

2014 Mariposa County

Integrated Weed Management Workshop

Introduction to

Spray Adjuvants

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Spray Adjuvants

- **What are adjuvants?**
- **What do they do?**
- **What determines proper selection?**
- **What are common use rates?**

Spray Adjuvants

Definition

- An adjuvant is a material added to a mixture to aid or modify the action of an agrochemical, or to alter the physical characteristics of the mixture.

ASTM Definitions

Adjuvant types

- 1. Surfactants/Spreader-Activators**
- 2. Penetrants**
- 3. Spreader-Stickers**
- 4. Acidifiers/Buffers**
- 5. Deposition and drift management**
- 6. Anti-foaming agents**
- 7. Colorants and dyes**

Adjuvant Type Examples

Brand names used for illustration purposes

- **R-11® Spreader-Activator** – nonionic surfactant
- **Super Spread 7000** - nonionic spreader/buffer/acidifier
- **Mor-Act® Adjuvant** - crop oil concentrate
- **R-56® Spreader-Sticker** – increases deposition/retention
- **In-Place®** - deposition agent/drift retardant
- **No Foam** - anti-foaming agent
- **SylCoat®** - organosilicone surfactant
- **Hasten®** - spreader-penetrant
- **SYL-TAC** - silicone/modified vegetable oil blend
- **Competitor** - aquatic surfactant
- **Bronc Plus Dry EDT** - AMS, surfactant, deposition agent

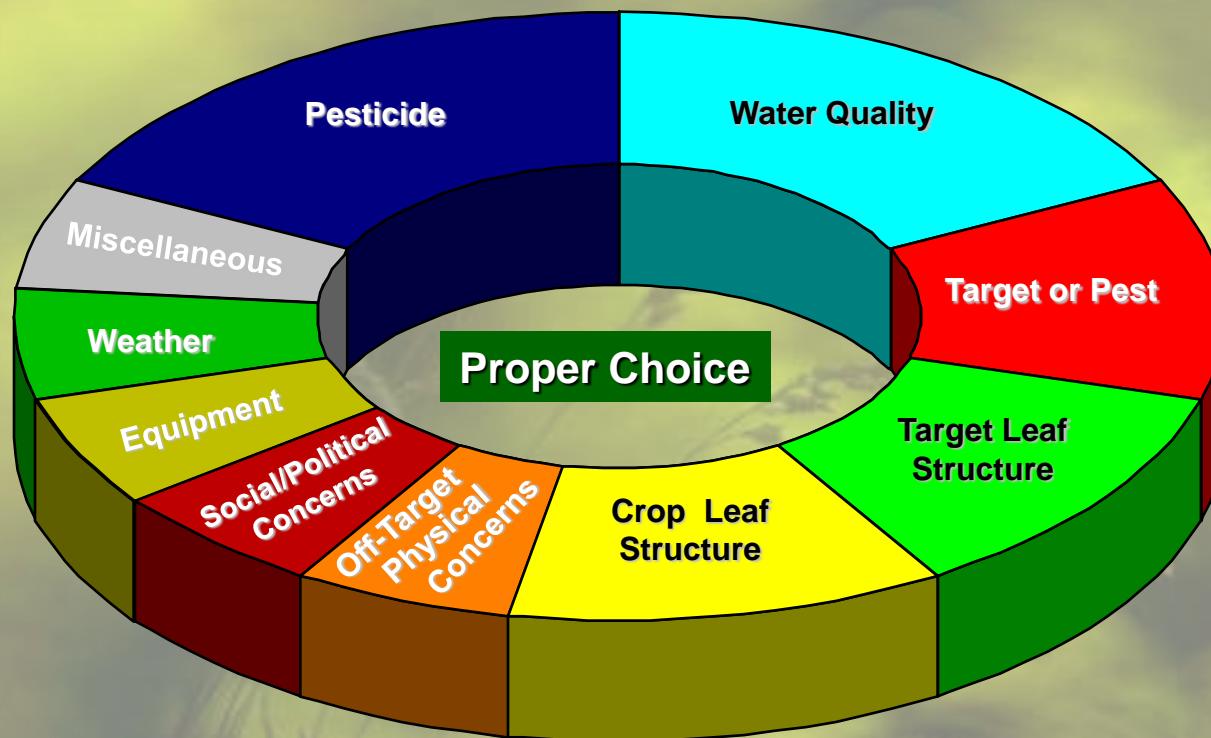
Why use adjuvants?

1. Reduce spray application problems
2. Improve herbicide performance

Spray application is the **weakest link**
the pesticide follows through its
synthesis, testing, registration, and
final use...

Adjuvant Selection Factors

Consider all factors and your experiences to make the proper adjuvant choice.



Surfactants

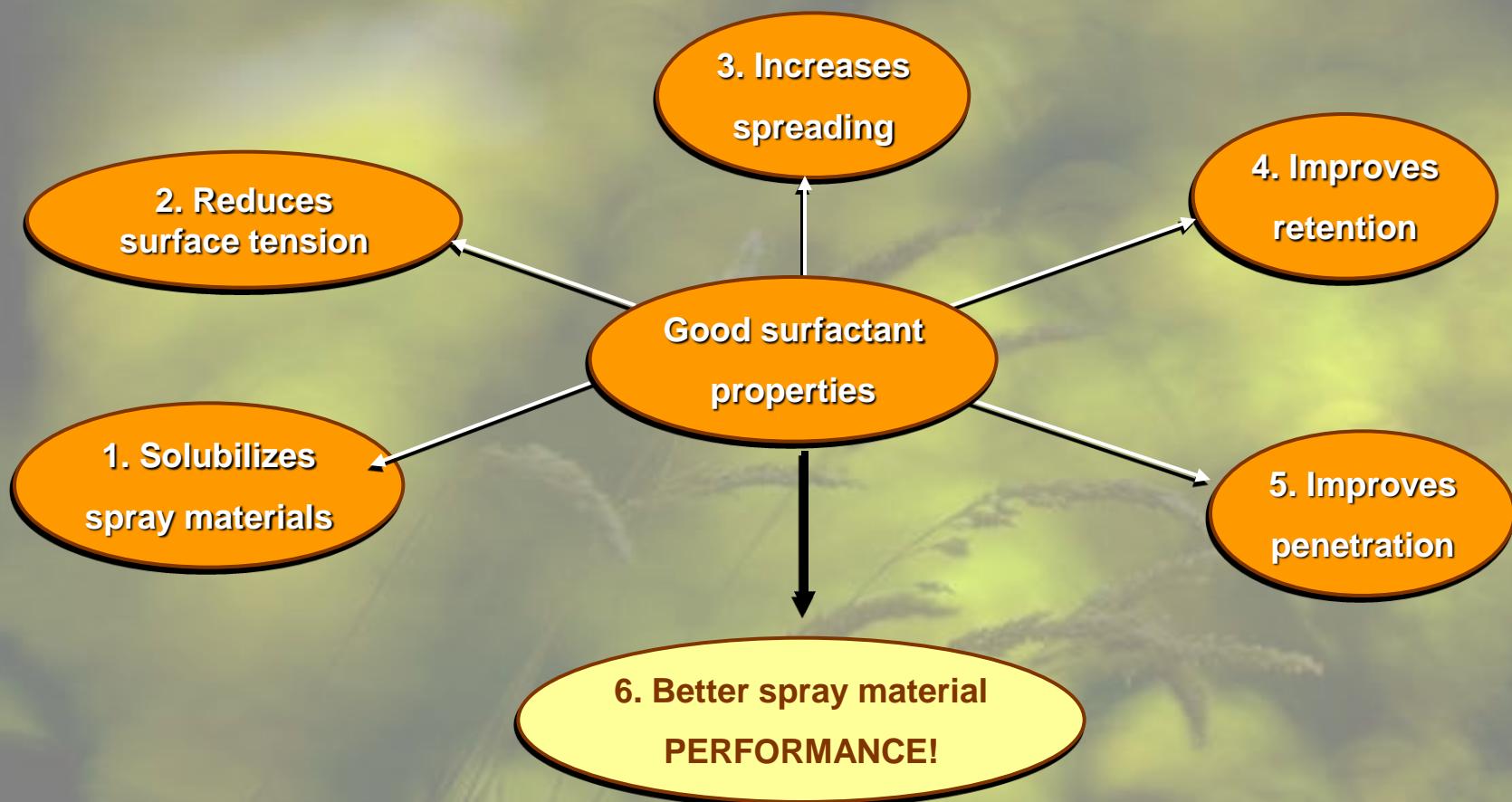
- **What are surfactants?**
- **What do they do?**
- **What is their mechanism?**
- **What affects their performance?**

Surfactants

Definition

- **Surfactant is a word derived from the term “surface-active agent.”**
Surfactants are adjuvants that reduce the surface tension of water or increase its wettability. They aid the emulsifying, spreading, wetting or other surface-modifying properties of liquids.

Functions of a High Quality Surfactant



Droplet Without Surfactant



- **Surface tension of water is 72 dynes/cm.**
- **Droplets sit on leaf hairs or leaf surface**
- **Little leaf contact**
- **Reduced spray activity**

Droplet Without Surfactant



- **Giant salvinia; thick cuticle, covered with leaf hairs.**
- **Little leaf contact.**
- **Spray droplets evaporate.**
- **Severely reduced control.**

Surfactants

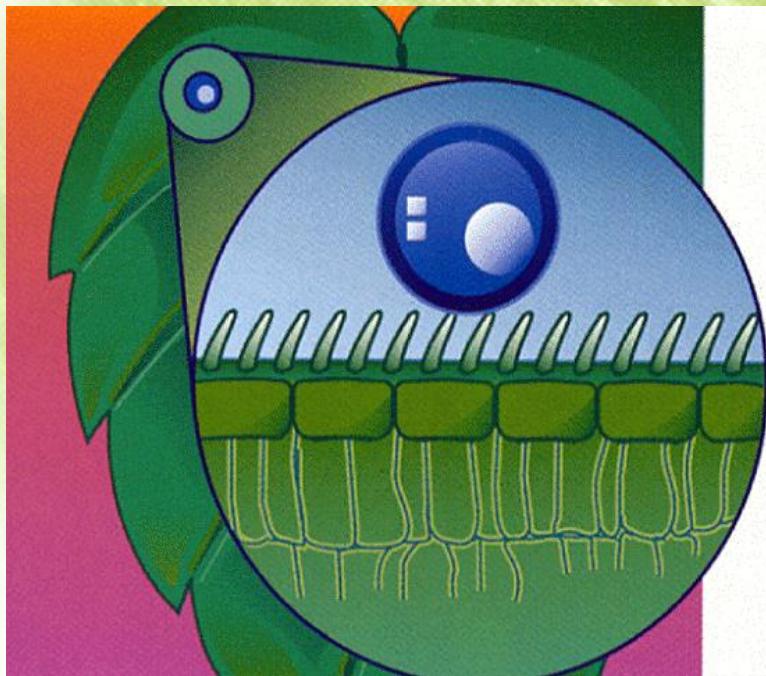
Schematic Representation of Molecule



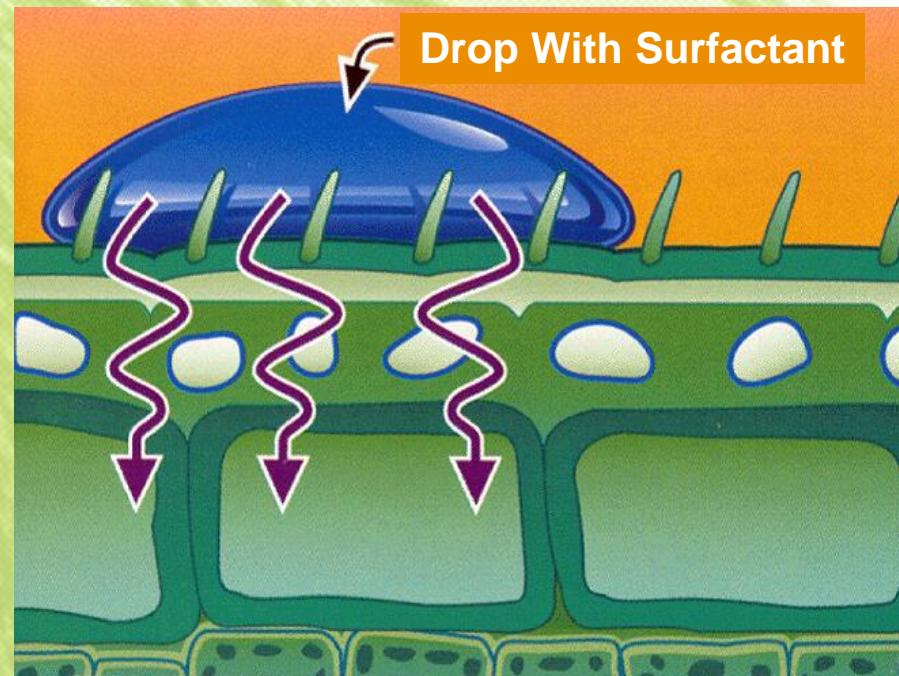
Hydrophilic
“Water-Loving”

Lipophilic
“Fat-Loving”

Surfactant Effects

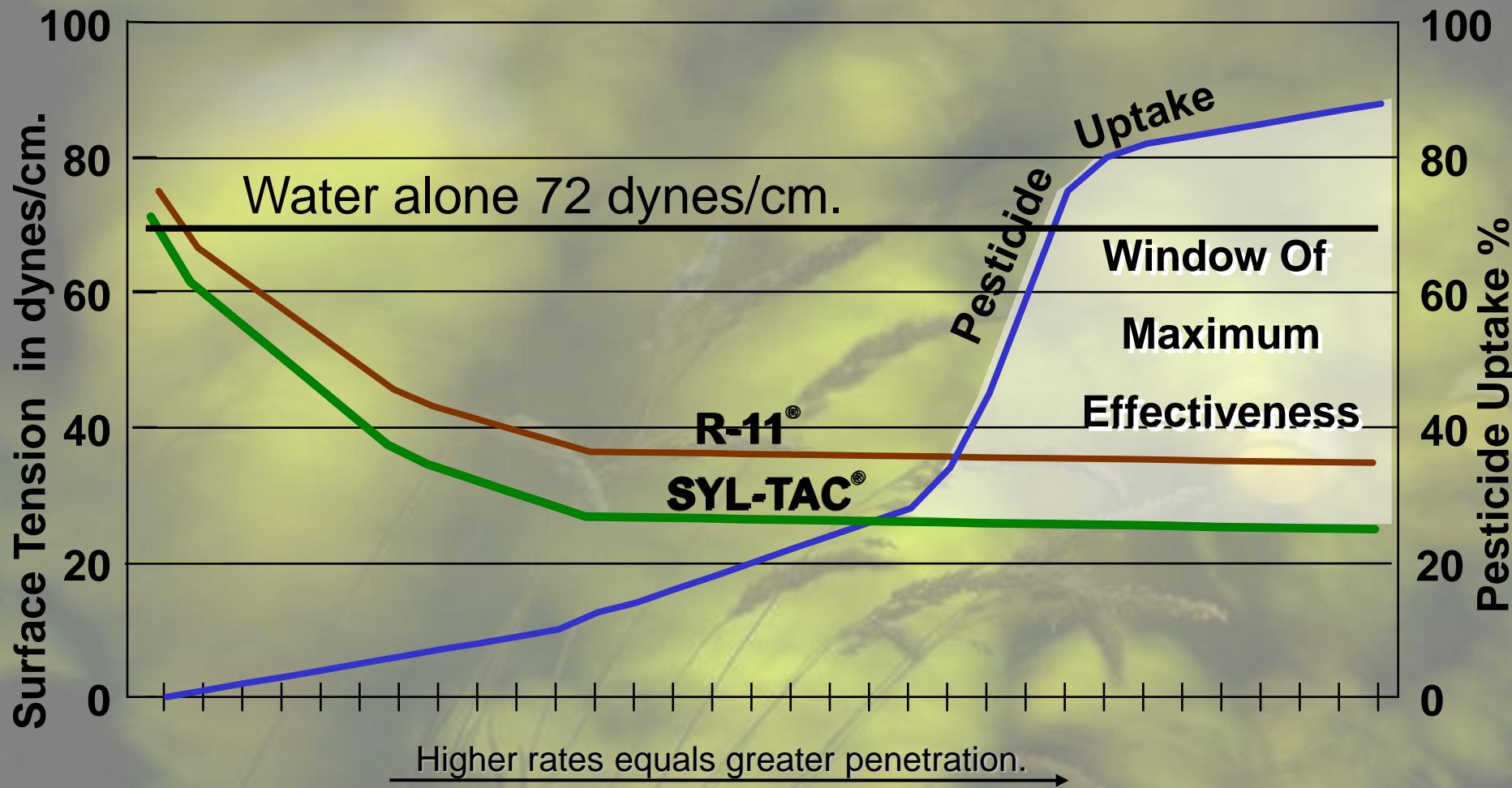


Water without surfactant



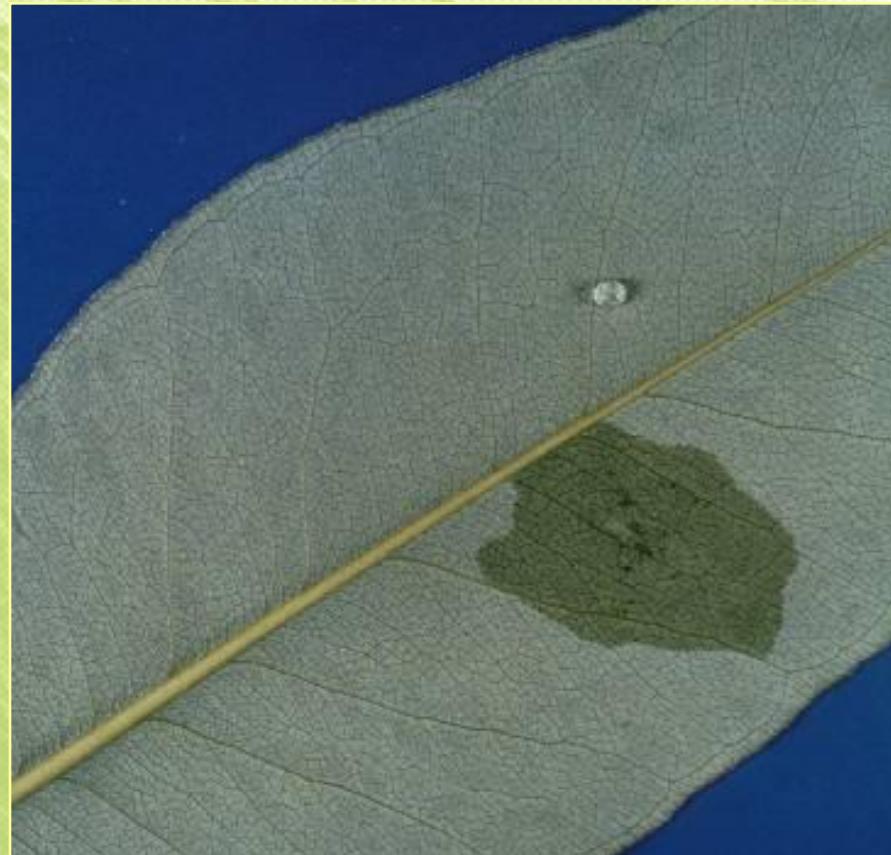
Water with surfactant

Surface tension and pesticide uptake vs. surfactant rate



Surfactant Effects

- **Surfactant reduces surface tension to 20-40 dynes/cm.**
- **Droplets spread over leaf, penetrate hairy surface**
- **Broader leaf contact**
- **Increased spray activity**

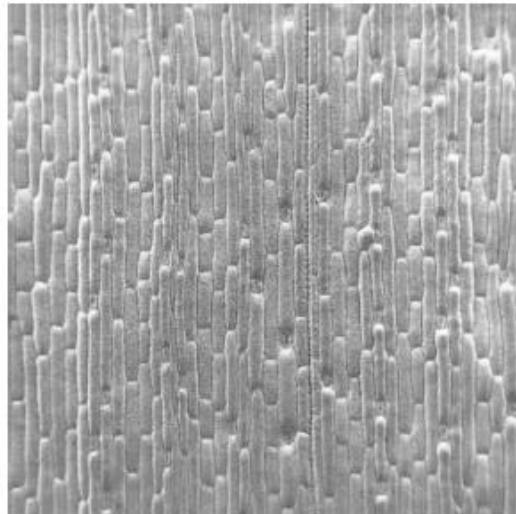


Surfactants

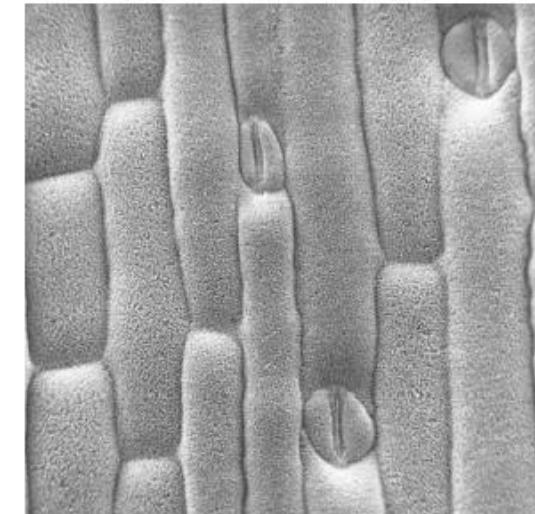
For post-emergence herbicide enhancement

- **Surfactant works to increase the amount of herbicide reaching the targeted site of action:**
 - Wax barrier of leaf surface
 - Cuticle

Scanning electron microscope – 70X



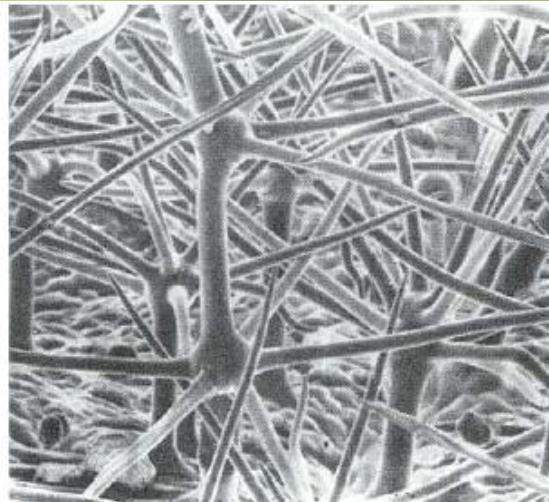
Scanning electron microscope – 350X



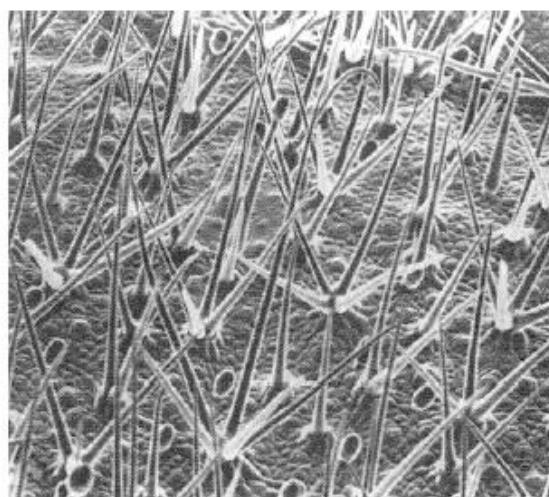
Surfactants

For post-emergence herbicide enhancement

- Plant protective mechanisms must be overcome:
 - Cuticle hairs
 - Leaf angles



Trichomes (hairs) on common mullein



Trichomes (hairs) on velvetleaf

Surfactants are specific

- **Pesticide specific - work well with some pesticides but not all.**

- *Example: Nonionic surfactants work well with glyphosate, while petroleum oil-based surfactants inhibit glyphosate performance.*

- **Weed specific - work with some weeds but not all.**

- *Example: Oil based surfactants are generally more effective for annual grasses or weeds that have waxy cuticles.*

- **Environment specific - soil moisture, temperature, humidity.**

- *Examples: NIS provide better crop tolerance during high humidity than OBS. MSO-based surfactants provide better control during very dry conditions than COC.*

Surfactant types

ANIONIC - surfactant that has a negative (-) charge and limited compatibility. Cayuse® Plus, Bronc™ Plus

CATIONIC - surfactant that has a positive (+) charge and limited compatibility.

NONIONIC - surfactant that has no electrical charge and is generally compatible with all pesticides. Hasten®, SS 7000, R-11®

NIS Spreader-Activator

Common Properties

- quick spreading
- uniform coverage
- Increased absorption and coverage
- high active ingredient level (90%)
- nonionic, for greatest compatibility
- low-foaming (with defoamer included)

...usually add last, after pesticides are mixed...

Organosilicone Surfactant

Common Properties

- reduces surface tension
- quickens spreading
- speeds pesticide uptake
- provides rainfastness/improves control
- low rates and concentrations
- enhances post-emergence herbicide control of even tough, mature weeds

Penetrants

Definition

- A penetrant is a material that enhances the ability of a pesticide to enter a substrate or penetrate a surface. Penetrants, such as crop oil concentrates, are typically used with herbicides to help enter waxy leaves or woody plant tissue.

Crop Oil Concentrate

Common Properties

- blend of paraffinic and phytobland crop oil
- works with oil-water emulsifiable mixes
- increased spray retention on plant surface
- wetting and dispersing surfactant properties
- suitable for low-volume applications
- “CAUTION” label

Modified Vegetable Oil/MSO/ESO

Common Properties

- 100% esterified vegetable oil and surfactant blend
- Canola or soy oil reacted with ethanol or methanol
- Excellent wetting and penetration
- Aids in transporting herbicide through the waxy plant cuticle
- Stable emulsion
- “CAUTION” label

Combination Silicone/ESO Blend

Common Properties

- Blend of modified canola seed oil and a silicone surfactant designed for spray materials requiring nonionic surfactant, COC, or modified vegetable oil.
- Combines spreading properties of organosilicone with penetrating activity of ESO/MSO into one surfactant.
- Wide range of uses

Acidifier-Buffer

Definition

- Acidifier – a material that can be added to spray mixtures to lower the pH.
- Buffer – a material that, when contained in solution, causes the solution to resist change in pH. Each buffer has a characteristic limited pH range over which it is effective.

Acidifying & Buffering Agent

Common Properties

- reduces pH of alkaline water
- reduces chemical degradation of some pesticides
- not a corrosive mineral acid
- does not contain heavy metals
- “CAUTION” label

...always add before pesticides are mixed...

TRI-FOL acidifying & buffering agent

Use rates

For water with **less** than 500 PPM alkalinity:

- 8 to 16 ounces per 100 gallons of spray solution.

For water with **greater** than 500 PPM alkalinity:

- 16 to 32 ounces per 100 gallons of spray solution.

TRI-FOL acidifying & buffering agent



A Wilbur-Ellis test kit is a simple way to determine the rate of TRI-FOL or Super Spread 7000 to adjust the spray pH.

Water-conditioning agent

Definition

- A material that reduces or eliminates the antagonism between a pesticide formulation and ions present in the water that is utilized in a pesticide application.
- Cayuse Plus = AMS + nonionic surfactant
- Bronc Max = liquid ammonium sulfate
- Bronc Plus Dry EDT = AMS + nonionic surfactant + deposition agent

Drift

Spray drift is the movement of a pesticide away from the target area. This can cause the product to hit non-target sites, often resulting in expensive legal action and insurance claims. These non-target sites include:



Neighboring crops



Gardens



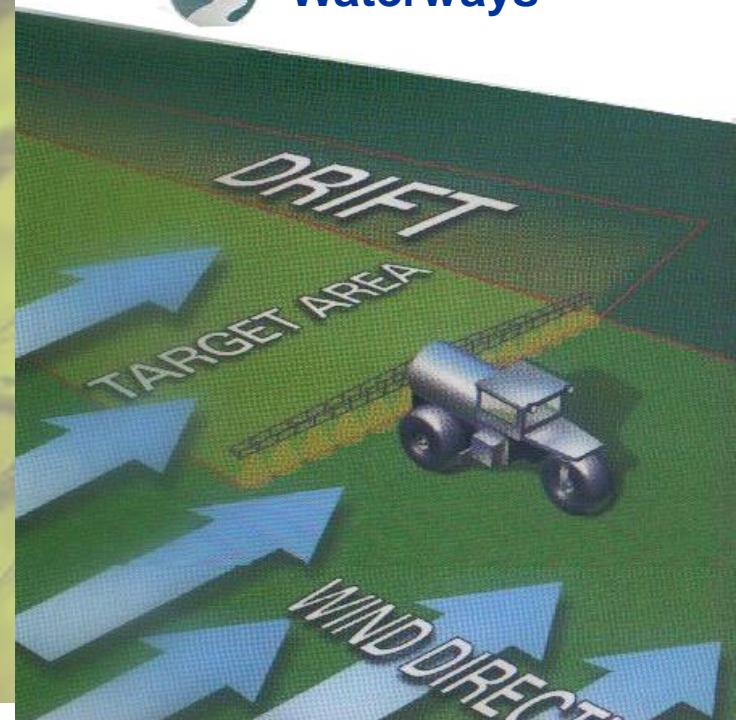
Lawns



Ornamentals



Waterways



Factors affecting spray drift

Factors affecting spray drift include:

- Droplet size
- Boom height
- Wind speed and direction
- Air temperature and temperature inversions



Factors affecting spray drift

1 micron = 1/25,000 inch

Toothbrush bristle = 300 microns

Human hair = 100 microns



The main contributing factor

to spray drift problems are fine spray droplets (100 microns or less in size) called “fines”.

Factors affecting spray drift

Another way of looking at the relative micron droplet sizes is to compare various types of precipitation ranges from only 20 microns for fog to 1,000 microns for heavy rain. Notice that the smaller the droplet, the greater the drift.

Droplet Diameter in microns	Type of Droplet	Droplets per sq. Inch	*Drift Distance in ft. for 10 ft. fall
20	Wet Fog	144,000	1,109 ft.
100	Misty Rain	1,150	45 ft.
200	Light Rain	144	15 ft.
1000	Heavy Rain	1	5 ft.

*Drift distance based on 3 mph wind, not including evaporation, and was applied by air.

Drift Retardants

- A drift retardant, or drift control agent, is a material used in liquid spray mixtures to reduce spray drift.
- Polymers increase droplet size, which decreases the distance the larger droplet travels.
- Invert emulsion suspensions create smaller, uniform droplets to increase deposition and decrease drift.

Conventional - thickeners/polymers

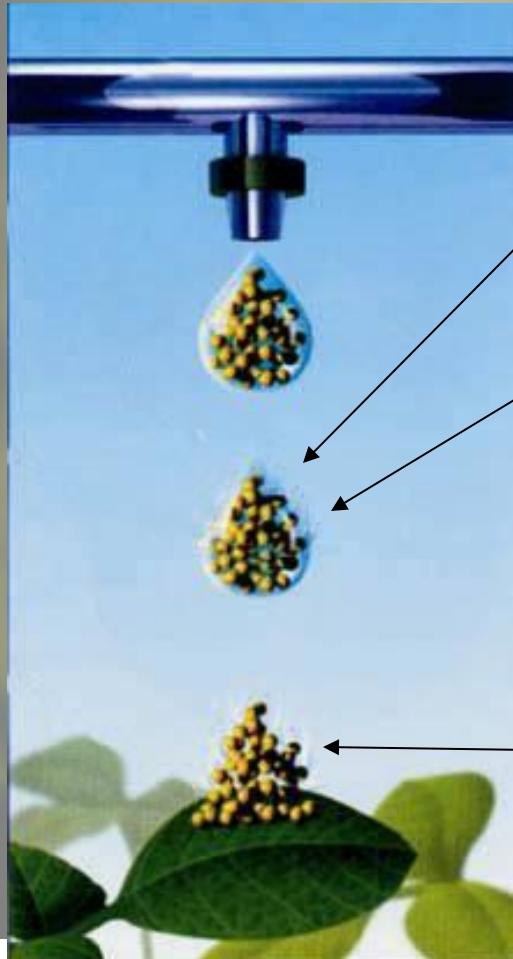
- **Polymers work by thickening the spray solution, forming very large droplets that can reduce spray coverage.**
- **Thickeners only treat the water.**
- **Thickening the spray solution constricts the spray pattern, causing streaks.**
- **The effectiveness of thickeners is reduced by pump shear.**

In-Place invert emulsion

- In-Place produces uniform positively-charged capsules that stick to the negatively-charged plants and soil.
- In-Place treats the chemical – not the water – and does not affect droplet size.
- In-Place minimizes drift and helps keep equipment cleaner.
- The effectiveness is not decreased by pump shear.

Application comparison with In-Place

IN-PLACE



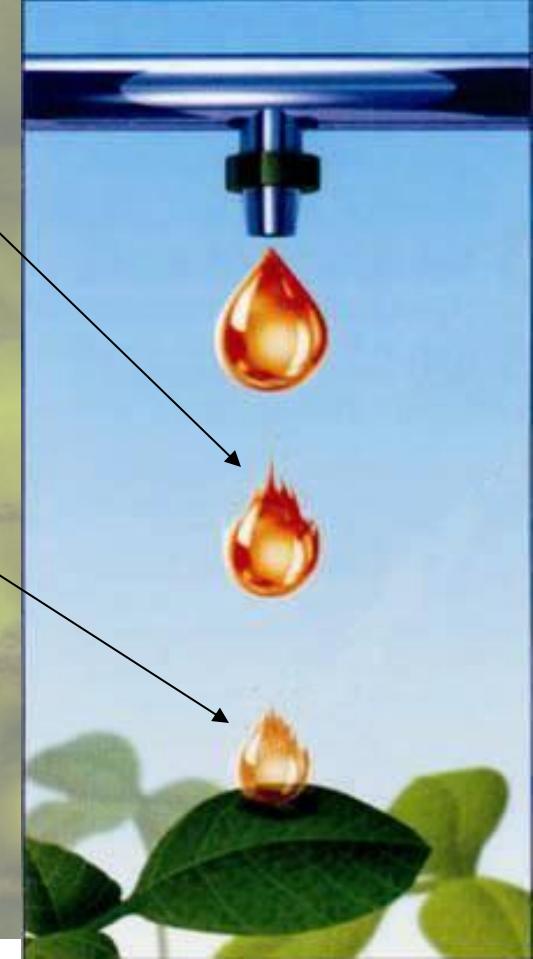
Filler water
evaporates

Capsules
containing active
ingredient do not

Loss of active
ingredient with
water

More Active
Ingredient hits the
target

CONVENTIONAL





**In-Place encapsulation
of Treflan in water**



Treflan plus water

Spray drift management

Effective spray drift management may be accomplished by:

- Using a drift control agent**
- Managing droplet size with equipment.**
- Using good judgment**

Adjuvants - Summary

Adjuvants are materials added to a spray mixture to aid or modify the action of an agrichemical, or to alter the physical characteristics of the mixture.

Adjuvants are tools that can improve or ensure the efficacy of a spray program. The proper tool for the job will help deliver the desired result.

Adjuvants - Inhibiting factors:

- waxy cuticle
- leaf hairs
- leaf position
- plant maturity
- spray pH
- environmental conditions
- dust
- rainfall



Adjuvants - Inhibiting factors:

- waxy cuticle
- leaf hairs
- leaf position
- plant maturity
- spray pH
- environmental conditions
- dust
- rainfall



Adjuvant Rate Examples

Brand names used for illustration purposes

- **R-11®** - 6 to 48 oz/100 gallons. Aquatic – 64 oz/100 gallons.
- **Super Spread 7000** – 1 to 4 pints/100 gallons.
- **Mor-Act® Adjuvant** – 1 to 2 qt/100 gal. L.V. – 1 to 4 pt/acre.
- **R-56® Spreader-Sticker** – 1 to 3 pt/100 gallons.
- **In-Place®** - varies by pesticide formulation.
- **No Foam** – 1 to 2 oz/100 gallons.
- **SylCoat®** – 1 to 3 pt/100 gallons. (4-16 oz/100 adequate)
- **Hasten®** - 1 to 4 pt/acre.
- **SYL-TAC** – 1 to 3 pt/100 gal. Backpack – 1 to 3 tsp/gal.
- **Competitor** – 2 to 4 pt/100 gallons.
- **Bronc Plus Dry EDT** – 10 to 20 lbs/100 gallons.

Thank you



For your attention!