Cranberry Meeting

Adjuvants 101

Dan Comingore
Wilbur-Ellis Company
Branded Product Territory Manager
UNITED we stand.....
An adjuvant is a material added to a mixture to aid or modify the action of an agrichemical, or alter the physical characteristics of the mixture.
Adjuvant Types

- Spreaders
- Spreaders + AMS
- Spreader-Activators
- Penetrator-Activator
- Spreader-Stickers
- Sticker-Extenders
- Silicones
- Crop Oil Concentrates
- High Surfactant Oil Concentrate
- Modified Seed Oils
- Modified Seed Oil + Organosilicone Blend
- Modified Seed Oil + Nitrogen
- Acidifier/Buffers
- Alkaline/Buffers
- Water Conditioners
- Deposition and Drift Management
State Adjuvant Registration

• In some states adjuvants are required to be registered; WA, CA, ID, UT and WY in the western states.
• In order to be registered these adjuvants must comply with the definitions established by ASTM.
CPDA
Council of Producers & Distributors of Agrotechnology

- **Voluntary Adjuvant Certification Program**
- Only organization representing adjuvants to the EPA. (EPA sets some of the requirements needed to be CPDA certified, along with U.S. Dept. of Transportation, U.S. OSHA)
- Certification program that sets viable minimum standards
  - Toxicology on all products required
  - Must meet ASTM definitions
  - Standards for active ingredients.
  - Certified formulation facilities
CPDA

CPDA Certified Products

- Started Certifying Products in 2001
- Probably in excess of 2000 adjuvants in marketplace.
- Currently 102 adjuvants have received CPDA Certification
- Wilbur-Ellis – 11 products CPDA Certified
- Supporting companies are Wilbur-Ellis, Winfield Solutions, Helena, Loveland/CPS, United Suppliers, Intec and others.
CPDA Certified Products

- **Helena**
  - Agri-Dex®
  - Crop Oil Concentrate
  - Induce®
  - Kinetic®
  - Penetrator® Plus
  - Vegetable Oil Concentrate®

- **Winfield Solutions LLC**
  - Alliance®
  - Class Act® NG™
  - Destiny® HC
  - Droplex™
  - InterLock®
  - Level 7®
  - Powerlock®
  - Superb® HC

- **Loveland**
  - Choice® Weather Master™
  - MSO® Concentrate with Leci-Tech

- **Monterey AgResources**
  - Magnify
  - Monterey Cop Oil

- **Wilbur-Ellis**
  - BRONC® MAX
  - CAYUSE® PLUS
  - R-11®
  - RAINER-EA™
  - HASTEN®
  - CROSSHAIR®
  - IN-PLACE®
  - RENEGADE-EA™
  - SUPER SPREAD® 7000
  - SUPER SPREAD® MSO
  - SYL-TAC®

- **Rosen’s**
  - R-Way®
  - Sundance® II
  - Tradition® 93

- **United Suppliers, Inc.**
  - Air Force®
  - AMSol Plus®
  - AmSurf Xtra™
  - Between® HSOC
  - Chemsurf 80
  - Chemsurf 90
  - Double Down®
  - Downdraft®
  - Fastrack™
  - Formula® 1
  - Premium Crop Oil Concentrate
  - Speedway®
  - Sprint ™ ADT
  - Succeed®
  - Ultra-Lite®
  - Ultra Surf AMS

*Ideas to Grow With®*
When you are CPDA Certified it is a requirement that you have to show your actual **Surfactant Content** on your Label.
NIS Comparison SOLVENT or SURFACTANT?

**SUPER SPREAD® 90**
- NIS 90/10
- 10% water
- 40% Solvent Glycols
- 50% TRUE Surfactant

**R-11®**
- NIS 90/10
- 10% water
- 10% Solvent Glycols
- 80% TRUE Surfactant

**RAINIER-EA™**
- NIS 90/10
- 10% water
- 2% Solvent Glycols
- 88% TRUE Surfactant
pH of 9 – 11.5

20% Surfactant???
Just because it makes Crop Life, doesn’t mean it’s a good surfactant!!

10.9% Surfactant Package

- ORO HSMSO is an MSO adjuvant that is trying to claim it is heated up in a proprietary fashion.
- Oro-Agri is making claims that it is an HSMSO which stands for High Surfactant MSO.
- But ORO HSMSO product according to its label only contains 10.9% surfactant and contains 64% MSO, which is outside the 40:60% MSO range that would normally be classified as an HSOC (High Surfactant Oil Concentrate).
• CPDA Certified Products Means Something

IN-PLACE®
CROSSHAIR®
HASTEN®
SUPER SPREAD® MSO
RENEGADE-EA™

SYL-TAC®
With Translam® Technology
R-11®
RAINIER-EA™

BRONC® MAX
CAYUSE® PLUS

NPE Free DRT
Oil
NPE Free Surfactant
NPE Free Water Quality
NPE Free Oil

Ideas to Grow With®
Adjuvant Selection Factors

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

Contact, translaminar, systemic

Water hardness, pH & solubility

Hot & Dry

Cool & Humid

Ground, aerial air blast, chemigation backpack

Weather

Equipment

Social/Political Concerns

Drift Off-Target

Crop Leaf Structure

Target Leaf Structure

Target or Pest

Pesticide

Water Quality

Miscellaneous

Proper Choice

Grass, Broadleaf
Surfactants

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

ASTM Definition
Surfactant Types

**ANIONIC** - surfactant that has a negative (-) charge and **limited compatibility**.

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

**NON-IONIC** - surfactant that has no electrical charge and is generally **compatible with all pesticides**.
Functions of a High Quality Surfactant

Good surfactant activities:
- Reduces surface tension
- Solubilizes spray materials
- Increases spreading
- Improves retention
- Improves penetration

Better spray material PERFORMANCE!
Spray 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
Surfactant Effects

- Surfactant reduces surface tension to 20-40 dynes/cm.
- Droplets spread over leaf, penetrate hairy surface
- Increased leaf contact
- Increased spray activity
Japanese Maple with and without ProNatural® Spreader-Sticker

With Surfactant  Without Surfactant
Common Mullein
Hairs, trichomes, and glands
Differences Between Spreaders, Spreader-Activators and Penetrator-Spreader-Activators

- **Spreader** – reduces the surface tension and increase the surface area covered by the pesticide.

- **Spreader-Activator** – reduces surface tension, increases the surface area covered and **moves** pesticide around, under and into the water channels of the leaf.

- **Penetrator-Spreader-Activator** – Lifts and dissolves the wax on the leaf surface allowing the pesticide to enter the leaf.
Penetration vs Coating

• **Super Spread MSO®** is an Modified Seed Oil (MSO)
  – Exceptional **penetration**

• **R-11®** is a nonionic surfactant (NIS)
  – **Spreader-Activator**

• **Mor-Act®** is a Crop Oil Concentrate (COC)
  – **Coats** versus penetrate
Where do you want the product?

- Do want to spread and coat the outside of the leaf/plant?
- Do you want the product inside the leaf, so it can move throughout the leaf and entire plant?
  - Is it a **Contact** product?
  - Is it a **Translaminar** product?
  - Is it a **Systemic** product?
0 Minutes
Trump’s Foreign Policy....

BREAKING NEWS

TRUMP SENDS KIM JONG UN A FREE AIRLINE TICKET TO DISCUSS HIS NUCLEAR WEAPONS PROGRAM.
The Importance of Water Quality!!
Why Is Water Important?

Water is the carrier for 98% of all pesticides sprayed.

Once you put pesticides into bad water the damage is done and can’t be reversed.
When Do You Treat?

• If you are conditioning your water for;
  • pH adjustment
    up
    down
  • water hardness

YOU MUST......

Treat the water before adding any pesticide to the spray water !!!!
What Are The Problems?

pH Sensitivity

Certain spray materials break down if spray water is either too **BASIC** (high pH) or **ACIDIC** (low pH).

Solubility of Pesticides

- Some pesticides increase in solubility as the spray water pH increases.

Mineral Antagonism

- Water Hardness (dissolved minerals) directly interfere with a broad range of spray materials.
  - Calcium
  - Magnesium
  - Iron
  - Sodium
pH Sensitivity

pH of 5 - 6.5 is generally the optimum for most spray solutions

pH above 7 is considered basic

pH below 7 is considered acidic
What Is Your Spray Water pH?
pH Sensitivity

- Generally, the ideal pH for water used in applying spray materials is slightly acidic (pH 5 to 6.5) but some exceptions exist. Read Labels.

- Sulfonylureas such as Ally®, Escort®, Amber®, Harmony®Extra, Express® and Accent® begin to degrade when left in spray solution that is below pH 7.

- Some herbicides, insecticides and fungicides, such as Topsin®, Captan™ & Imidan® break down in basic (pH above 7) ALKALINE HYDROLYSIS.
### Effects of pH on Imidan Half Life

<table>
<thead>
<tr>
<th>pH</th>
<th>Half Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>178 hours</td>
</tr>
<tr>
<td>5.5</td>
<td>92 hours</td>
</tr>
<tr>
<td>6.0</td>
<td>36 hours</td>
</tr>
<tr>
<td>6.5</td>
<td>14 hours</td>
</tr>
<tr>
<td>7.0</td>
<td>10 hours</td>
</tr>
<tr>
<td>7.5</td>
<td>2 hours</td>
</tr>
<tr>
<td>8.2</td>
<td>33 minutes</td>
</tr>
</tbody>
</table>

**Effect of pH on Residual Efficacy of Imidan** J. Attaway, CA. 1996.  
**Effects of Field-Aged Residues on Efficacy** J. Brunner, WSU. 1996.  

From field studies conducted for Gowan Company
Solubility vs Spray Water pH

- As the spray water pH increases some products increase in solubility.

- As solubility increases, it increases the bioavailability of active ingredient for better and more consistent efficacy.
## Spray Solution pH vs Solubility

<table>
<thead>
<tr>
<th></th>
<th>pH 5.0</th>
<th>pH 7.0</th>
<th>pH 9.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maverick</td>
<td>18 ppm</td>
<td>1,627 ppm</td>
<td>482 ppm</td>
</tr>
<tr>
<td>Amber</td>
<td>32 ppm</td>
<td>815 ppm</td>
<td>13,500 ppm</td>
</tr>
<tr>
<td>Peak</td>
<td>30 ppm</td>
<td>3,580 ppm</td>
<td>n/a</td>
</tr>
<tr>
<td>Glean</td>
<td>587 ppm</td>
<td>31,800 ppm</td>
<td>n/a</td>
</tr>
<tr>
<td>Finesse</td>
<td>587 ppm</td>
<td>31,800 ppm</td>
<td>n/a</td>
</tr>
<tr>
<td>(Glean + Ally)</td>
<td>548 ppm</td>
<td>2,790 ppm</td>
<td>213,000 ppm</td>
</tr>
<tr>
<td>Ally</td>
<td>548 ppm</td>
<td>2,790 ppm</td>
<td>213,000 ppm</td>
</tr>
<tr>
<td>Express</td>
<td>48 ppm</td>
<td>2,040 ppm</td>
<td>18,300 ppm</td>
</tr>
<tr>
<td>Harmony Extra</td>
<td>223 ppm</td>
<td>2,240 ppm</td>
<td>8,830 ppm</td>
</tr>
<tr>
<td>(Harmony GT + Express)</td>
<td>48 ppm</td>
<td>2,040 ppm</td>
<td>18,300 ppm</td>
</tr>
<tr>
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<td>223 ppm</td>
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*WSSA Herbicide Handbook 2002 eighth edition*
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<th>pH 9.0</th>
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<tbody>
<tr>
<td>Olympus</td>
<td>2,900 ppm (pH 4.0)</td>
<td>42,000 ppm</td>
<td>42,000 ppm</td>
</tr>
<tr>
<td>Osprey</td>
<td>7 ppm</td>
<td>483 ppm</td>
<td>15,390 ppm</td>
</tr>
<tr>
<td>Everest</td>
<td>3,000 ppm</td>
<td>44,000 ppm</td>
<td>44,000 ppm</td>
</tr>
<tr>
<td>Rave</td>
<td>32 ppm</td>
<td>5,815 ppm</td>
<td>13,500 ppm</td>
</tr>
<tr>
<td>Ally Extra</td>
<td>548 ppm</td>
<td>2,790 ppm</td>
<td>213,000 ppm</td>
</tr>
<tr>
<td>Achieve</td>
<td>6 ppm</td>
<td>7 ppm</td>
<td>9,800 ppm</td>
</tr>
<tr>
<td>UpBeet</td>
<td>3 ppm</td>
<td>110 ppm</td>
<td>11,000 ppm</td>
</tr>
<tr>
<td>Poast</td>
<td>257 ppm</td>
<td>4,390 ppm</td>
<td>n/a</td>
</tr>
<tr>
<td>Beacon</td>
<td>3 ppm</td>
<td>243 ppm</td>
<td>5,280 ppm</td>
</tr>
</tbody>
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## Spray Solution pH vs Solubility

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<th>pH 9.0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oust</strong></td>
<td>10 ppm</td>
<td>300 ppm</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Telar</strong></td>
<td>587 ppm</td>
<td>31,800 ppm</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Escort</strong></td>
<td>548 ppm</td>
<td>2,790 ppm</td>
<td>213,000 ppm</td>
</tr>
<tr>
<td><strong>Landmark</strong></td>
<td>10 ppm</td>
<td>300 ppm</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Landmark</strong></td>
<td>587 ppm</td>
<td>31,800 ppm</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Weststar</strong></td>
<td>10 ppm</td>
<td>300 ppm</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Oust Extra</strong></td>
<td>10 ppm</td>
<td>300 ppm</td>
<td>n/a</td>
</tr>
<tr>
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<td>548 ppm</td>
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What Is Your Spray Water Hardness?
Hardness Levels

0 - 125 – Yellow
126 - 250 – Red
251 - 375 – Turquoise
375 - 500 – Blue
501 - 625 – Green
626 - 750 – Purple
751 - 875 – Black
876 - 1000 – White
Mineral Antagonism

- Water hardness (dissolved minerals) directly interfere with a broad range of spray materials.
Mineral Antagonism

Calcium [Ca++]
Magnesium [Mg++]
Iron [Fe++]
Sodium [Na+]
Mineral Antagonism

- **Dissolved minerals** specifically interfere with the performance of some herbicides such as:
  
  Glyphosate, Achieve®, Poast®, Pursuit®, Raptor®, Beyond®, Select®, Dicamba, Liberty®, Rely®, 2,4-D Amine and MCPA Amine.

  2,4-D is completely deactivated at **500 ppm** water hardness.

  Glyphosate less effective noticeably as low as **150 ppm** hardness.
Addition of Ammonium Sulfate...Why?

The Sulfate ion “blocks” the mineral cation.

The Ammonium ions attach and “escort” the glyphosate into the plant.
Mineral Antagonism

Time of Application | 85° F
Evaporation of Spray Droplet
Effects on Salt Concentration

Time of Application: Hardness = 100 ppm = Low
7.5 % Glyphosate antagonism
Mineral Antagonism
2.5 Minutes Post-Application
Evaporation of Spray Droplet
Effects on Salt Concentration

50% Evaporation

50% Evaporation: Hardness = 200 ppm = Low
15% Glyphosate antagonism
Mineral Antagonism
4 Minutes Post-Application | Note Formation of Salt Deposits
90% Evaporation: Hardness = 900 ppm = **Extremely High**
67.7 % Glyphosate antagonism
University of Idaho Trials 2005 - Dr. Donn Thill
Using sub-lethal rates of Buccaneer™ - Water Hardness of 1100 ppm
Herbicides That May Be Susceptible To Hard Water Tie Up

- **2,4-D** (amine) – (Base Camp™ Amine 4, Weedar®, 64, Broadrange™ 55)
- **2,4-DB** (amine)
- **MCPA** (amine) (WIL-POWER®, Vengeance® Plus)
- **Dichlorprop** (amine)
- **Mecoprop** (amine)
- **Dicamba** (Banvel®, Clarity®, Vanquish®)
- **Picloram** (Tordon®)
- **Triclopyr** (Garlon®, Crossbow™, WIL-POWER®, Vengeance® Plus, DeadLock®)
- **Clopyralid** (Stinger®, Curtail®, Curtail® M, Transline®, Lontrel®, Confront®, Redeem®, WideMatch™)
- **Aminopyralid** (Milestone™, Milestone™ VM, Milestone™ VM Plus, CleanWave™, ForeFront™)

- **Quinclorac** (Q-4®, Facet®, Paramount®)
- **Sethoxydim** (Poast®)
- **Clethodim** (Select®, Select Max™, Envoy®, Volunteer™, Shadow®)
- **Tralkoxydim** (Achieve®)
- **Imazamethbenz** (Assert®)
- **Imazapyr** (Arsenal®, Chopper®, Sahara®, Stalker®, Habitat®)
- **Imazaquin** (Scepter®)
- **Imazamox** (Raptor®, Beyond®, ClearCast™ ClearMax™)
- **Imazapic** (Plateau®, Journey®)
- **Imazethapyr** (Pursuit®)
- **Glufosinate** (Liberty®, Rely®, Ignite®, Finale®)
- **Glyphosate** (Roundup®, Touchdown®, Agri Star® Landmaster® BW)
Thank You!!