Adjuvants
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What are they?
When to use them?
• *Adjuvant* is a broad term describing any additive to a spray tank that enhances pesticide activity.
• Adjuvants can determine efficacy
• When used inappropriately, they can cause crop damage.
Types of Adjuvants

- Surfactants
- Spreader/Stickers
- Crop Oils
- Anti-foaming
- Buffering Agents
- Compatibility Agents
- Anti-drift agents
Surfactants

- **Surface Active Agents**

- Surfactants are adjuvants that facilitate and accentuate the emulsifying, dispersing, spreading, wetting, or other surface modifying properties of liquids.
Surface Tension

Molecule in the bulk: attraction forces from all sides

Molecule in the surface: attraction forces just from the water side.
Molecule pulled towards the bulk
Spherical shape
Surface Tension

- A property of the surface of a liquid that allows it to resist an external force.
- Is revealed in floating of some objects on the surface of water (some insects can run on the water surface).
- Gives water droplets their near-spherical shape, because a sphere has the smallest possible surface area to volume ratio.
Surfactants

- compounds that lower the surface tension of a liquid, allowing easier spreading, and lowering of the interfacial tension between two liquids, or between a liquid and a solid.

- may act as: detergents, wetting agents, emulsifiers, foaming agents, and dispersants.
Wetting

Water bead without the addition of a surfactant

Poor wetting, water does not spread, higher surface tension

Good wetting, water can spread, lower surface tension

Water bead with the addition of a surfactant
Types of Surfactants

- **Anionic Surfactants** - negatively charged, enhance foaming and other spreading properties. Mostly used in shampoos.

- **Cationic Surfactants** - positively charged, often very toxic to plants. Mostly used in heavy-duty cleaning compounds.
• **Amphoteric Surfactants** will form either a positive or negative charge in water, depending upon the pH of the solution.

• Used to match the properties of specific pesticide formulations to carrier components (Industry level).
Nonionic Surfactants – no charge, most commonly used surfactants in agriculture.

When used properly, they as a class do not harm plants, remain stable, and do a good job of breaking water surface tension.

However, application rate is critical.
Anti-drift

- to reduce drift of sprays by reducing volatility, cause the carrier solution to become heavier.

- When applied at too high a rate, they can cause surface deposits on foliage, phytotoxicity or clog spray nozzles.
Emulsifiers

• work by coating tiny particles of the liquid molecules and preventing them from coagulating.

• allow oil and water solutions to mix. These products are usually added by the manufacturer and are commonly mixed with petroleum-based pesticides to help them mix more readily with water.
Spreader/Stickers

• Compounds that cause the surface tension of the pesticide to be reduced in such a way that it easily spreads into a very thin film over a surface.
• Technically different but practically like surfactants, they increase the efficiency of the pesticide.
• Cause the pesticide solution to adhere to the leaf surface, thereby resisting rain-off, evaporation and runoff.
Oils

- Two types:
- Crop oils derived from soybean and other crops
- Inorganic oils that come from petroleum refineries.
- With insecticides to suffocate or penetrate
- Others used like surfactants, forming film over the leaf, breaking down the cuticle.
- Some oils are blended with surfactants, to take advantage of the properties of both adjuvants.
Organosilicates

• Are not new; developed in the 1970s, used with silicone-based sprays for waterproofing. Ag use started about 10+ years ago.
• Very good at increasing the “rainfastness” of pesticides.
• These products have phenomenal wetting abilities.
• Phytotoxicity at too high a rate or when temperatures are above 90 degrees F.
• Some research suggests that the wetting properties are so good that they can also allow bacteria and fungi to more easily invade plants (via stomata).
Natural Surfactants

- Are biodegradable
- coconut oils, palm oils, castor oils, lanolins, wheat amino acids, and many others
- Very little research to verify these products are effective
- There is evidence that these products may serve as food sources for bacteria and fungi.
Bottom Line

• Certain pesticides are recommended to be applied with an adjuvant (oil, non-ionic surfactant, spreader/Sticker etc.

• Label will specify; pesticide company knows their product.

• They will tell you if a surfactant is present in the pesticide or which surfactant products can safely be used with the pesticide.

• Recommendations are strict for a reason.
Example

- O’Neal averaged 42.5 percent yield loss, ranged from 8 to 84 percent depending on proximity to the spray middle.
- Replicated trials in North Carolina and New Jersey showed that the injury was due solely to the surfactant.
- Variations in severity were attributable to application method, rate, cultivar and crop phenology
When/What?

- Herbicides
- Insecticides
- Fungicides
- Growth regulators
Herbicides

- Glufosinate – COC or Surfactant may be used but not needed – avoid plant contact
- Callisto and Chateau. Crop oil concentrate (COC) @ 1% v/v improves postemergent activity. Avoid plant contact.
- Glyphosate – depends on formulation; many generics require additional surfactant
- Paraquat - .25% nonionic, v/v is necessary
- Basagran - .25% COC required
- Carfentrazone – 1% COC or .25% nonionic
- Clethodim - .25% nonionic
Insecticides

• Carbaryl – water pH above 8 add buffering agent, otherwise the use of a surfactant will increase the chance of phytotoxicity
• Spinetoram (Delegate) – COC @ .25%
• Phosmet (Imidan) – pH 8 add buffering agent
Fungicides

• Most fungicide labels read “adjuvant may be used” or “may increase efficacy” but not required.
• Captan - Do not use a COC, wetting agent or sulphur.
• Phosphonates - Do not use adjuvants, liquid fertilizers or copper.
• Bravo Weather Stik – nothing!
• Indar - label no longer supports the use of an adjuvant at all.
Growth Regulators

- Dormex - .25% v/v nonionic surfactant
- Giberrillic Acid (GA) - .25% organosilicate surfactant (Flood, Kinetic, X-77, Silwet L-77)
- Ethephon - .25% nonionic surfactant
Tips

• Agitate while loading
• Mix order: WSP, WDG, WP, DF, buffering or defoamers, LF, EC, surfactant
• Don’t mix WP’s with EC’s (ex. Captan + Diazinon or Malathion)
• Calibrate/Equipment
• Captan L plus COC
• 48 hrs