Adjuvants are management tools that:

CANNOT

The use of tank-mix adjuvants **CANNOT** correct or cover for poor judgment, improperly selected pesticide mixes, or worn equipment.

CAN

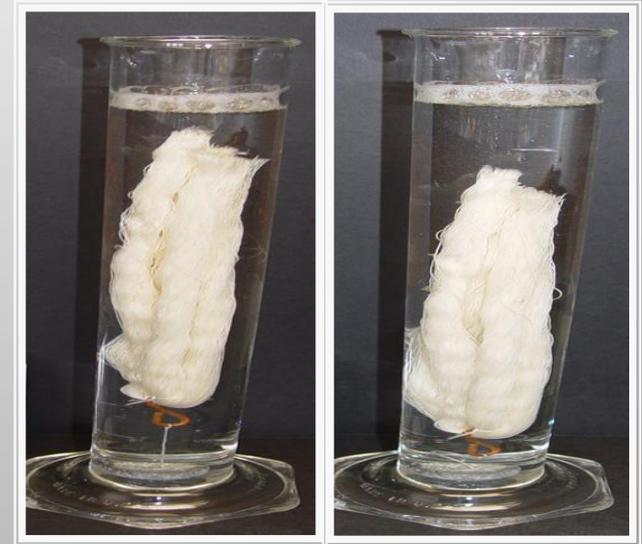
The proper and prescriptive use of tank-mix adjuvants **CAN** make the difference between a successful or failed application by better managing the pre & post spray disruptors and spray barriers.

Measuring Wetting Performance

The industry has adopted the “Draves” wetting test as a means to measure and predict how well a pesticide solution will wet and spread on a solid surface (i.e.: plant, weed, etc.). This standard method test measures the time (seconds) it takes to wet a woven cotton skein.

A superior wetting agent at a 0.25% v/v concentration will require less than 20 seconds to wet the cotton skein. Untreated water without surfactant added will take more than 300 seconds to wet the same cotton skein.

The lower the score on this test the better and faster wetting characteristics the adjuvant treatment.



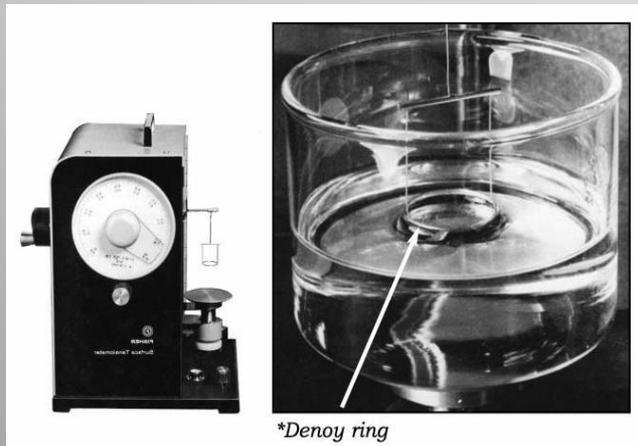
Initial Time



Elapsed Time

Measuring Surface Tension

Surface tension is a condition that exists at the free surface of a solution and can be measured in terms of the amount of force required to pull a *denoy ring off the surface of the solution. The force is measured and expressed as dynes per centimeter (dynes/cm).



*Denoy ring

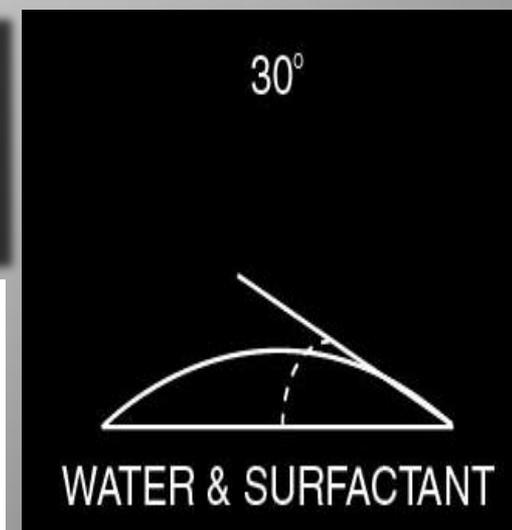
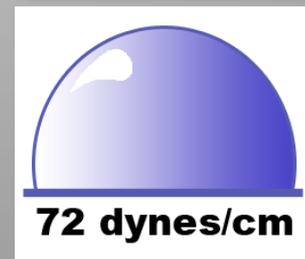
**Good Surfactants
Reduce the Surface
Tension of Water
by 40-50%**

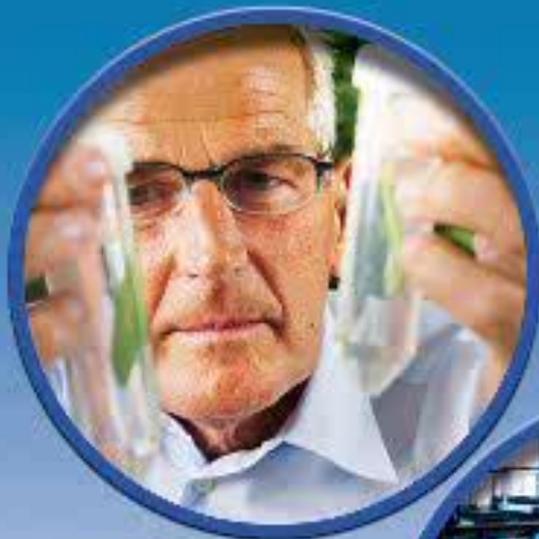
Dynes/cm

A measure of force associated with the surface tension; the smaller the number, the less surface tension to restrict spray droplet spread.

Measuring Contact Angle

- Contact angle is a profile measurement of a drop of water in contact with a solid surface.
- The lower the contact angle produced by the surfactant, the greater the spreading and coverage properties of that spray solution.
- Water has a contact angle of 93 degrees. A typical surfactant influences the contact angle by 30-45 degrees.

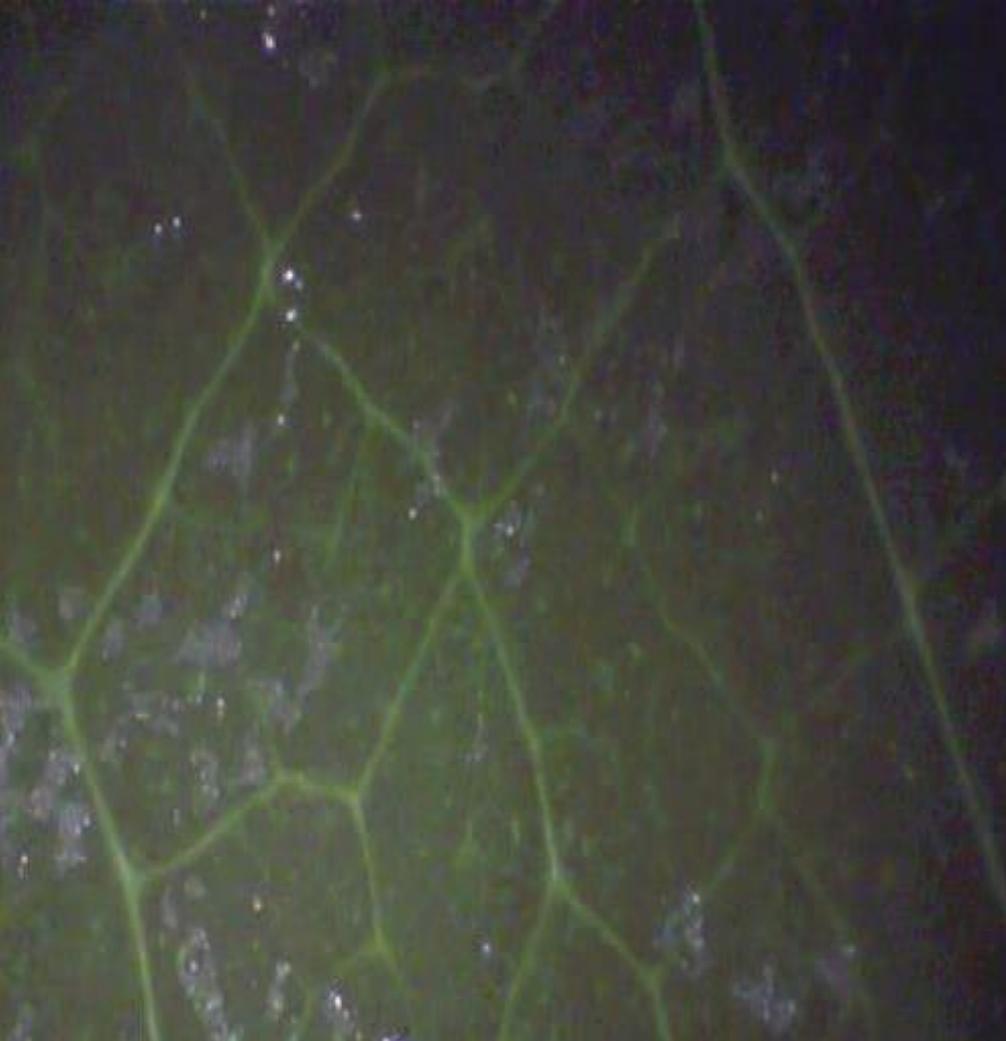




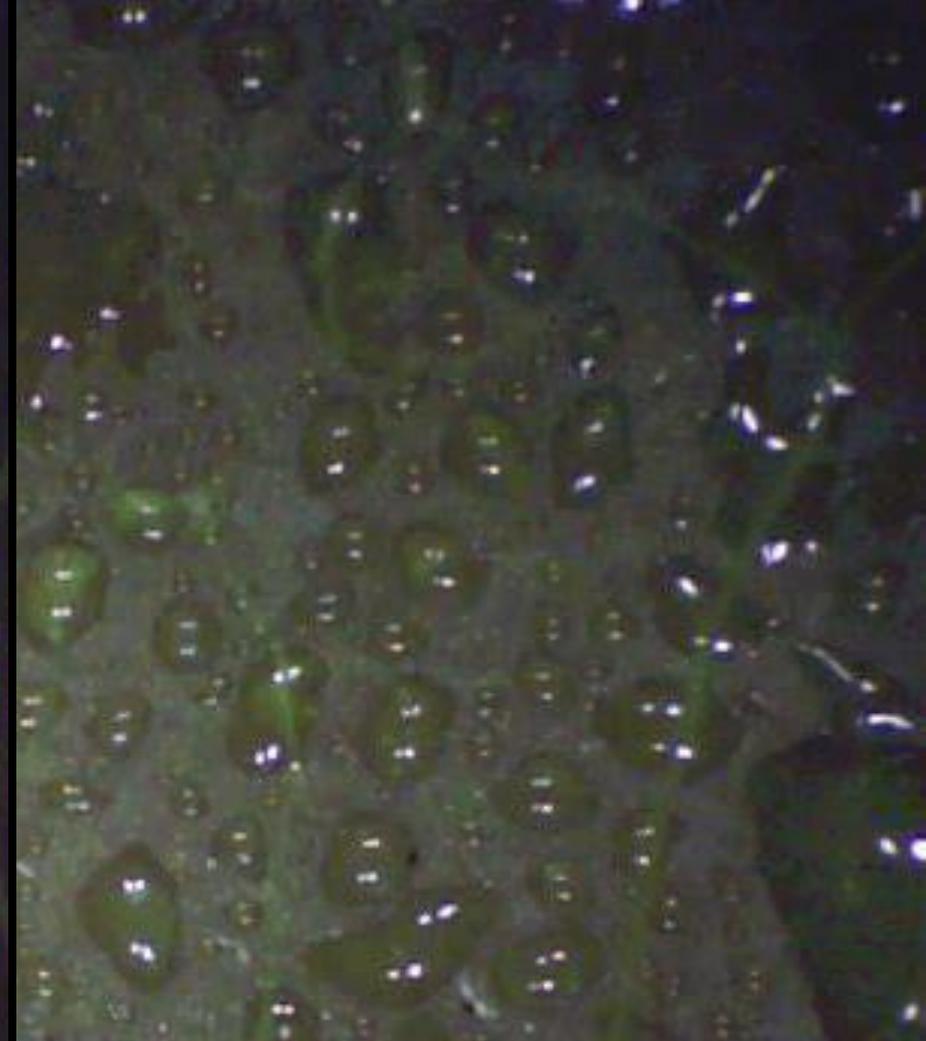
SPRAY DROPLET SURFACE TENSION



**ADJUVANT
ANSWER LAB**



Superior Spray
Coverage with
Nonionic Surf



Untreated Spray
"Beading Up" on
Waxy Leaf Surface

Why Nonionic?

ANIONIC — negative ionic charge

CATIONIC + positive charge

NONIONIC / no ionic charge

Nonionic activator adjuvant systems are preferred for broad-use adjuvants so that the products do not react with the actual herbicide. Nonionic adjuvants treat the water, but do not interfere with water and spray chemistry.

Anionic and cationic materials are used in adjuvant systems, but must be used carefully and are generally selected for more specific performance purposes.

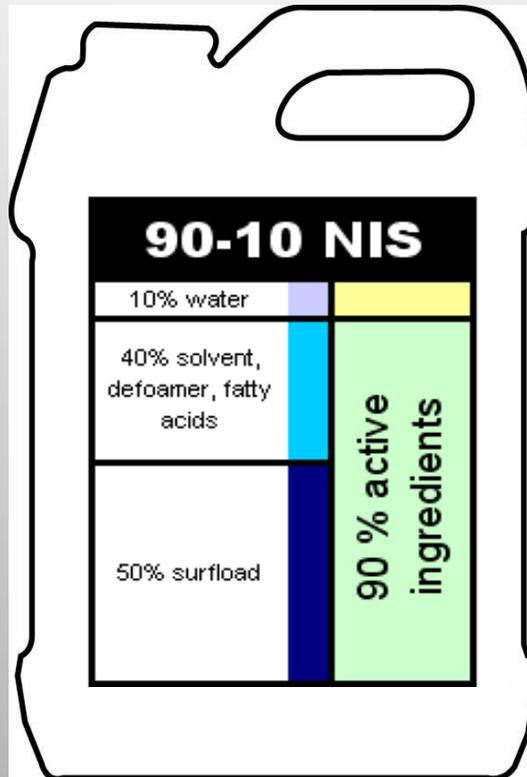
Know and Understand What you are Using!

Both products A & B in this example would be properly sold and labeled as 90-10 NIS adjuvants in the market place. Both products have 90% active ingredients.

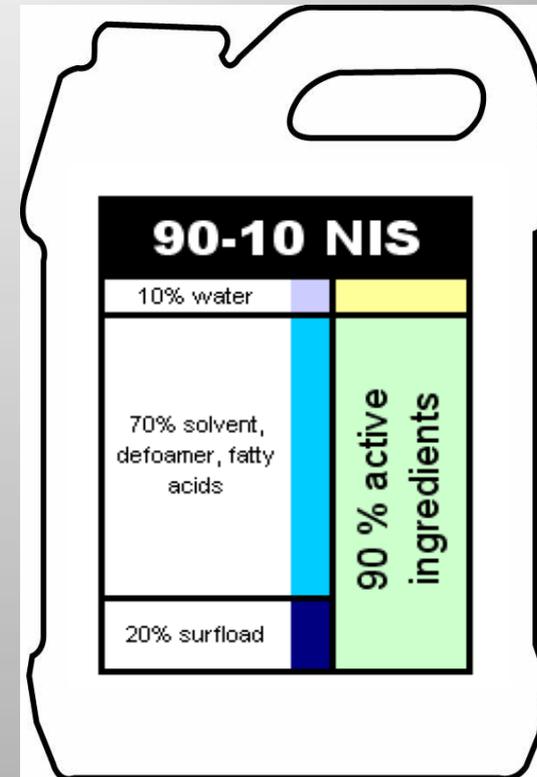
However, Product A in this example has 50% actual surfactant while Product B has only 20% surfactant.

Active ingredients does not always project surfactant quality and load!

A.



B.



In this example, Product A has more than 2X as much surfactant, the ingredient that actually gets the job done in the spray tank. It is important that customers understand the difference in product quality and the value difference in these two products.

NIS Comparison - Functioning Agents

Alkylphenol ethoxylate, propylene glycol
tall oil fatty acid.....90%

Alkylphenol ethoxylate, butyl alcohol,
Dimethylpolysiloxane.....90%

Alkylphenol ethoxylate, alcohol ethoxylate
tall oil fatty acid.....90%

Alkylphenol ethoxylate, isopropanol
and fatty acids.....90%

Alkylphenol ethoxylate, propylene glycol
tall oil fatty acid.....90%



90

Nonionic Surfactant



- Proven Field Performance
- Non-Ionic Formulation
- High Surfactant Content
- Resists Wash-off
- Contains Anti-Foam
- Common Use Rate .125% to .50% v/v

Example: The Use of Adjuvants as Spray Management Tools



Spray Barrier – Good Coverage
Adjuvant - Nonionic Surfactant

Spray Disruptor – Poor Water Quality
Adjuvant – Water Conditioner (AMS)

Spray Disruptor – Drift
Adjuvant - Drift Control Agent

Spray Disruptor - Tank Residues
Adjuvant - Tank Cleaner

6.0 MIXING

Clean sprayer parts immediately after using this product by thoroughly flushing with water.

NOTE: REDUCED RESULTS MAY OCCUR IF WATER CONTAINING SOIL IS USED, SUCH AS VISIBLY MUDDY WATER OR WATER FROM PONDS AND DITCHES THAT IS NOT CLEAR.

6.4 Surfactants

Nonionic surfactants (NIS) or wetting agents that are labeled for use with herbicides may be added to the spray solution. Do not reduce rates of this herbicide when adding surfactants. Read and carefully observe cautionary statements and other information appearing on the additives label.

When adding additional surfactant, use 0.5 percent surfactant concentration (2 quarts per 100 gallons of spray solution) when using surfactants that contain at least 70 percent active surfactant, or a 1 percent surfactant concentration (4 quarts per 100 gallons of spray solution) for those surfactants containing less than 70 percent active surfactant.

6.5 Ammonium Sulfate

The addition of 1 to 2 percent dry ammonium sulfate by weight or 8.5 to 17 pounds per 100 gallons of water may increase the performance of this product, particularly under hard water conditions, drought conditions or when tank mixed with certain residual herbicides, on annual and perennial weeds. The equivalent rate of ammonium sulfate in a liquid formulation may also be used. Ensure that dry ammonium sulfate is completely dissolved in the spray tank before adding herbicides or surfactants. Thoroughly rinse the spray system with clean water after use to reduce corrosion.

NOTE: When using ammonium sulfate, apply this product at rates recommended in this label. Lower rates will result in reduced performance. The use of ammonium sulfate as an additive does not preclude the need for additional surfactant.

6.6 Colorants or Dyes

Agriculturally approved colorants or marking dyes may be added to this product. Colorants or dyes used in spray solutions of this product may reduce performance, especially at lower rates or dilutions. Use colorants or dyes according to the manufacturer's recommendations.

6.7 Drift Reduction Additives

Drift reduction additives may be used with all equipment types, except wiper applicators, sponge bars and Controlled Droplet Applicator (CDA) equipment. When a drift reduction additive is used, read and carefully observe the cautionary statements and all other information appearing on the additive label. The use of drift reduction additives can affect spray coverage which may result in reduced performance.

Pesticide Label With Adjuvant Recommendations

PULL HERE TO OPEN ►

RESTRICTED USE PESTICIDE
DUE TO ACUTE TOXICITY
FOR RETAIL SALE TO AND USE ONLY BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION AND ONLY FOR THOSE USES COVERED BY THE CERTIFIED APPLICATOR'S CERTIFICATION.

Gramoxone[®] Inteon

Herbicide

A Weed, Grass, and Harvest Aid Desiccant/Defoliant Herbicide

Active Ingredient:
Paraquat dichloride (1,1'-dimethyl-4,4'-bipyridinium dichloride) 30.1%
Other Ingredients: 69.9%
Total: 100.0%

Contains 2.0 pounds paraquat cation per gallon as 2.762 pounds salt per gallon. Contains alerting agent (odor), emetic, dye and Inteon Technology.

KEEP OUT OF REACH OF CHILDREN.

DANGER/ PELIGRO  **POISON**

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Product of United Kingdom
Formulated in the USA
EPA Reg. No. 100-1217
EPA Est. 100-LA-001
SCP 1217A-L1B 0407

2.5 gallons
Net Contents

- NEVER PUT INTO FOOD, DRINK OR OTHER CONTAINERS.
- IF SWALLOWED, TAKE IMMEDIATE ACTION AS PRESCRIBED IN FIRST AID STATEMENT. SYMPTOMS ARE PROLONGED AND PAINFUL.
- DO NOT USE OR STORE IN OR AROUND THE HOME.
- DO NOT REMOVE CONTENTS EXCEPT FOR IMMEDIATE USE.
- THE ODOR OF THIS PRODUCT IS FROM THE ALERTING AGENT WHICH HAS BEEN ADDED, NOT FROM PARAQUAT.



®

Pesticide Label With Adjuvant Recommendations



APPLICATION

Since Gramoxone Inteon is a contact-type herbicide, it is essential to obtain complete coverage of target weeds to get good control. Improper application technique and/or application to large, stressed, or mown weeds will usually result in unacceptable weed control and unacceptable crop desiccation/defoliation. Complete coverage is also essential for good crop desiccation/defoliation. See details below for specific application instructions.

USE OF A NONIONIC SURFACTANT OR CROP OIL CONCENTRATE

Always add one of the following (failure to use one of the following at recommended rates will result in reduced performance of Gramoxone Inteon).

Nonionic Surfactant: Add nonionic surfactant containing 75% or more surface-active agent at a minimum of 0.125% v/v (1 pt./100 gals.), or add a nonionic surfactant containing 50-74% surface-active agent at a minimum of 0.25% v/v (2 pts./100 gals.), of the finished spray volume for ground applications. For aerial applications, add a nonionic surfactant at 0.25% v/v (2 pts./100 gals.) of the finished spray volume.

Crop Oil Concentrate: Add a nonphytotoxic crop oil concentrate or methylated seed oil containing 15-20% approved emulsifier, at 1.0% v/v (1 gal./100 gals.) of the finished spray volume for ground applications. For aerial applications, add 1 pint of crop oil concentrate per acre. Do not use crop oil concentrate when using Gramoxone Inteon for cotton harvest aid.

Two General Types of Oil Based Nonionic Activator Adjuvants



Petroleum Based Oil Adjuvants

Oil derived from petroleum production

Usually called "Crop Oil Concentrate" or COC

Seed Oil Based Adjuvants

Oils produced from oil plants and seeds such as Canola, Sunflower, and Cotton

Usually called "Modified Vegetable Oil" or MSO



Two Basic Types of Nonionic Activator Adjuvants

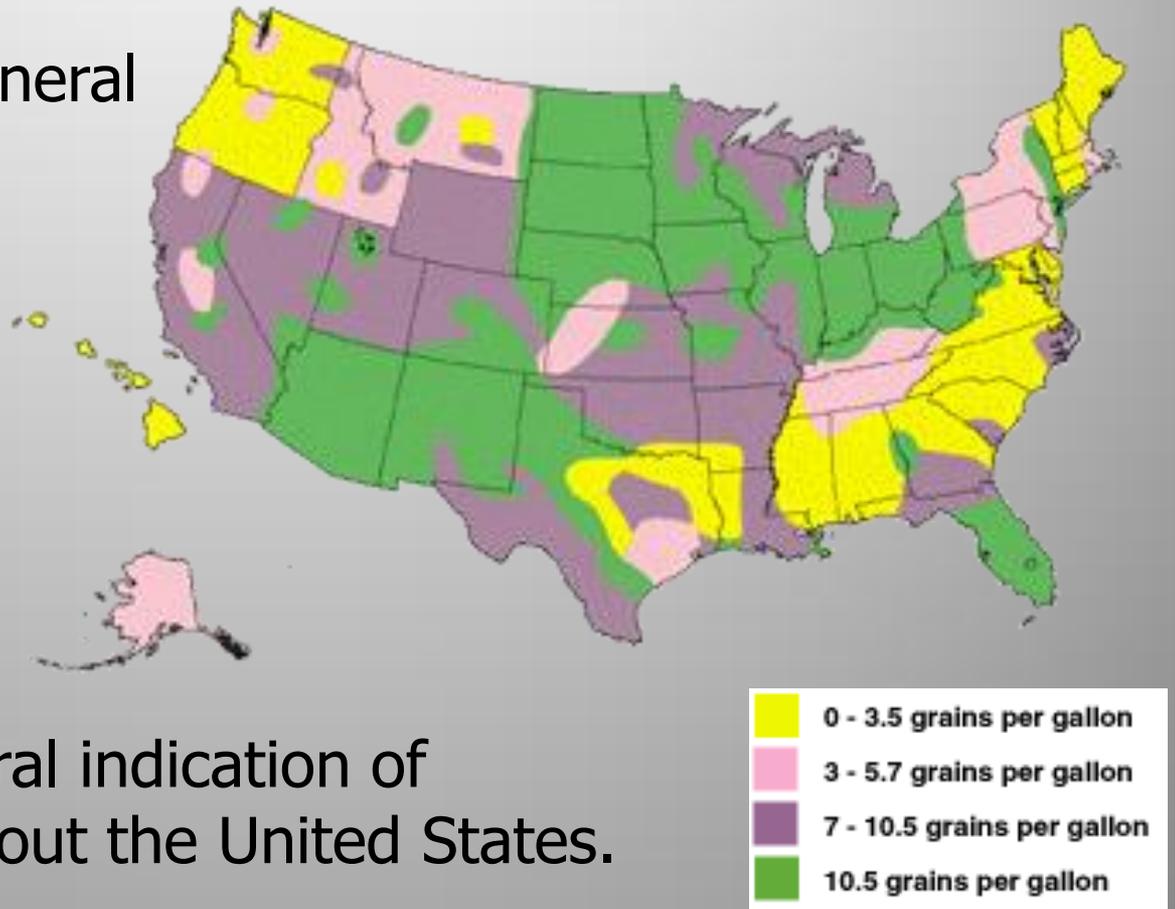
Performance Generalization

	Wetting & Spreading	Penetrating & Uptake
1. NIS Based	Excellent	Good
2. Oil Based	Good	Excellent

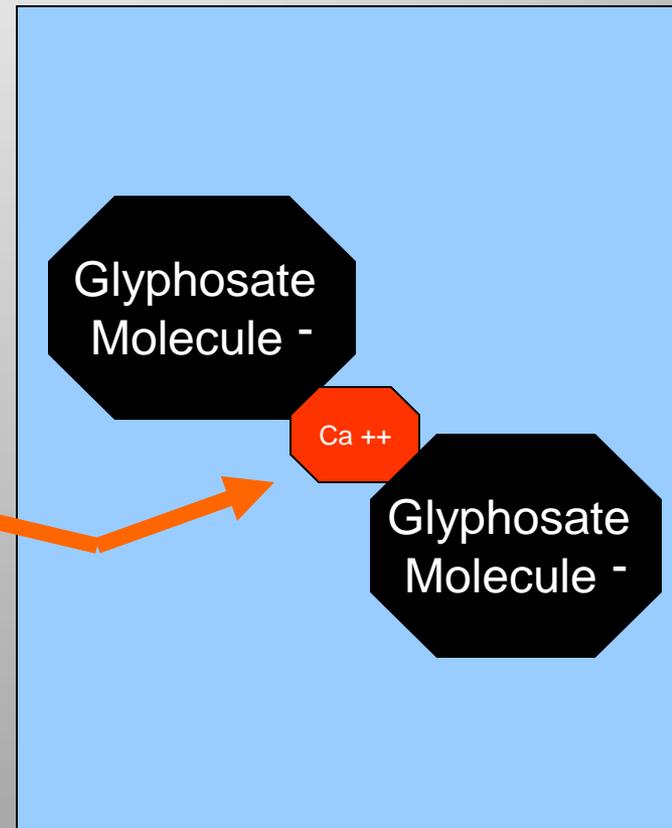
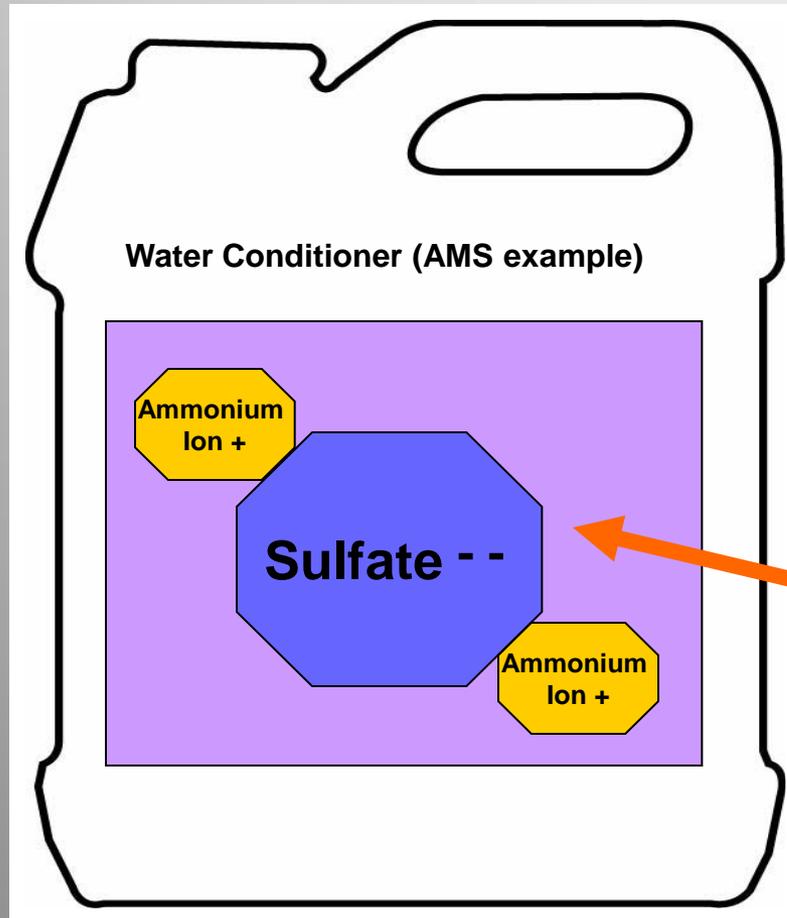
Water Quality Map of the United States

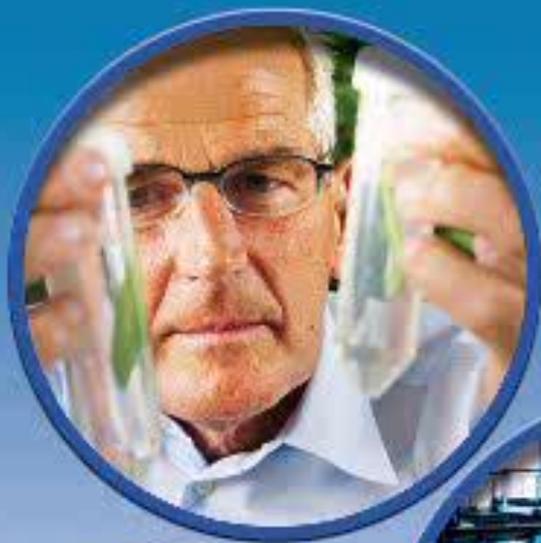
Understanding the general quality of the water source used in any application is very important.

Water quality is variable and ever changing. This map is provided as a general indication of water quality throughout the United States.



The Spray Conditioner **DISRUPTS** the Antagonism





WATER CONDITIONING ADJUVANTS



**ADJUVANT
ANSWER LAB**

Poor Water Quality Impacts Herbicide Performance by Hard Water Antagonism

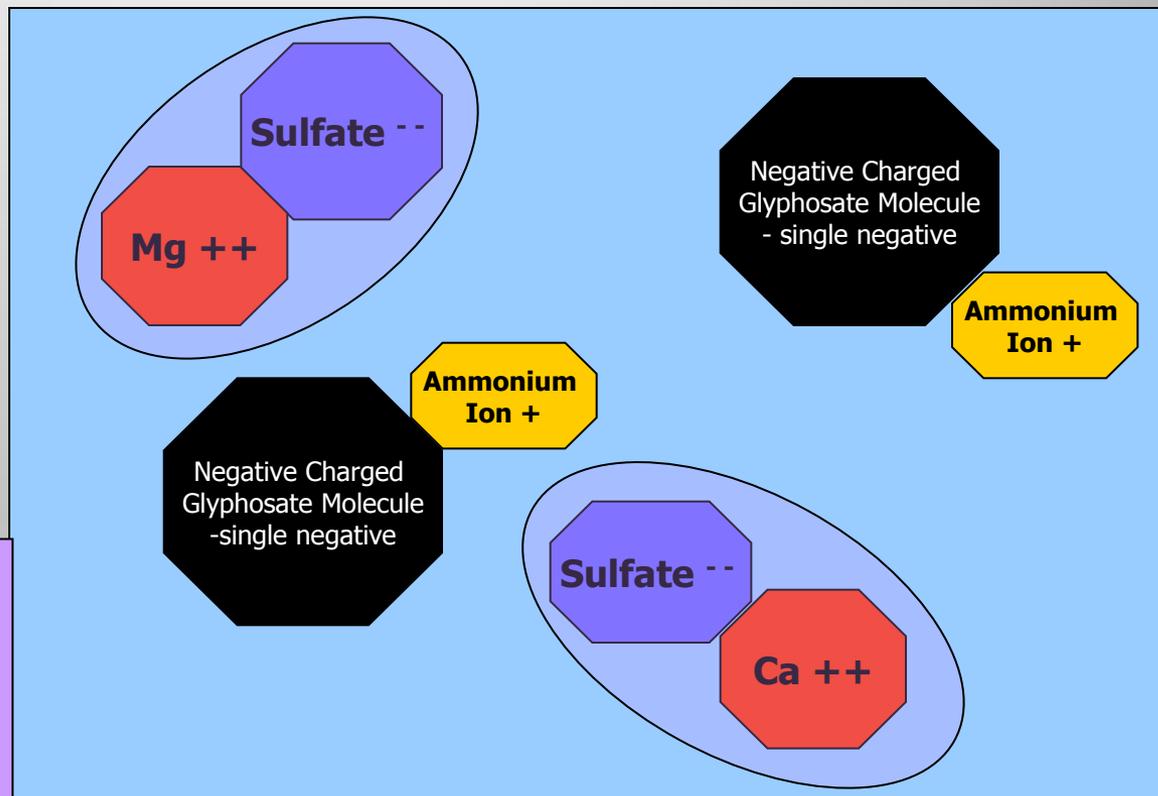
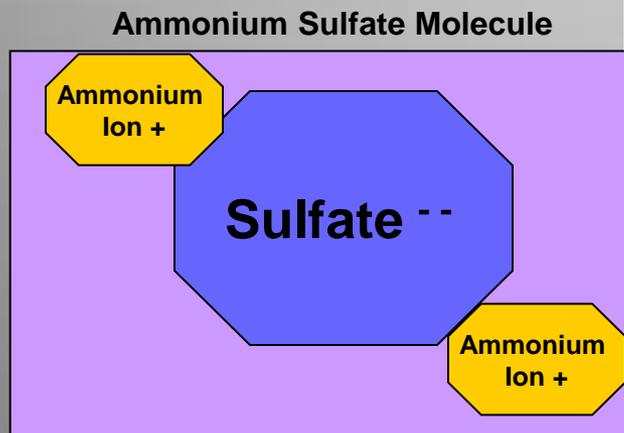
Hard water minerals including calcium, magnesium, sodium, and iron can antagonize herbicide performance by reducing the active ingredient availability in spray solution.

This picture shows the antagonistic impact of calcium minerals on the performance of glyphosate. Note how well glyphosate performed (middle) as compared to the same herbicide treated in the presence of hardened spray water (right).



Ammonium Sulfate “disrupts” hard water antagonism and conditions spray water in two ways.

Weakly bonded ammonium ions disassociate with the sulfate, leaving the double negative sulfate wide open for attraction to the double positive hard water minerals such as calcium, magnesium, and iron. The disassociated single-positive ammonium ions are attracted to the single-negative glyphosate molecule. Research has shown that the glyphosate molecule associated with ammonium ions is more readily available to be taken up by the plant.



Prevents minerals from reacting with herbicide.

The Evolution of the Sequestering Market ...

Liquid 3.4 Ib AMS Solution Products

Various Products, Many Manufacturers...

“Second Generation” Water Conditioners

Combinations of AMS, Acids and Surfactants...

- | | |
|---|--|
| •Bronc MAX (<i>Wilbur Ellis</i>) | AMS/ammonium alkyl-aryl sulfonates, polycarboxylic acid |
| •Choice (<i>Loveland</i>) | AMS, organic acids and phosphate ester |
| •Cayuse Plus (<i>Wilbur-Ellis</i>) | AMS, alcohol ethoxylates, ammonium nitrate |
| •Transport(s) (<i>Precision Labs</i>) | NIS, ammoniated ions, water conditioning agents and antifoam |
| •Quest (<i>Helena</i>) | Ammonium Citrate / Ammonium Phosphate Complex |
| •Request (<i>Buffered</i>) | Ammonium Citrate / Ammonium Phosphate Complex |
| •Accu-Quest (<i>Buffered</i>) | Ammonium Citrate / Ammonium Phosphate Complex |
| •Restore (<i>KALO</i>) | AMS, 1,2,3-Trihydroxypropane, Phosphoric acid |
| •MAX-IT (<i>IAP</i>) | Ammonium sulfate, glycerol, phosphoric acid |
-

“Third Generation” Water Conditioners

AMAD Combinations...

- | | | |
|--------------------------------------|------|-----------------------------------|
| •Hel-Fire (<i>Helena</i>) | AMAD | urea/sulfuric acid/adjuvant blend |
| •Load Out/Load Up (<i>Simplot</i>) | AMAD | urea/sulfuric acid/adjuvant blend |
| •Spray Prep (<i>KALO</i>) | AMAD | urea/sulfuric acid/adjuvant blend |

Liquid or Dry Adjuvant Conditioners



**SPRAY ADDITIVE
Water Conditioner and
Antagonism Disruptor**



GENESIS

AGRI-PRODUCTS

