Adjuvants

John Ed Smith
University of Georgia
Bacon CEC &
Mngr, Blueberry Research Farm

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

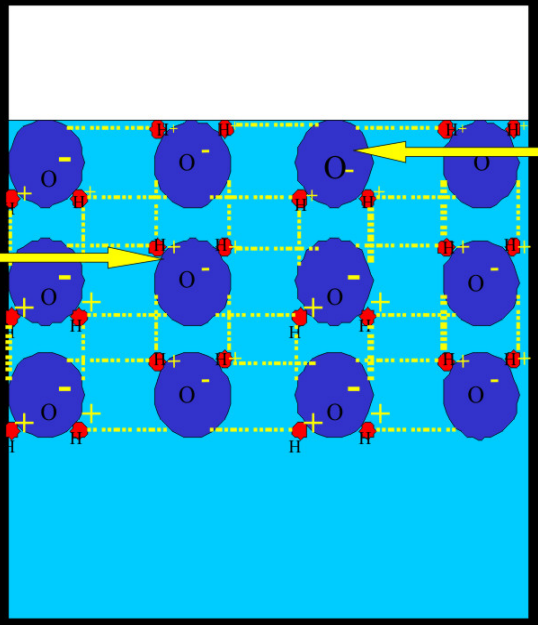
- Surfactants
- Spreader/Stickers
- Crop Oils
- Anti-foaming
- Buffering Agents
- Compatibility Agents
- Anti-drift agents

Surfactants

- ***Surf***ace ***Act***ive ***A***ge***nts***

- 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

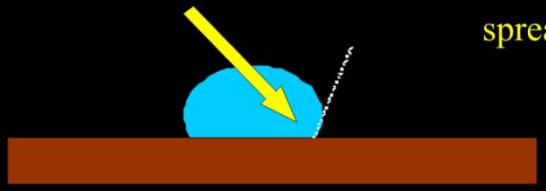
- compounds that lower the surface tension of a liquid, allowing easier spreading, and lowering of the interfacial tension between two liquids, or between a liquid and a solid.

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

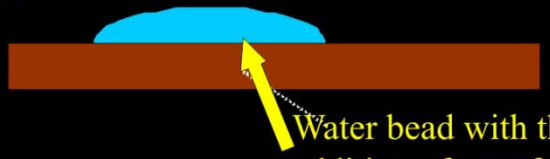
Wetting

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