



SURFACTANTS 101

JOEL FIELDS

WILBUR-ELLIS COMPANY

Adjuvant

- **An adjuvant is any additive used in conjunction with a pesticide to increase biological activity and/or to modify various physical properties of the spray solution.**

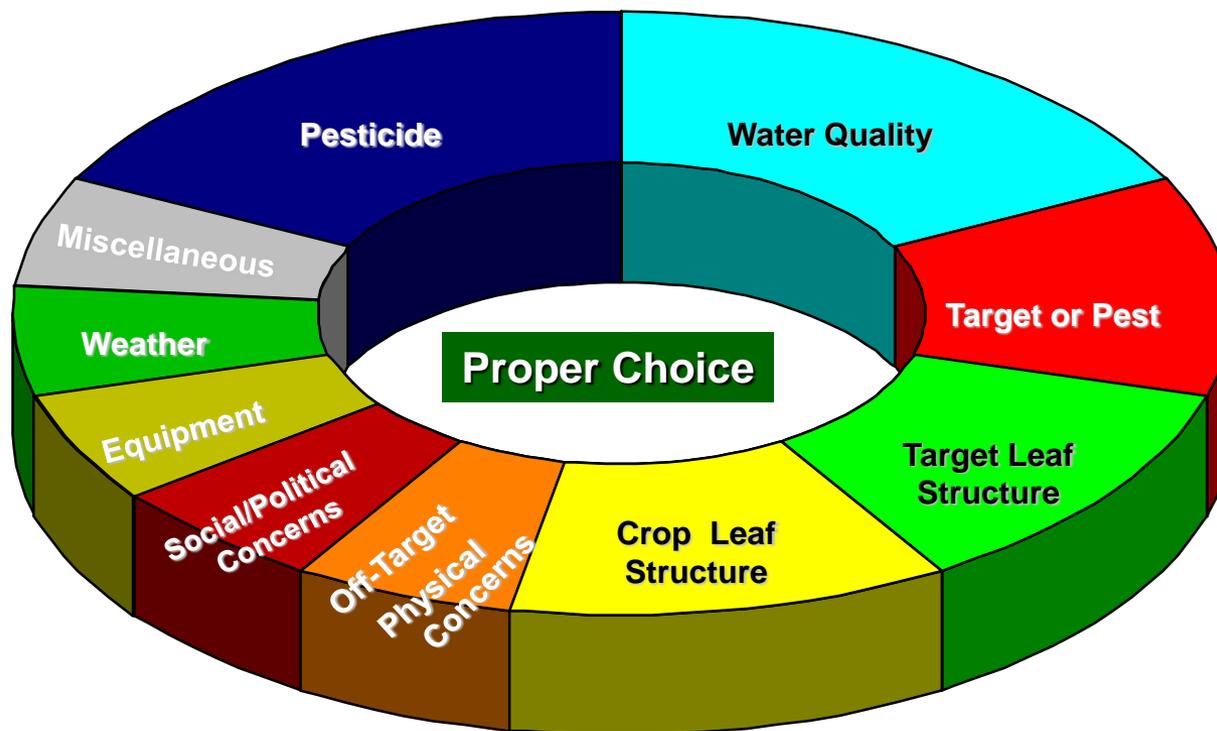
ASTM Definition

Importance of Adjuvants

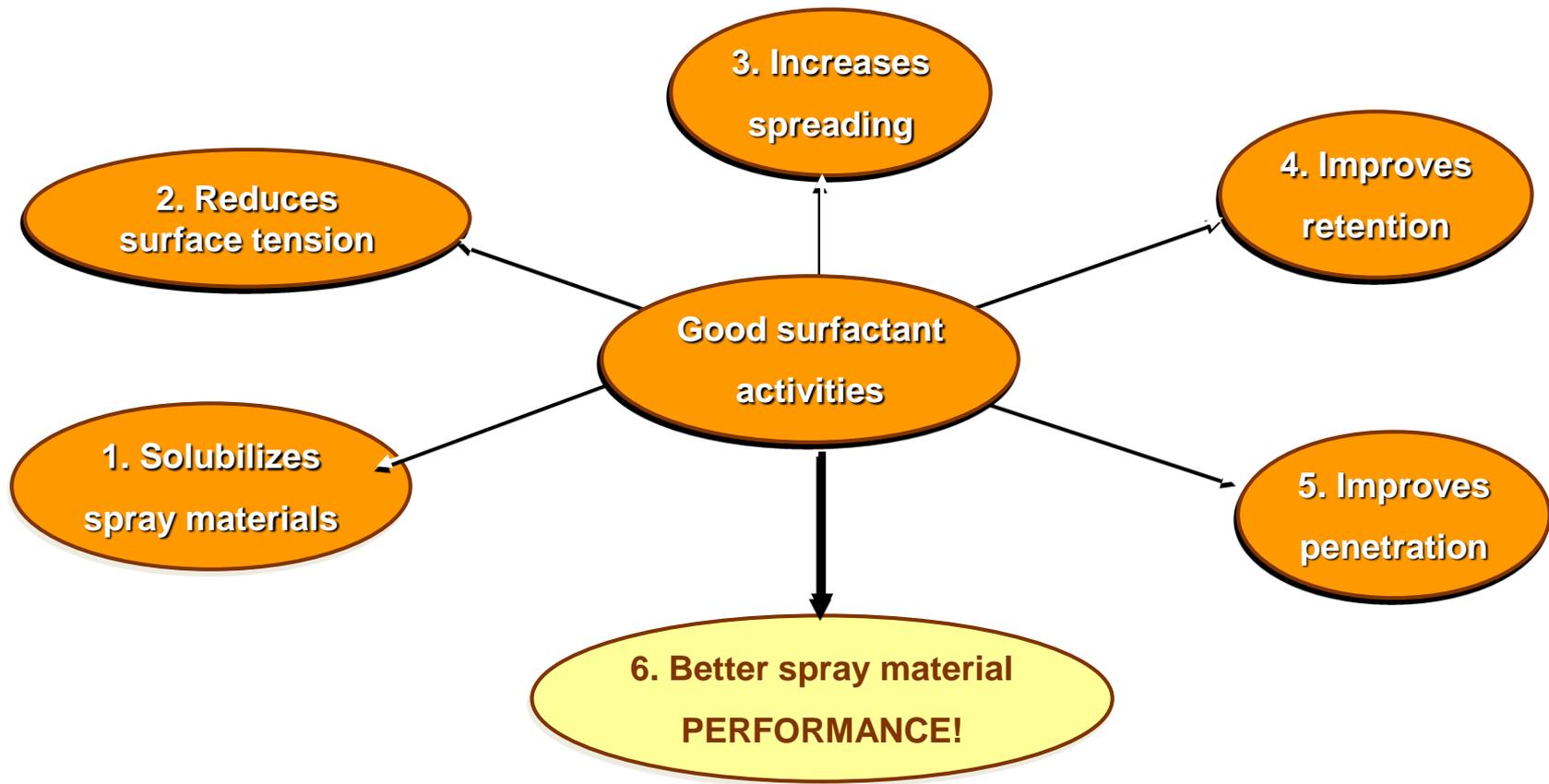
- **Pesticide Stability**
- **Solubility**
- **Compatibility**
- **Foaming**
- **Suspension**
- **Surface Tension**
- **Droplet Size**
- **Drift**
- **Volatilization**
- **Coverage**
- **Adherence**
- **Penetration**

Adjuvant Selection Factors

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

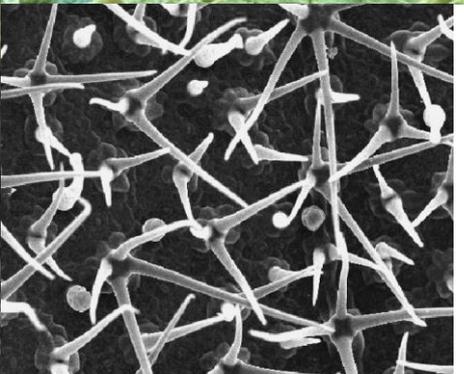
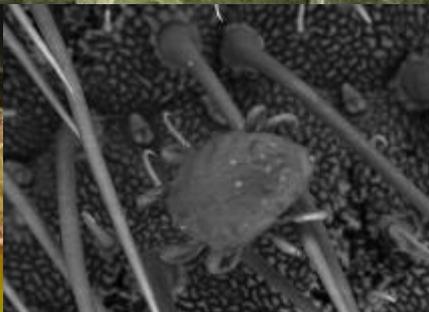
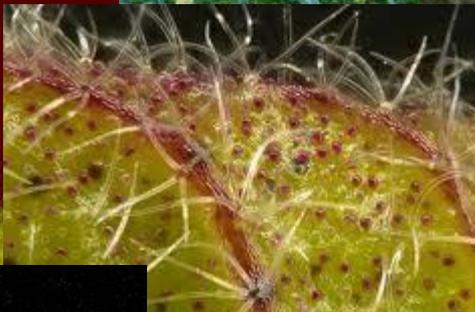
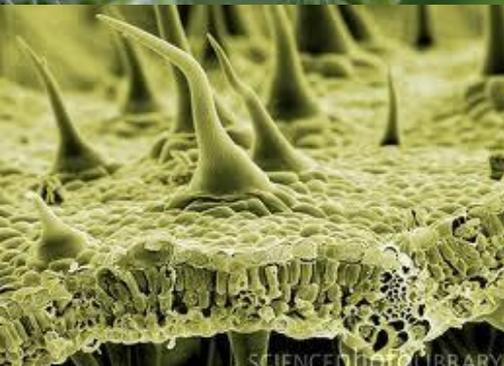
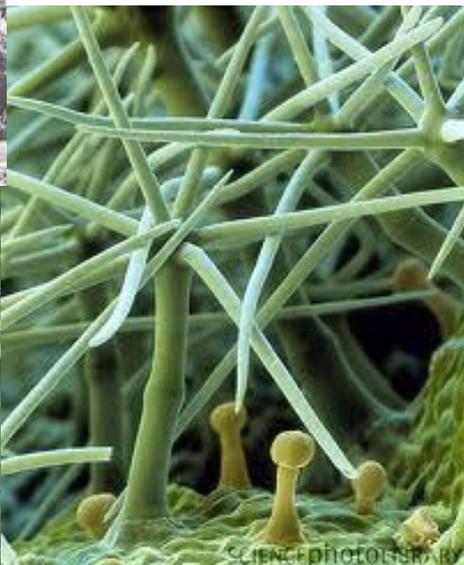


Functions of a High Quality Surfactant

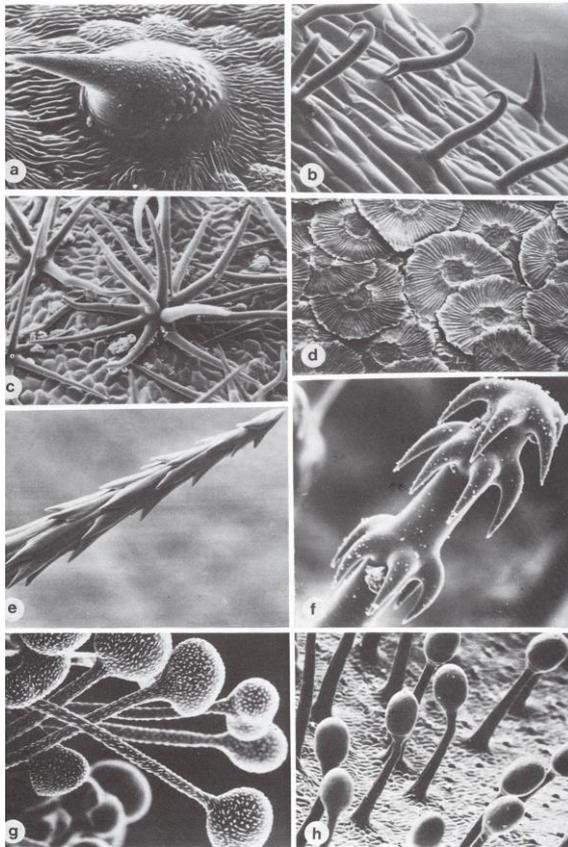




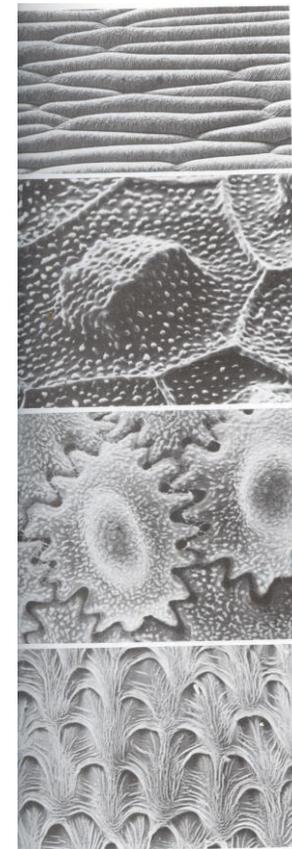
WILBUR-ELLIS®



Leaf Surfaces



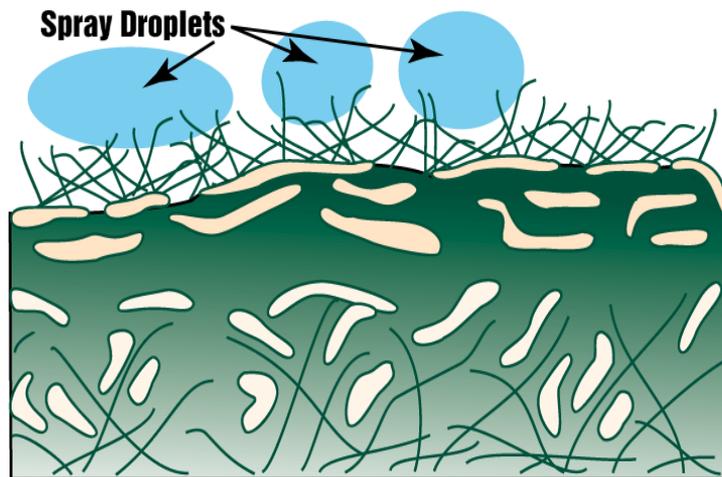
Surface of leaves



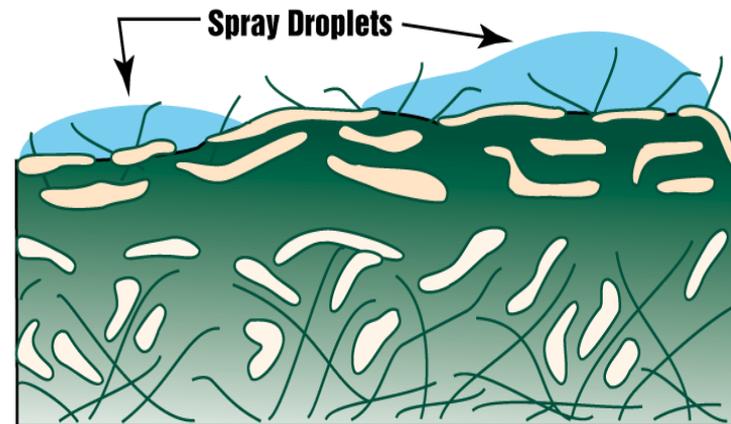
Waxy layers

PESTICIDES - BARRIERS OF ENTRY

Leaf hairs (pubescence)



Dense pubescence prevents wetting



Sparse pubescence may increase wetting.

Surface Tension

-
- **Surface tension is the force of adjacent molecules in solution. This force is measured in dynes/cm. Water has a value of 74 while typical surfactants will have a value of 30-50 dynes/cm. Organosilicone surfactants will be <25 dynes/cm.**



Droplet Without Surfactant



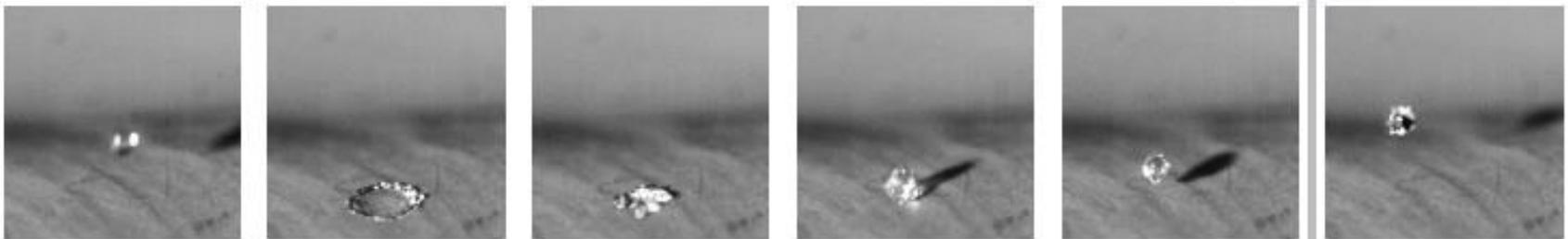
- Surface tension of water is ~72 dynes/cm.
- Droplets sit on leaf hairs or leaf surface
- Little leaf contact
- Reduced spray activity

Surface Tension

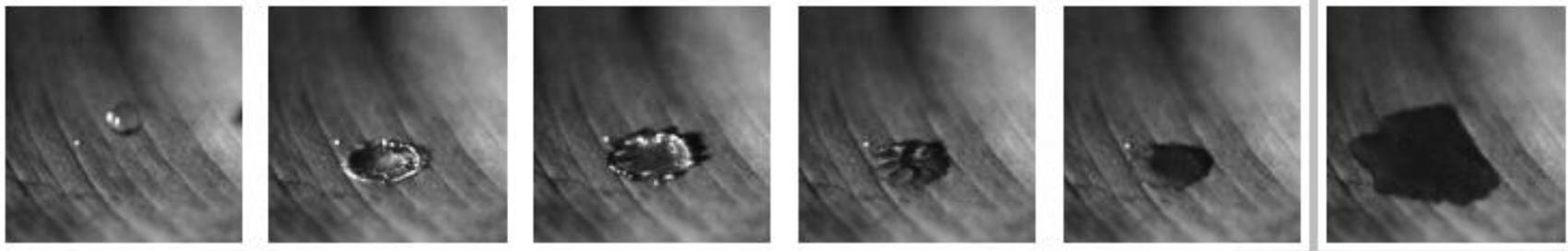


ADHESION AND RETENTION - SPREADING AND WETTING

Water droplet without surfactant

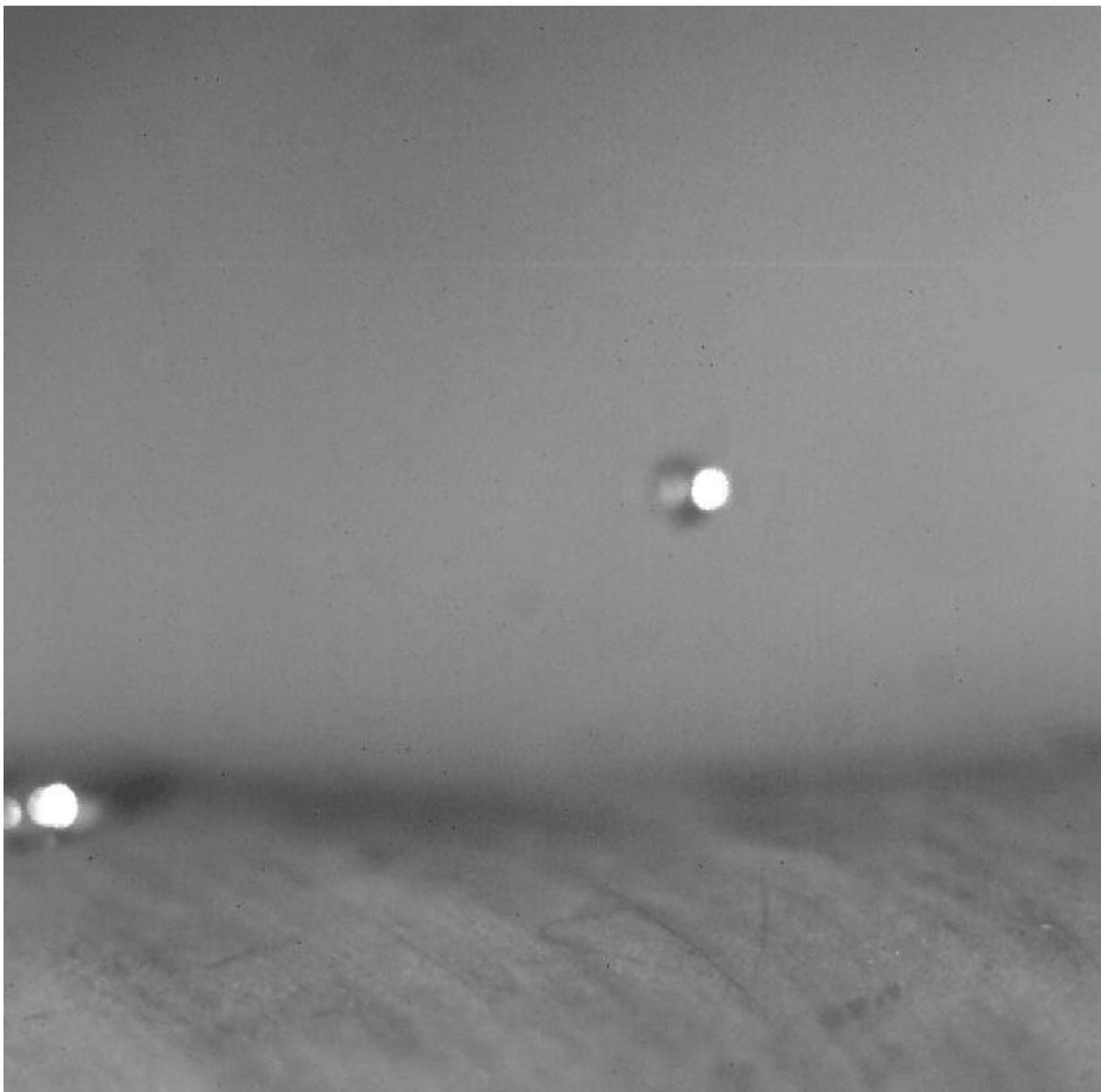


Water droplet with surfactant



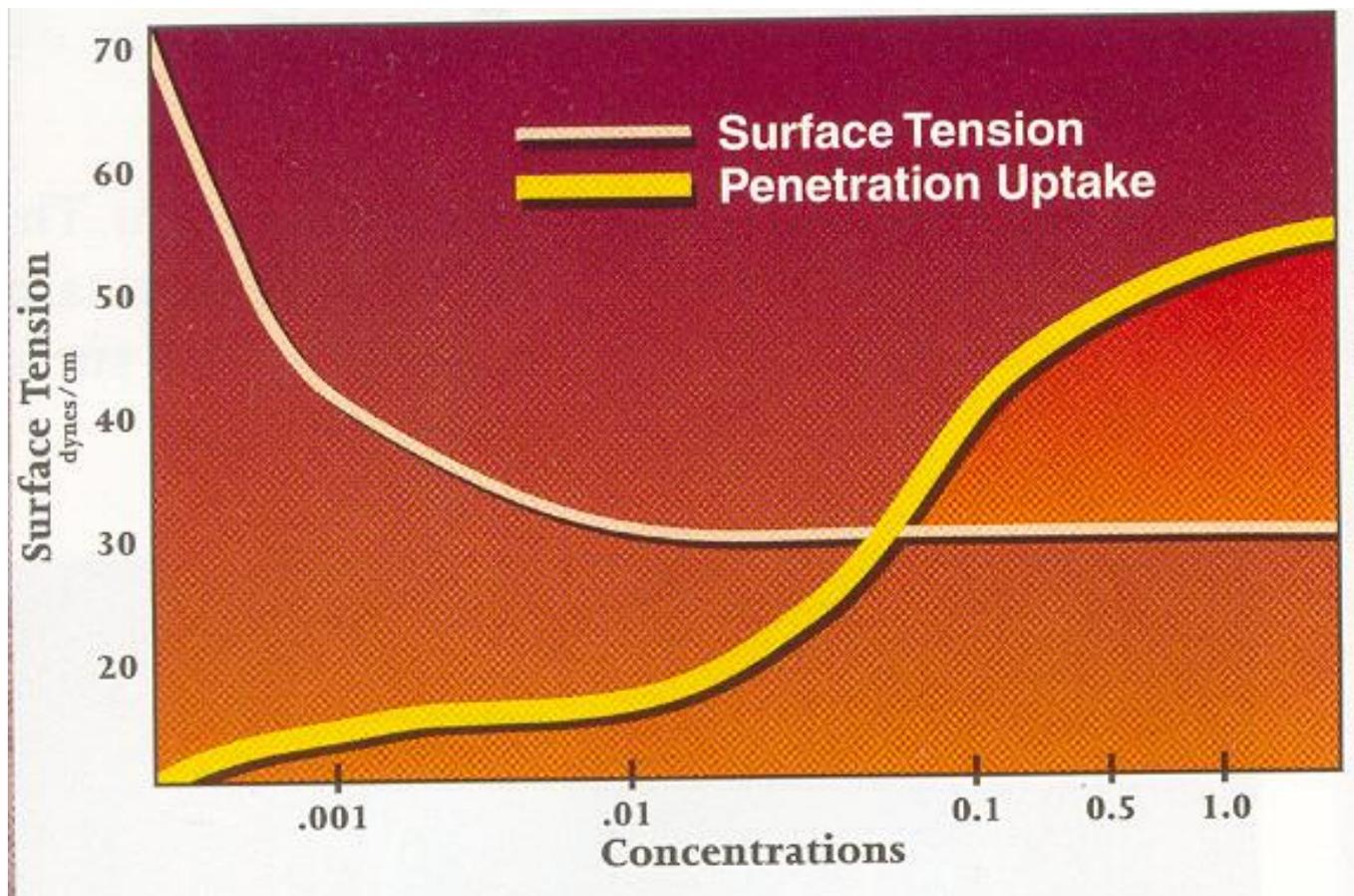


WILBUR-ELLIS®



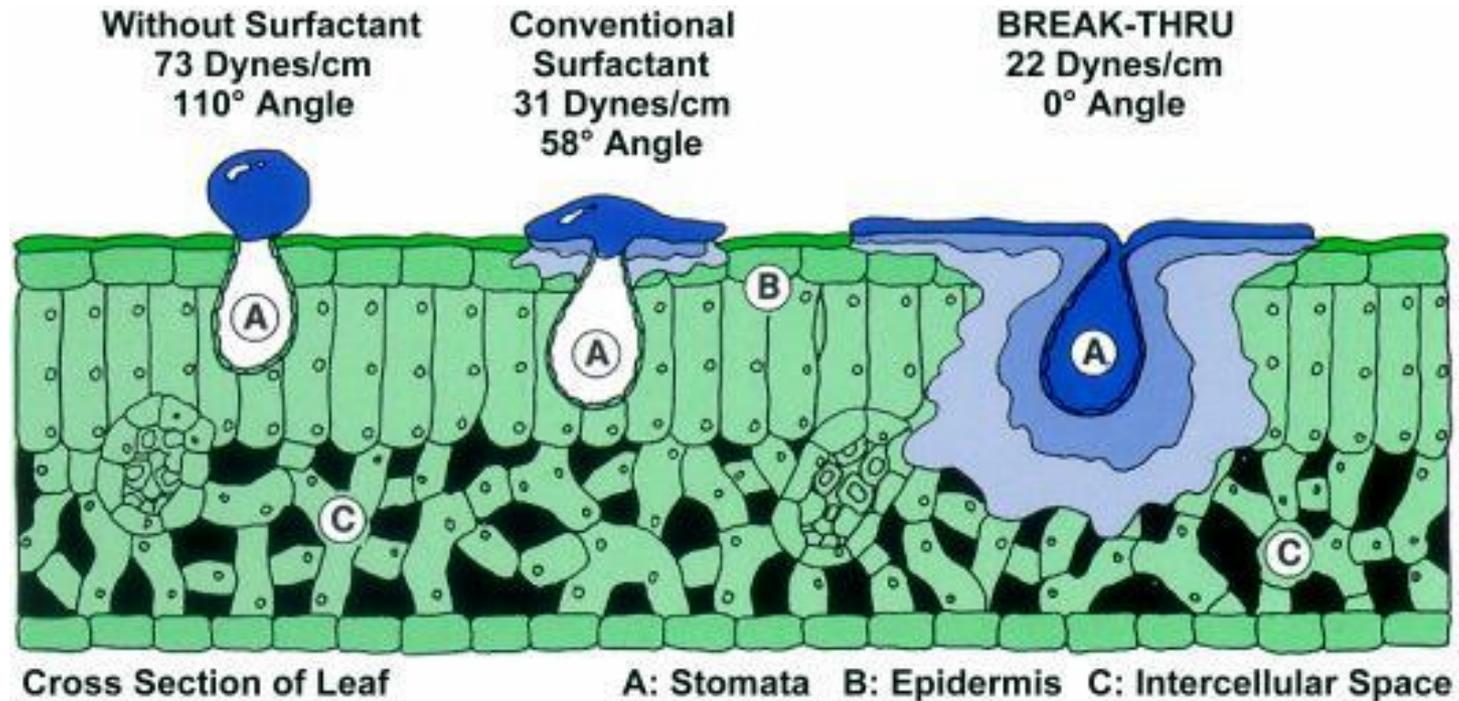


Surface tension and pesticide uptake vs. surfactant rate



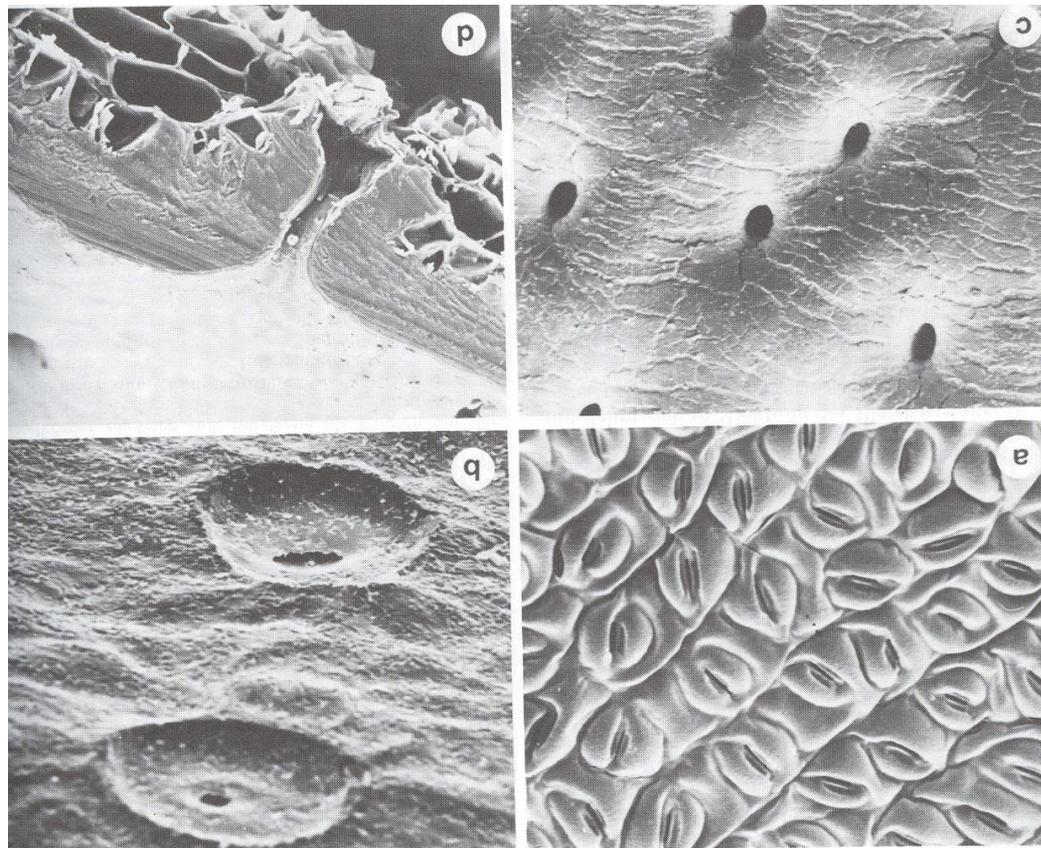
Pesticide Uptake

STOMATAL INFILTRATION/FLOODING





Leaf Surfaces



Stomata



Water Only vs. Sylgard® 309 at 8 oz/100 gal

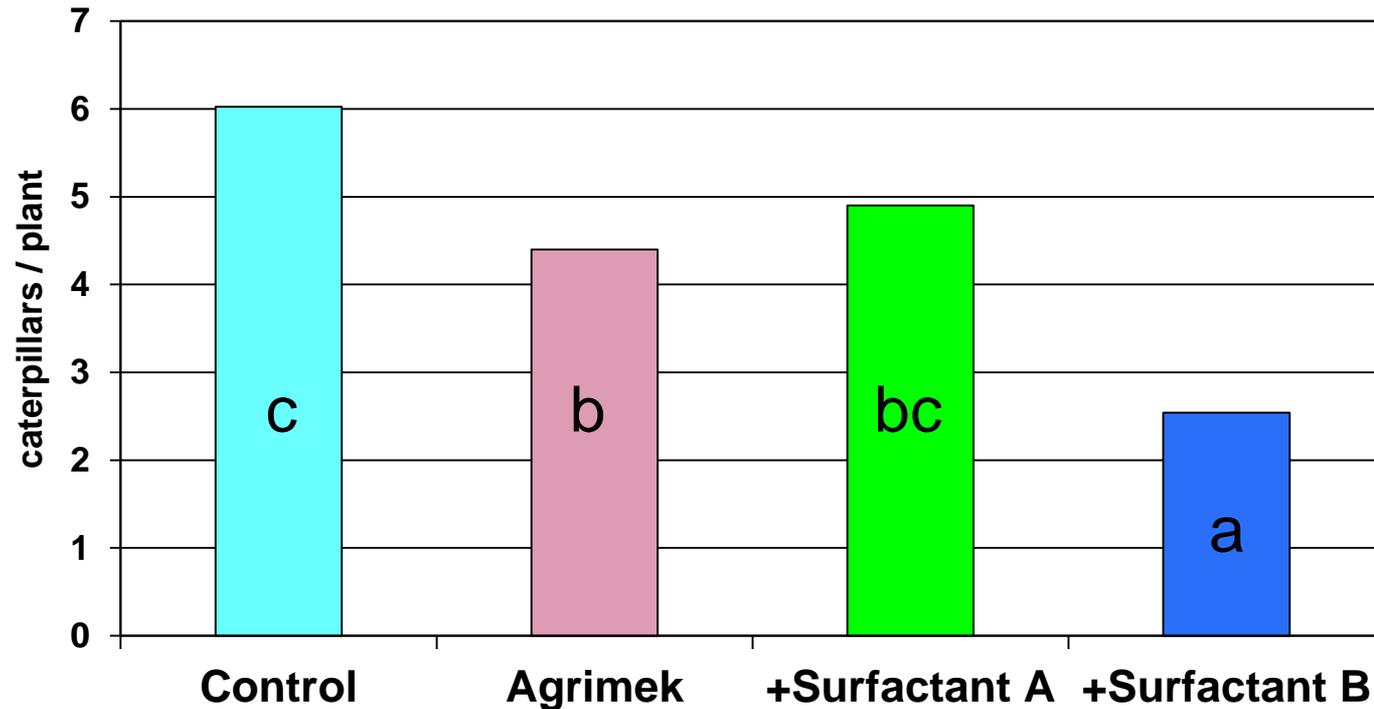
Note runoff and virtually no retention of water on leaf surface



Note complete cover of leaf surface and excellent retention

Benefits of Surfactants

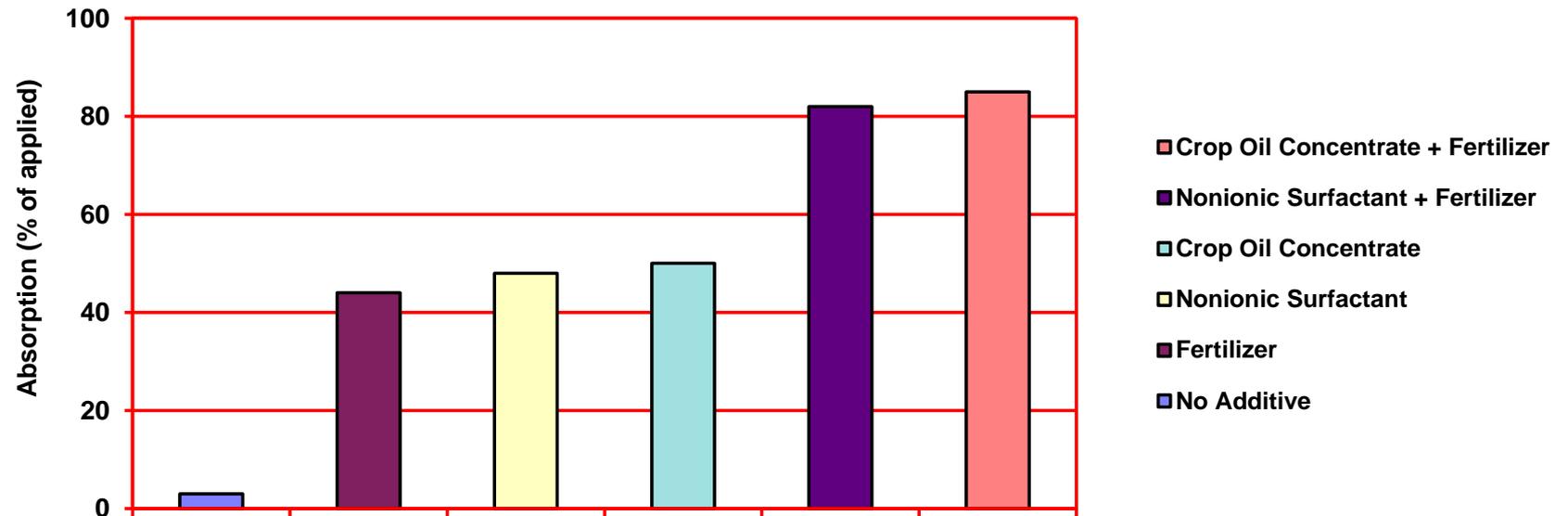
ALL SURFACTANTS ARE NOT CREATED EQUAL



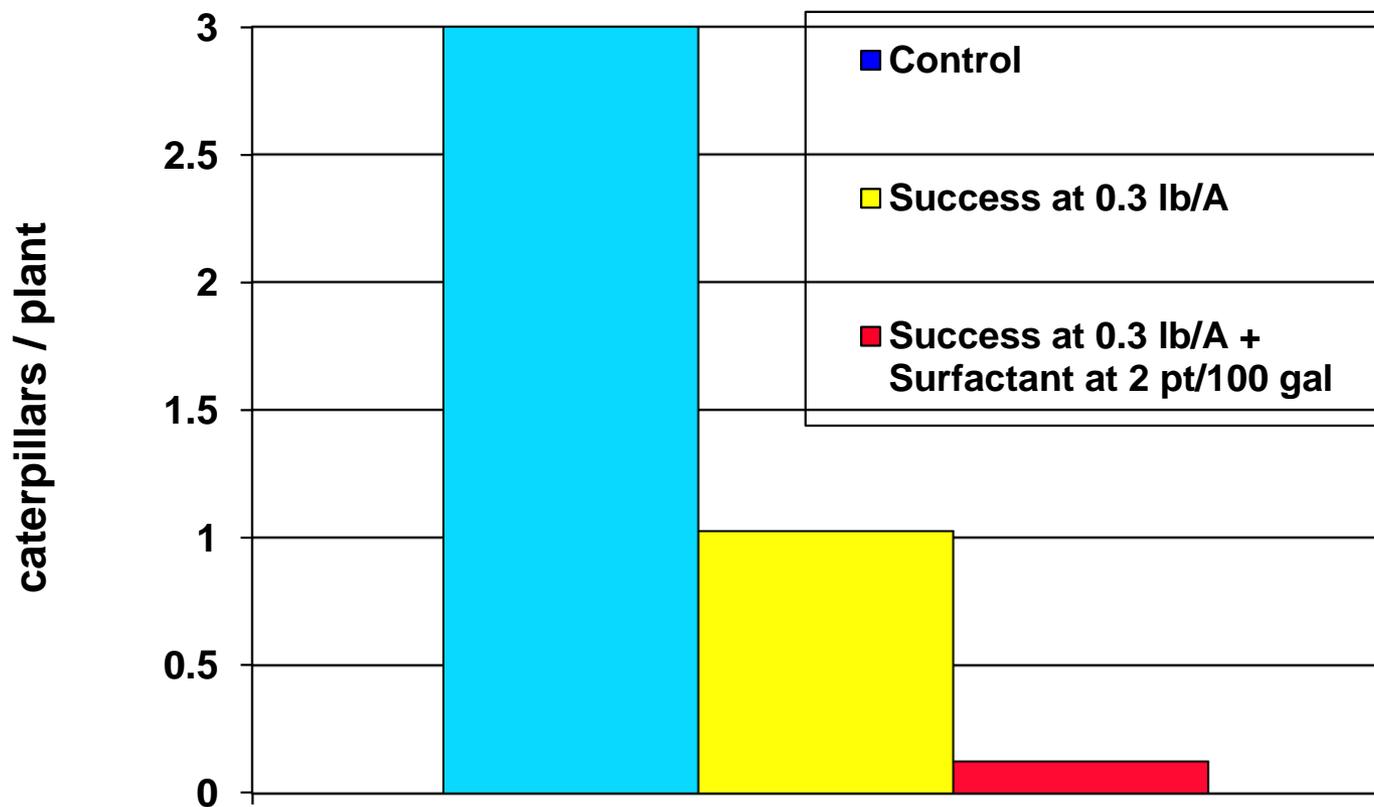
LEAFMINER CONTROL ON LETTUCE

HERBICIDES + ADJUVANTS

FOLIAR ABSORPTION OF IMAZETHAPYR



INSECTICIDES + SURFACTANTS



DIAMONDBACK CATERPILLARS ON BROCCOLI



SURFACTANT ENHANCEMENT OF INSECTICIDES



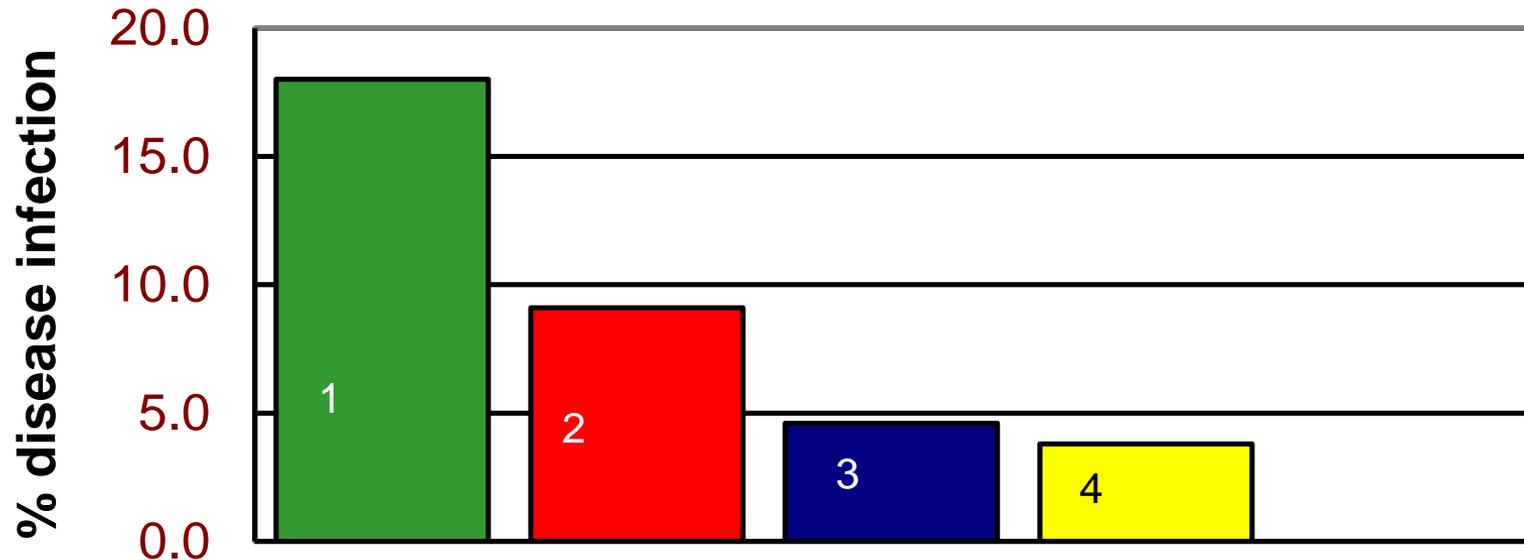
without surfactant



with surfactant

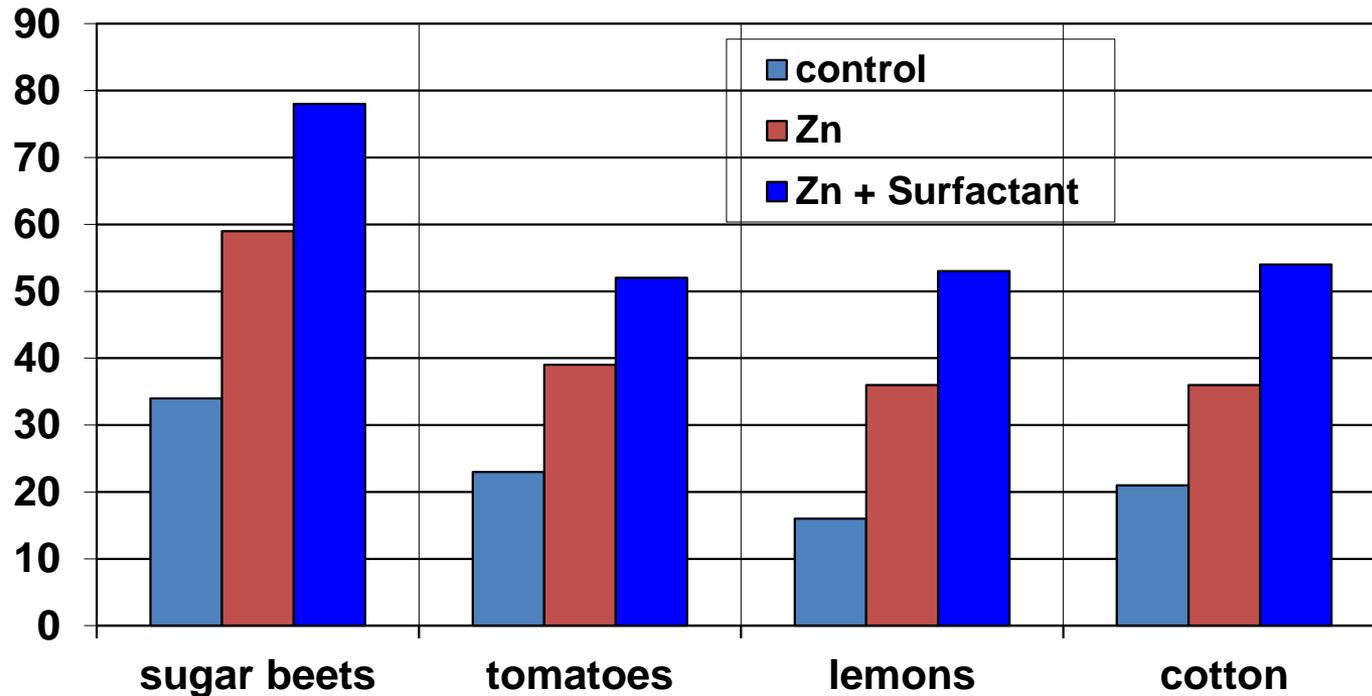
FUNGICIDES + SURFACTANTS

1. Control
2. Captan
3. Captan + Surfactant at 1 pt/100 gal
4. Captan + Surfactant at 2 pt/100 gal



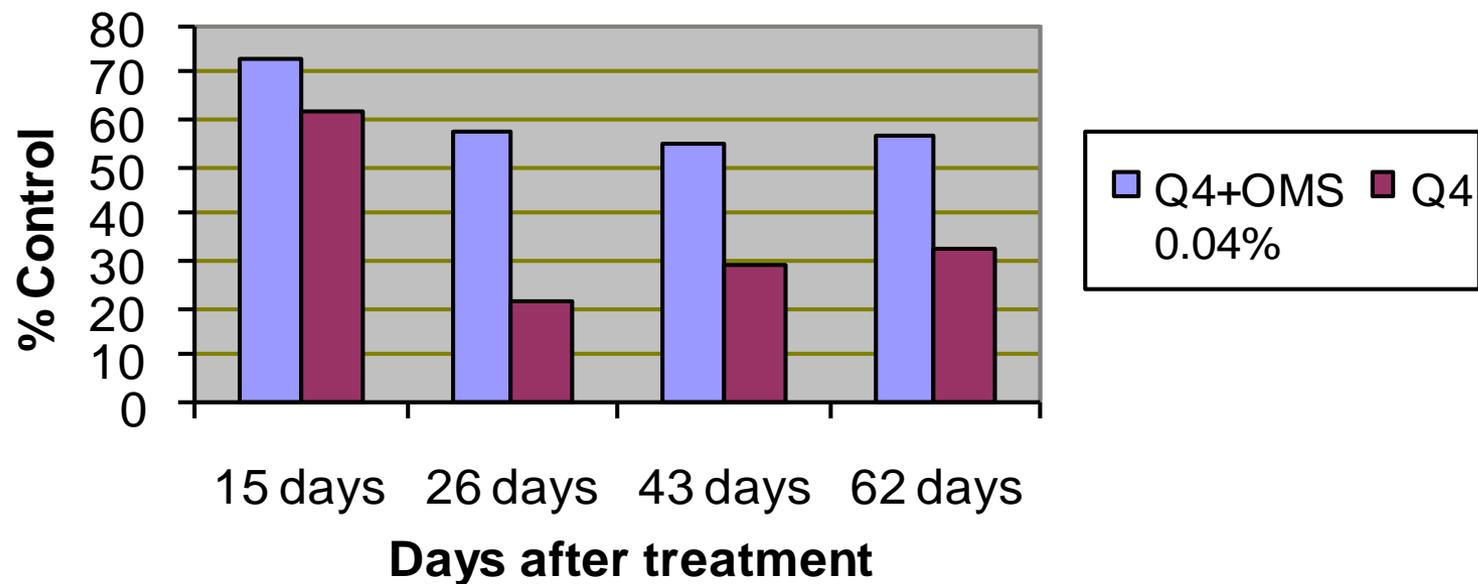
APPLE SCAB CONTROL

FERTILIZERS + SURFACTANTS



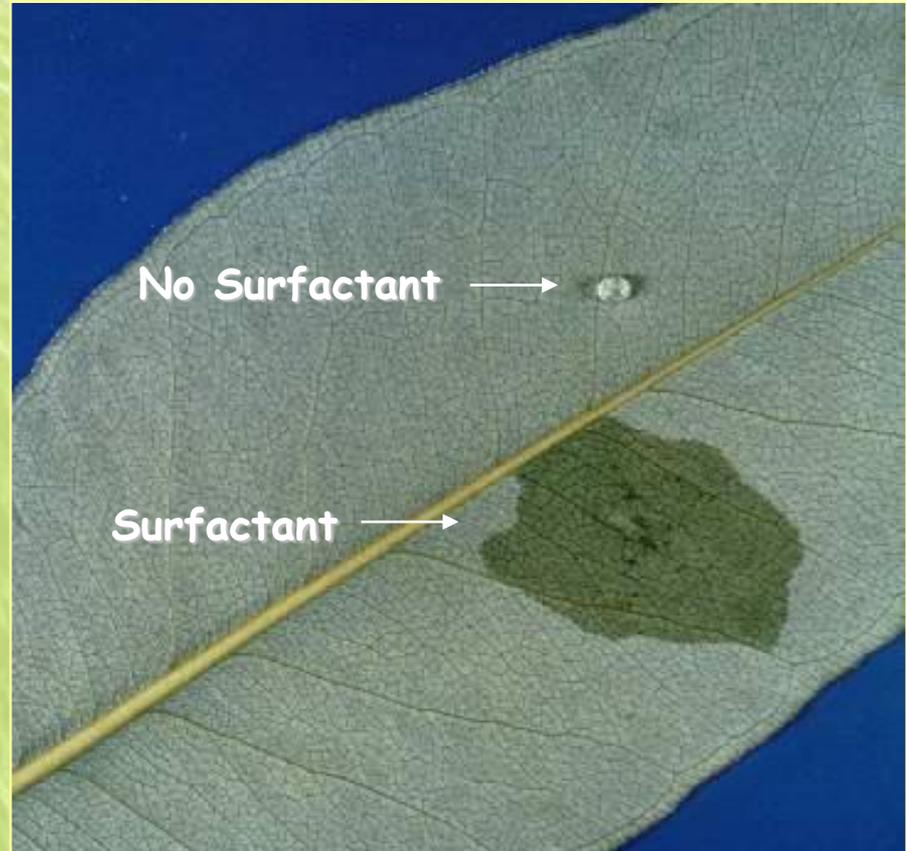
PERCENT INCREASE IN UPTAKE OF ZINC

Large crabgrass control with PBI/Gordon Q4 herbicide +/- organosilicone surfactant



Surfactant Summary

- Surfactant reduces surface tension to <20-50 dynes/cm.
- Droplets spread over leaf, penetrate surface
- Broader leaf contact
- Increased spray activity



Product Portfolio





Spreader-Activator



Spreader-Activator

Properties

- **Quick spreading**
- **Uniform coverage**
- **Increased absorption and coverage**
- **High active ingredient level (90%)**
- **Nonionic for greatest compatibility**
- **Low-foaming (with defoamer included).**

Note: Usually add last, after pesticides are mixed.



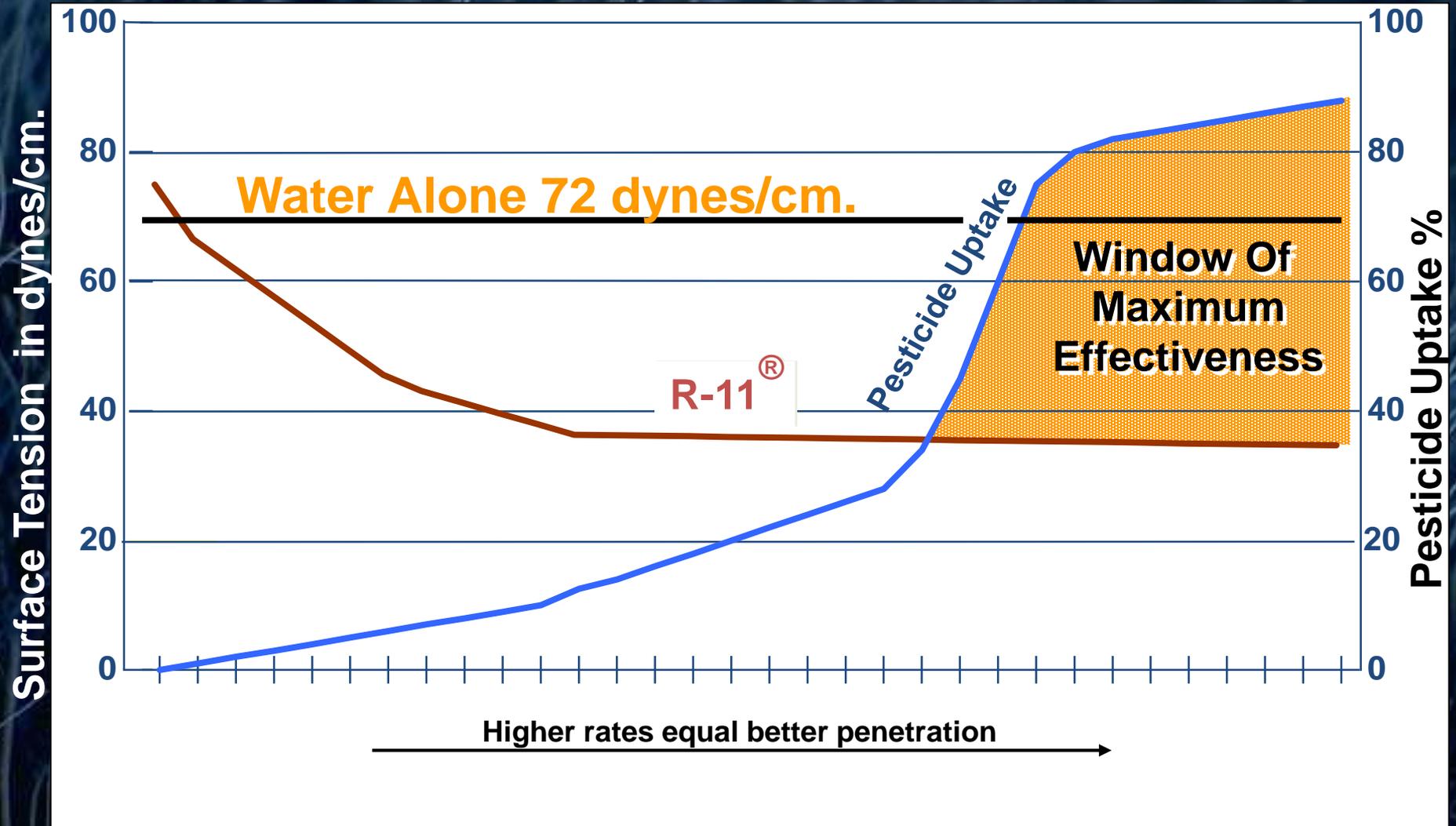
Spreader-Activator



R-11[®] is the standard NIS used at Oregon State University, University of Idaho, and North Dakota State University.



Surface Tension and Pesticide Uptake vs. Surfactant Rate



- **Defoliants, Desiccants and Herbicides**
- **Acaricides, Insecticides and Fungicides**
- **Plant Growth Regulator**
- **Approved for aquatic use**
- **Vegetation Management**



– **Ask your local Wilbur-Ellis Representative for more information.**



Penetrator-Activator

R-900[®]

Penetrator-Activator

Properties

- Quick spreading
- Uniform coverage
- Superior penetration into leaf
- 90% active
- Nonionic
- Low foaming
- Effective with both contact and selective herbicides
- Excellent for use on tough perennial weeds

Note: Always add last, after pesticides are mixed.



R-900[®]

Penetrator-Activator



FEATURES	BENEFITS
90% active ingredient (non-ionic)	Uniform coverage Quick spreading
Contains ethoxylated and linear alcohols	Superior leaf penetration Low foaming
Formulated for increased plant foliage penetration	Can be used with contact and systemic herbicides

R-900[®] USES

- Defoliants, Desiccants and Herbicides
- Vegetation Management
 - Ask your local Wilbur-Ellis Representative for more information.



ALWAYS READ THE LABEL FOR COMPLETE USE INSTRUCTIONS

*Not registered in California



FEATURES	BENEFITS
100% active ingredient (non-ionic)	Enhanced efficacy of pesticides over silicone / NIS blends
Excellent surface tension reduction	Better coverage at reduced rates
Improved rain-fastness at higher rates	Reduce spray material wash-off by increasing penetration
Quicker uptake by the plant	More consistent weed control



WILBUR-ELLIS®



Syl-Tac®

Features & Benefits

- Organosilicone / Vegetable oil
 - Sylgard® 309 + Hasten®
- Spreading, Wetting, Penetration
- Humectant properties
- Low Use Rates
- Crop Safe



Uses

- **Defoliants, Desiccants, Herbicides**
- **Miticides, Insecticides, Fungicides**
- **Plant Growth Regulators**
- **4 oz./A**

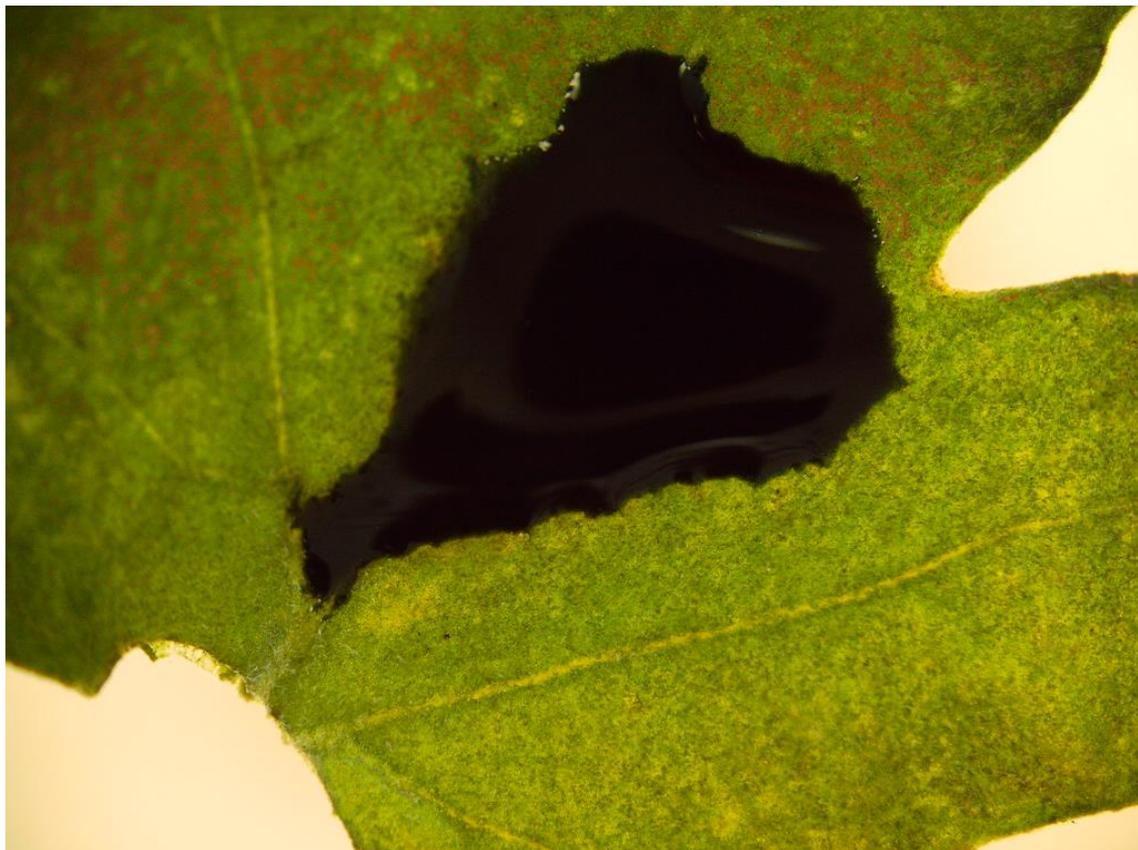


- **Reduces surface tension**
 - Excellent coverage of leaf surface
 - Enhanced uptake into plant tissue
- **Advanced emulsifier system**
 - Consistent emulsification
 - Good stability as a tank mix partner
- **Low use rates**
 - Economical to use
 - Ease of handling and mixing

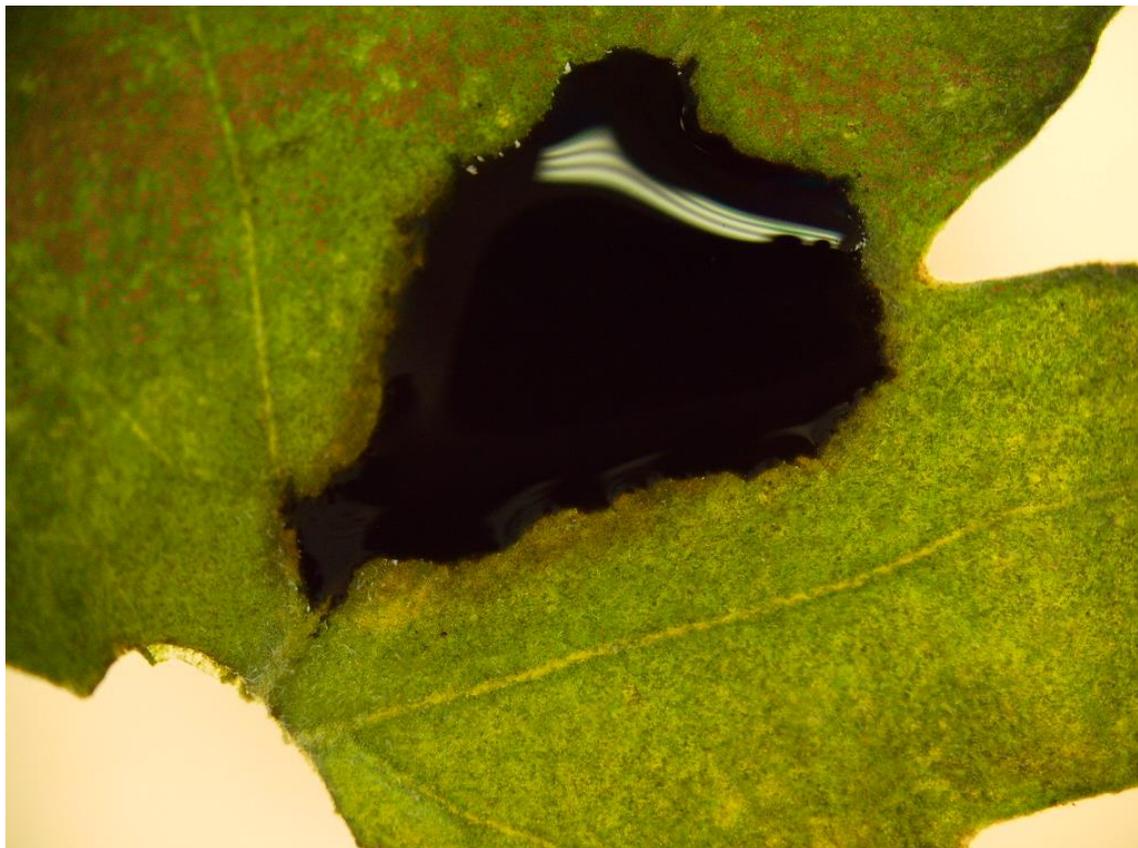




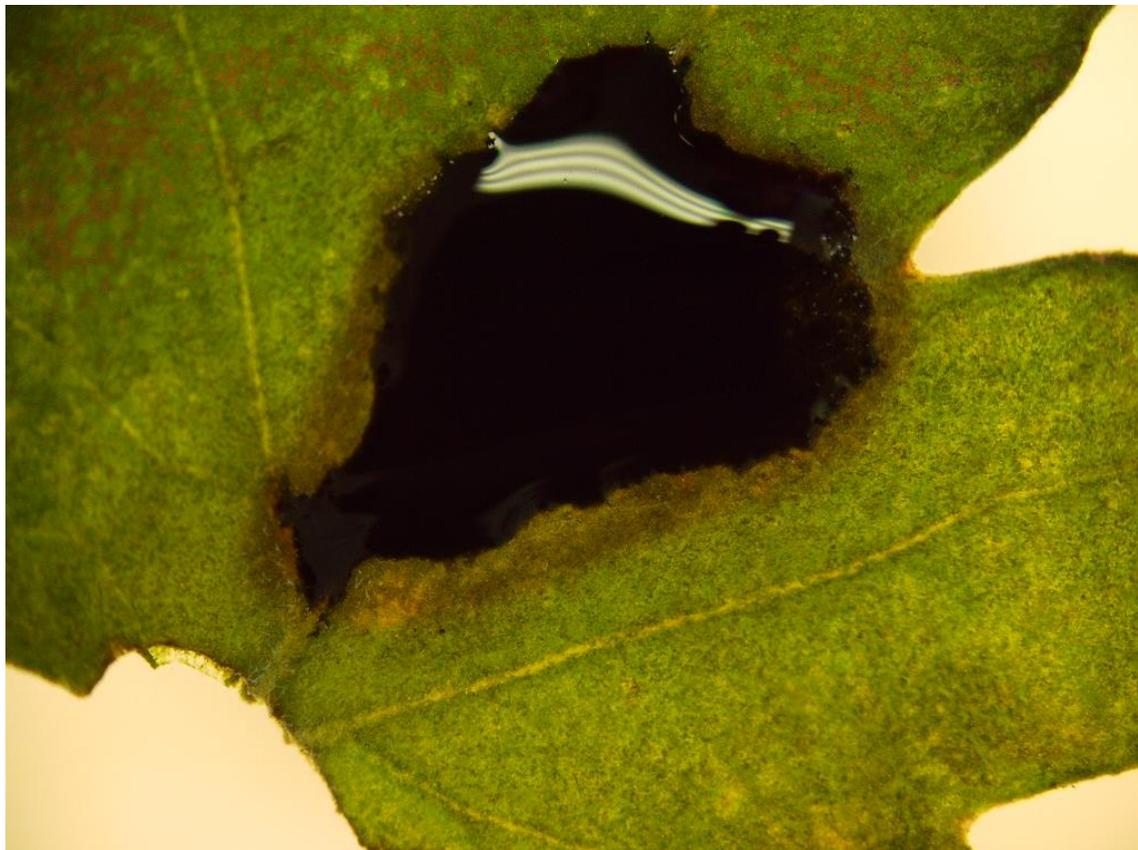
- Follow label instructions on pesticide
- General use 2-5 oz./acre
- Backpack or hand held sprayers use 1 tablespoon (1/2 fluid oz) per gallon of spray
- Syl-Tac comes in:
 - Quarts
 - 1 gallon jugs
 - 2.5 gallon jugs



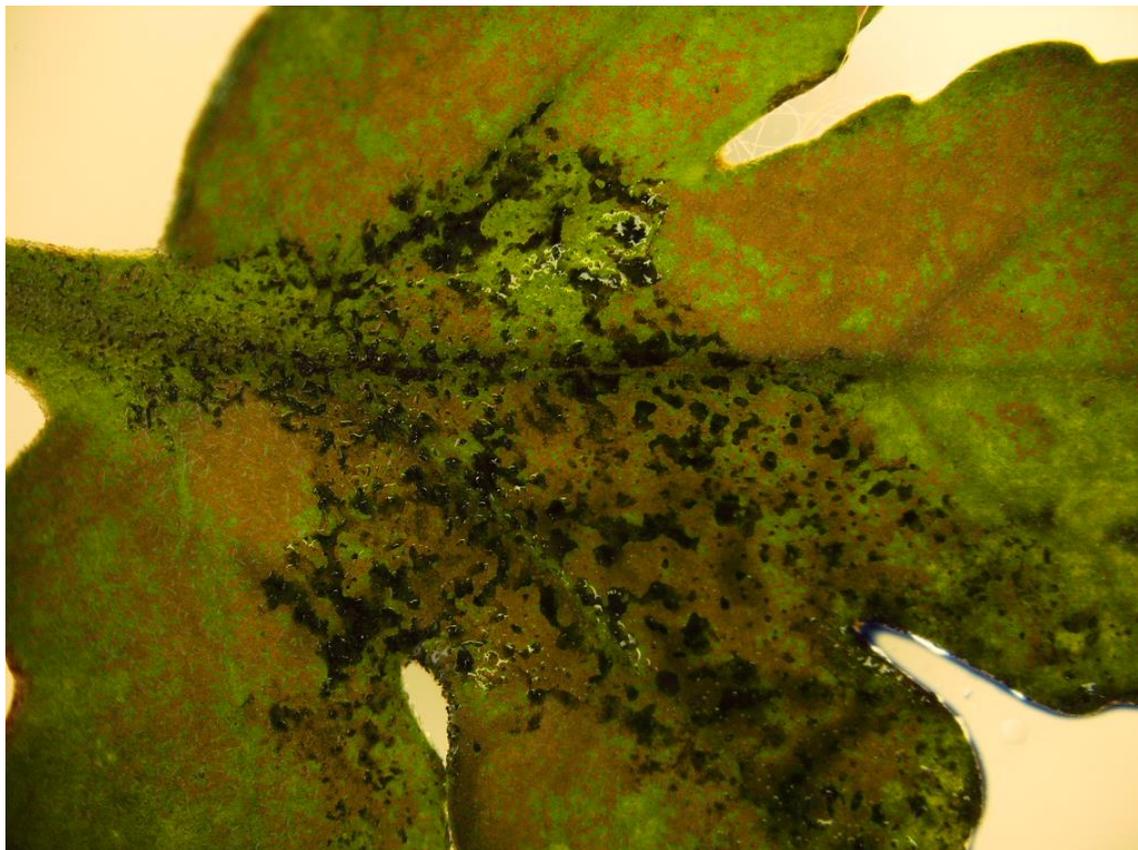
Dye 10 minutes



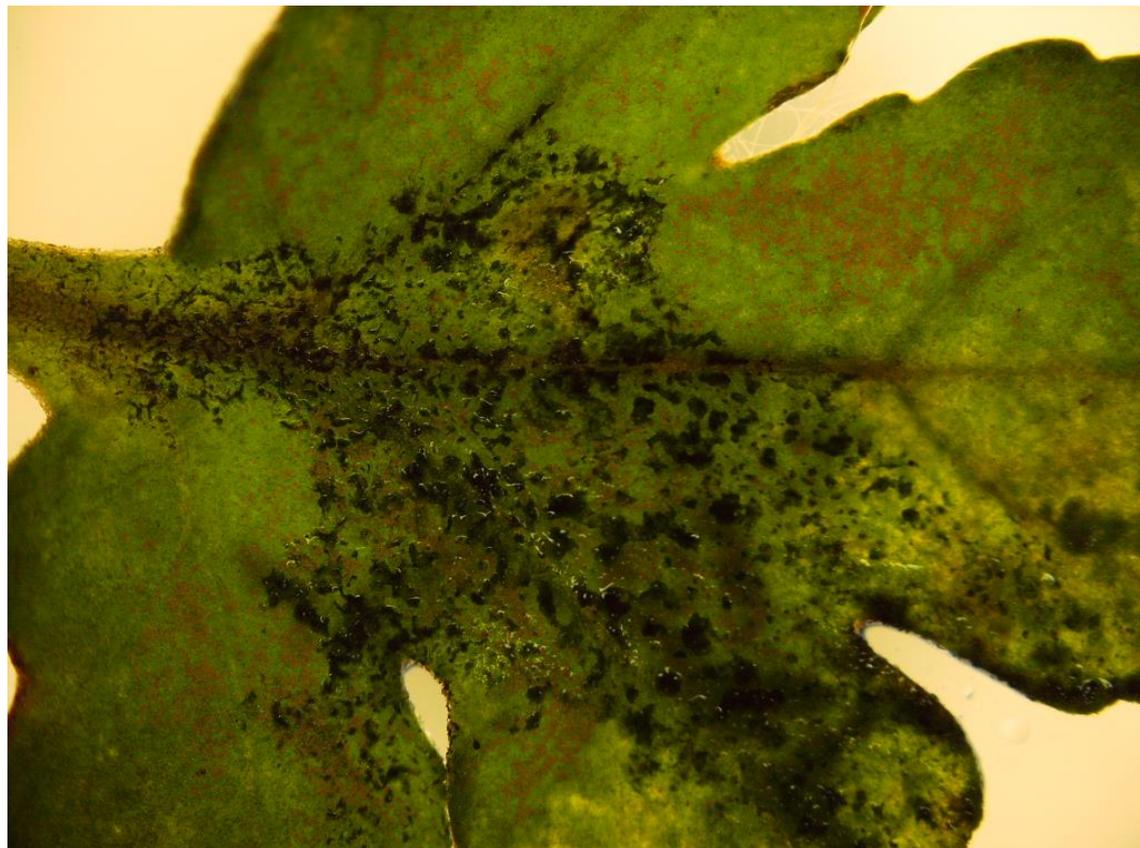
Dye 20 minutes



Dye 30 minutes



SYL-TAC 10 minutes



SYL-TAC 30 minutes



SYL-TAC Underside of leaf after 30 minutes

Conium maculatum.



Bruce Barnes



POISON HEMLOCK

APIACEAE

- Escort- 1 oz/AC
- 2,4-D- 1-2 qt/AC
- Opensight 3.3 oz per acre
- Surfactant – ?

Centaurea maculata



(c) Cindy Roche'



(c) Cindy Roche'



photo by Karl Urban



Centaurea diffusa



BUR-ELLIS®





DIFFUSE, MEADOW, AND SPOTTED KNAPWEED

ASTERACEAE

- Tordon 22K- 1 pt/AC
 - Use caution around trees
 - Best long term control where conditions allow
- Prescott R&P- 2 pt/AC
 - Excellent control; good in “sensitive” areas
- Transline- 1 pt/AC
- Milestone – 5-7 oz per acre
- Opensight 3 oz per acre
- Apply from rosette to mid-bolt

Tanacetum vulgare



Bruce Barnes



WA State Noxious Weed Control Board



WILBUR-ELLIS®

COMMON TANSY

Asteraceae

- Escort 1 oz
- Opensight 3.3 oz per acre
- Add 1-2 qt 2,4-D for broad spectrum control



WSNWCB



Cirsium arvense

photo by Bruce Barnes

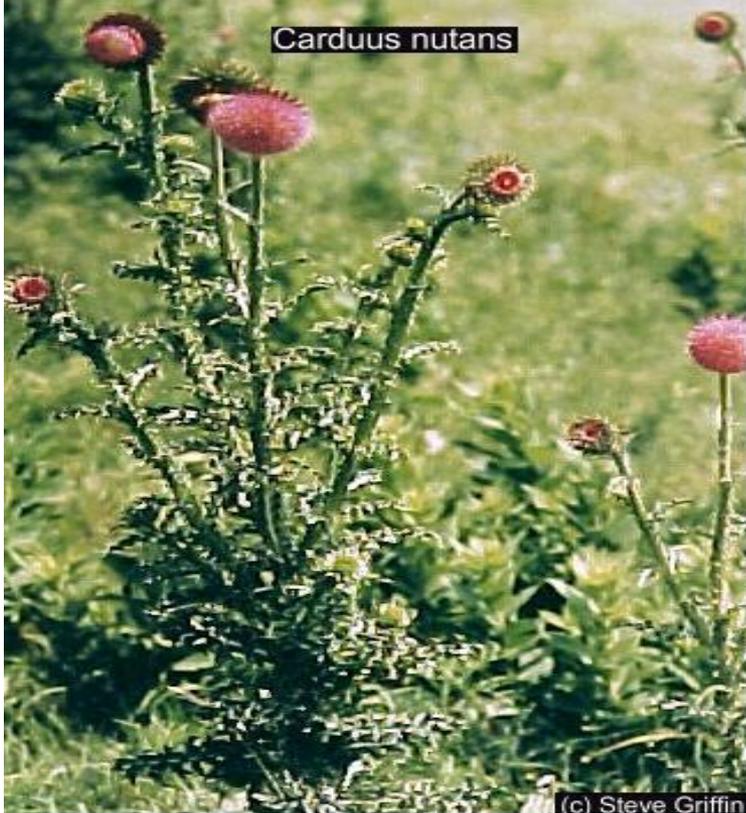


CANADA THISTLE

ASTERACEAE

- Tordon 22K- 1.5-2 pt/AC
 - Apply emergence to bud stage or fall regrowth
 - Prescott R&P- 3-4 pt/AC
 - Apply emergence to bud stage or fall regrowth
 - Transline- 0.66-1 pt/AC
 - Apply emergence to bud stage or fall regrowth
 - Better results without 2,4-D
- Milestone 5 – 7 oz per acre
- Opensight 3 oz per acre

Carduus nutans



(c) Steve Griffin



WA State Noxious Weed Control Board

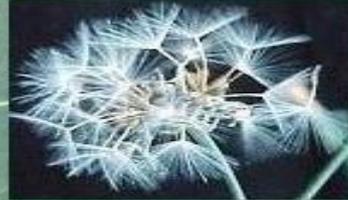


MUSK AND SCOTCH THISTLE

ASTERACEAE

- Tordon 22K- 0.5 pt/AC + 1 qt/AC 2,4-D
 - Apply before bolting or in fall before freeze up
- Escort/Telar- 1 oz/AC
 - Apply to spring or fall rosettes
- Prescott R&P- 1.5-2 pt/AC
 - Use higher rate from mid-bolt to bud stage
- Weedmaster 2 pt/AC
 - Apply to spring or fall rosettes
- Milestone – 5-7 oz per acre

Chondrilla juncea



WA State Noxious Weed Control Board



RUSH SKELETONWEED

ASTERACEAE

- Tordon 22K- 1 qt/AC
 - Apply late fall or spring from full emergence to 4” bolt (don’t wait too long)
 - Great results from fall applications
 - Provides good residual
- Prescott R&P- 3-4 pt/AC
 - Late fall or spring from full emergence to 4”
- Transline- 1 pt/AC
 - Same timing as above (watch rosette leaves)
- Milestone – 7 oz per acre fall or spring
- Opensight 3 oz per acre

Yellow Hawkweed



MEADOW, ORANGE HAWKWEED



WILBUR-ELLIS®

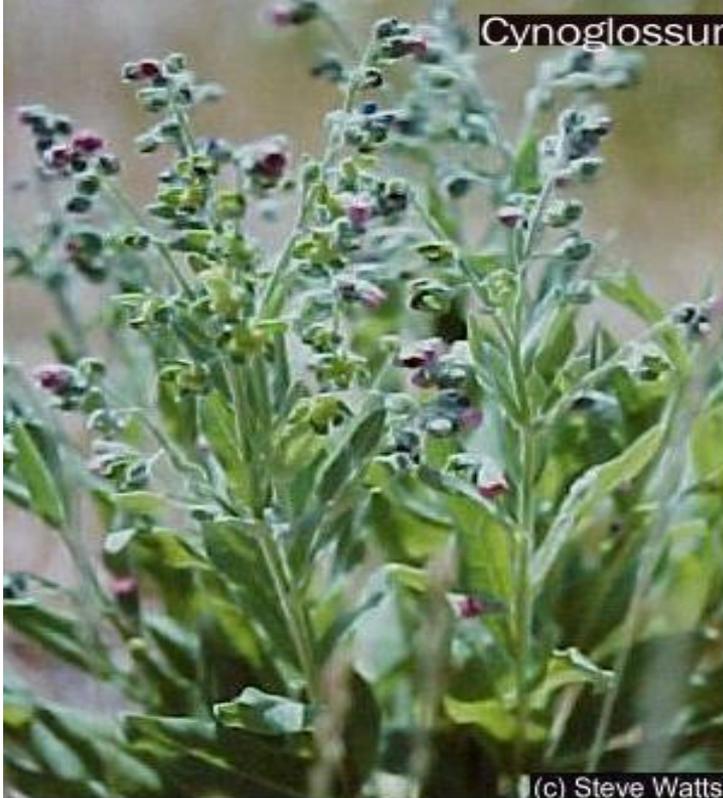
ASTERACEAE

- Tordon 22K- 1.5 pt/AC
 - Apply full emergence to early bloom
 - Can use 1 pt/AC if 1.5 qt/AC 2,4-D is added
- Milestone – 5-7 oz per acre
- Prescott – 3-4 pints per acre

Transline- 0.66-1 pt/AC

- Addition of ammonium sulfate has helped above 2 qts per 100 Bronc Max

Cynoglossum officinale



(c) Steve Watts



Bruce Barnes



HOUNDSTONGUE

Boraginaceae

- Escort 1 oz per acre
 - Add Hi-Dep @ 1-2 qts per acre
- Opensight 3.3 oz per acre

Cardaria draba



Perennial Whitetop/Hoary Cross

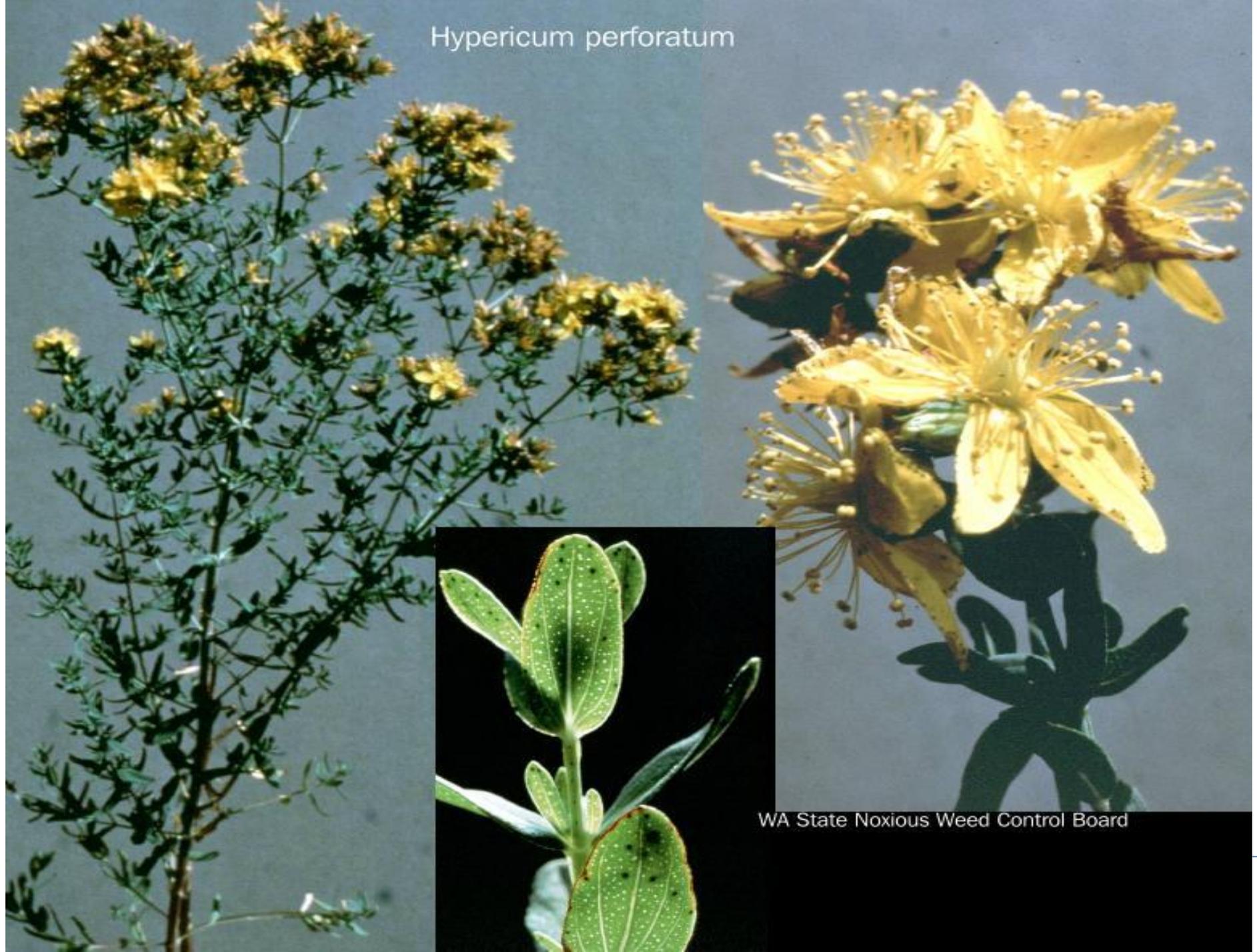
WA State Noxious Weed Control Board

HOARY CRESS

BRASSICACEAE

- “Easy” recommendation with S.U.’s
- Escort
 - Apply rosette to bloom stage
 - 1 oz/AC on Hoary Cress
- Telar- 1 oz/AC
 - Use silicone/blend surfactant (very waxy)
- Escort more consistent than 2,4-D (less AI)

Hypericum perforatum



ST JOHNSWORT

Clusiaceae

- Escort $\frac{3}{4}$ oz + 1-2 qt 2,4-D + surfactant
- Milestone – 7 oz per acre

Equisetum arvense



photo by Karl Urban

FIELD HORSETAIL

Equisetaceae

- Telar DF 2 oz per acre
 - Apply in spring prior to 6 inch bolt
 - Rainfall needed to activate
- Bareground
 - Landmark MP + Krovar
 - Or Landmark MP + Diuron

LEAFY SPURGE

EUPHORBIACEAE

- Plateau- 8-12 oz/AC
 - Higher rates increase grass damage
 - Use MSO plus nitrogen fertilizer source
 - Apply after light fall frost (Early Sept.- Early Oct.)
- Tordon 22K- 1-3qt/AC or 1qt plus 1qt 2,4D
 - Apply at bloom stage
- Krenite S- 1.5 gal/AC
 - Use in sensitive areas (around trees, near water)
 - Apply at bloom to late bloom

Verbascum thapsus



(c) Robert A. Nicholson



Bruce Barnes



WA State Noxious Weed Control Board

COMMON MULLEIN

Scrophulariaceae

- Escort 1 oz + Syl-tac 1-2 pts per 100
- Biennial weed, spray 1st years growth (rosette)
- Add 2,4-D for broad spectrum control
- Opensight 3.3 oz per acre

Linaria dalmatica





DALMATION, YELLOW TOADFLAX

SCROPHULARIACEAE

- Tordon 22K- 2 qt/AC
 - Apply at bud to bloom stage
 - Use silicone/blend surfactant (waxy leaves)
- Telar- 2 oz/AC
 - Apply bud to bloom or fall rosette stage
 - Surfactant use is critical
- Telar + Tordon 22K = TNT

QUESTIONS?

THANK YOU!

SPRAY

LIKE YOU MEAN IT™