



Factors Affecting Pesticide Performance.



Adjuvants and Surfactants.

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Pesticides

- **General term for all products used in pest control**
- **Herbicides, insecticides, fungicides, rodenticides, acaricides, avicides, piscicides**
- **- icides**
- **Why is it important to know this?**
 - **Surveys**
 - **Communication**

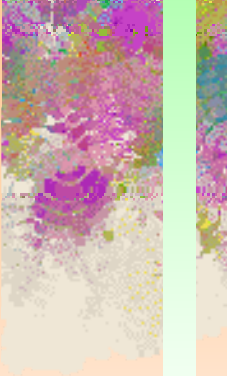


Pesticides: Active and Inert Ingredients

- **Active Ingredient (a.i)** - Part of the pesticide that has the pesticidal properties: kill, impair, or affect.
- **Inert Ingredients:** Part of the pesticide formulation that act as emulsifiers, solvents, carriers, and surfactant and supposedly will not affect the pest if used by itself.
 - Some inerts may be more toxic to humans than the A.I!



Adjuvants



Additives that are added to a spray solution in order to enhance or modify the performance of the spray mixture.



Adjuvants include:

- **Acidifiers** -neutralize alkaline solutions & lower pH.
- **Buffering agents** - stabilize the pH of spray solutions.
- **Anti-foaming agents**
- **Compatibility agents**
- **Deposition aids**
- **Drift control agents**
- **Emulsification aids**



Adjuvants also include:

- **Retention agents - help bond the pesticide to plants & soil particles by forming positively charged droplets. Provide resistance to rain wash-off and leaching.**
- **Suspension aids - added to a suspension in order to keep pesticide particles dispersed or to resuspend particles.**
- **Many surfactants (surface-acting agents)**



Four Groups of Adjuvants

- **Surfactants/wetting agents**
- **Oils**
- **Fertilizers**
- **Utility**



Surfactants

- **A broad category of adjuvants that facilitate and enhance the absorbing, emulsifying, dispersing, spreading, sticking, wetting and penetrating properties of pesticides.**
- **Some pesticides like Roundup Pro already have surfactants added. (14.5 %)**

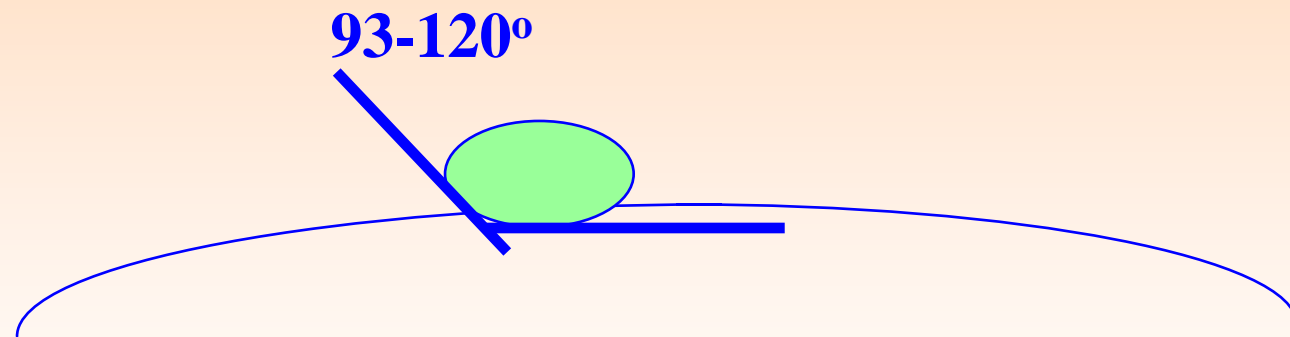


Surfactants

- **Because of the high surface tension of water, spray mixture droplets maintain their roundness and can sit on the leaf hairs or leaf surface without much of the mixture actually contacting the leaf.**

Contact Angle of water alone

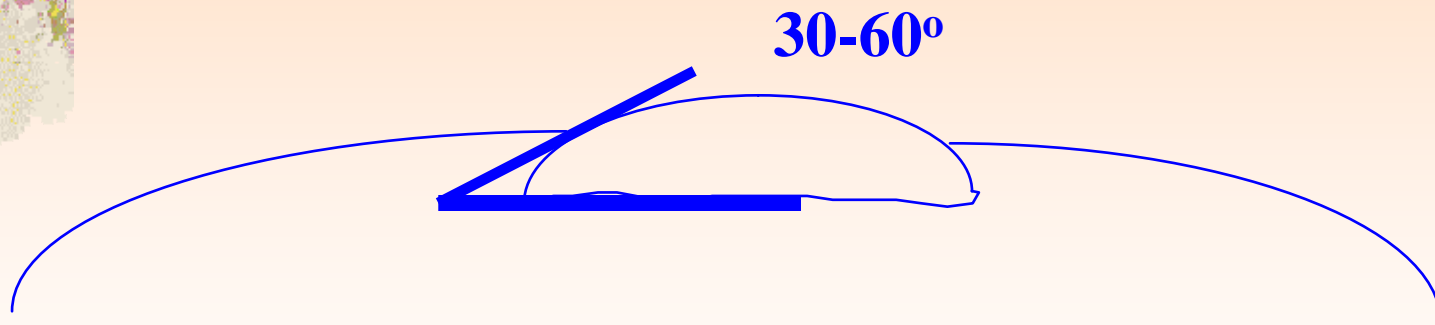
- * 93 to 120 degrees
- * Water has a high surface tension



- * Droplets tend to “stand” up
- * Less absorption, more degradation

Contact Angle with a surfactant:

- * 30 to 60 degrees.
- * More leaf surface is covered





1. Surfactants/wetting agents

- **Nonionic Surfactants**
- **Silicone compounds**



1. Surfactants/wetting agents

Non-ionic Surfactants

- Composed of alcohols and fatty acids
- Non-ionic = no charge
- Cationic (+) and anionic (-) surfactants may form precipitates (settle out).
- Reduces surface tension
- Improves spreading, sticking and herbicide uptake
- All purpose



1. Surfactants/wetting agents

Silicones

- **Blend of silicone & non-ionic surfactants: some are entirely silicone**
- **Big reduction in surface tension.**
- **Spread more than conventional surfactants**
- **Maximum rainfastness due to increased absorption.**
- **Can usually use at lower rates**



2. Oils

Crop Oil Concentrates (COC)

- **Blend of paraffin based petroleum oil and surfactants**
- **15-20% non-ionic surfactant; 80-85% emulsifiable crop oil**
- **Provides penetration characteristics of crop oil and surface tension reducing qualities of the NIS**
- **Used primarily with grass herbicides**



2. Esterified Seed Oils (ESO)

- Produced by reacting fatty acids from seed oils (corn, soybean, canola) with an alcohol to form an ester
- Methylated esters (MSO) are formed when a methyl group (CH_3) is added to an acid & alcohol group. Helps a herbicide penetrate the waxy plant surface.
- All purpose type of surfactant but...

2. Oils - Considerations

- **Roundup™ is readily soluble in water and should not be used with any oil product unless label specifies.**
- **Assure™ should not be used with MSOs because of a risk of crop injury.**
- **Improved results with MSOs with Accent™, Assert™, Basagran™, Beacon™, Fusilade™, Hoelon 3EC™, Poast™ and Poast Plus™.**
- **MSOs also improve performance with low rates of 2,4-D amine.**




3. Fertilizers - (Nitrogen-surfactant Blends)

- Improves herbicide uptake with hard-to-kill weeds
- Neutralizes or gives hard water mineral ions something to bind to instead of the herbicide.
- Ammonium sulfate has been found to promote the uptake of weak acid herbicides such as 2,4-D, Pursuit (imazethapyr), Poast (sethoxydim) and Basagran (bentazon) by adjusting the pH so that more of the active herbicide is transported across the leaf surface and into the plant.
- Used primarily with broadleaf herbicides.



4. Utility

- **Acidifiers** -neutralize alkaline solutions & lower pH.
- **Buffering agents** - stabilize the pH of spray solutions.
- **Anti-foaming agents**
- **Compatibility agents**
- **Drift control agents**
- **Emulsification aids**
- **Suspension aids** - added to a suspension in order to keep pesticide particles dispersed or to resuspend particles.



Water Quality

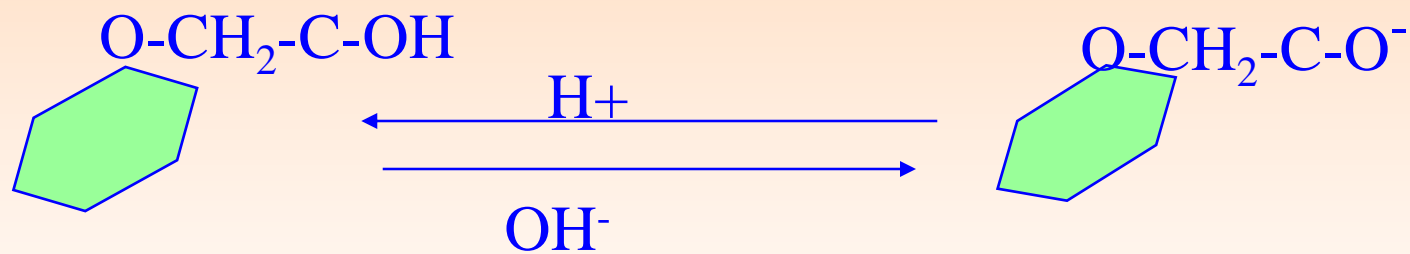
- **pH (alkalinity)**
- **Hard Water**
- **Dirty Water**



pH

- Measures the concentration of Hydrogen ions
- A scale for measuring acidity & alkalinity
- 0 - 14
- pH 2 is strongly acid; batteries
- pH 3-4; citrus fruits
- 7 is neutral
- pH 9-10; soaps
- pH 13; lye

- * At a low pH, 2,4-D is an uncharged molecule
- * At a high pH, 2,4-D becomes anionic or negatively charged



Alkaline Hydrolysis

- Breakdown of pesticides due to high pH (alkalinity.)
- Some pesticides can breakdown into inactive parts in a matter of hours and or minutes.
- The ideal pH for spray solutions is slightly acidic (pH 5-7).
 - **Always the exception: Ally & Escort (SUs) degrade in acid environments < pH 7. Stable in alkaline environments**
- Use a buffering or acidifying adjuvant.

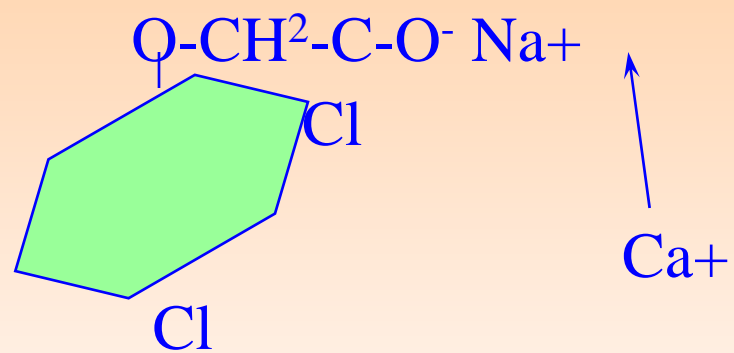
pH Effects On Commonly Used Pesticides

Trade Name	Common Name	pH	½ life 50% breakdown
Benlate	Benomyl	7.0 5.6	1 hour > 30 hours
Guthion	azinphos-methyl	9.0 7.0 5.0	12 hours 10 days 17 days
Captan	captan	10.0 4.0	2 minutes 4 hours
Furadan	Carbofuran	9.0 7.0 6.0	78 hours 40 days 200 days



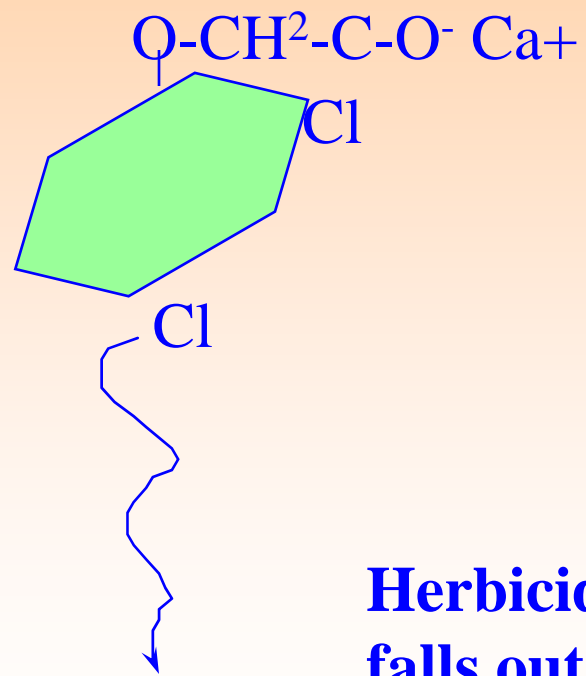
Water Hardness

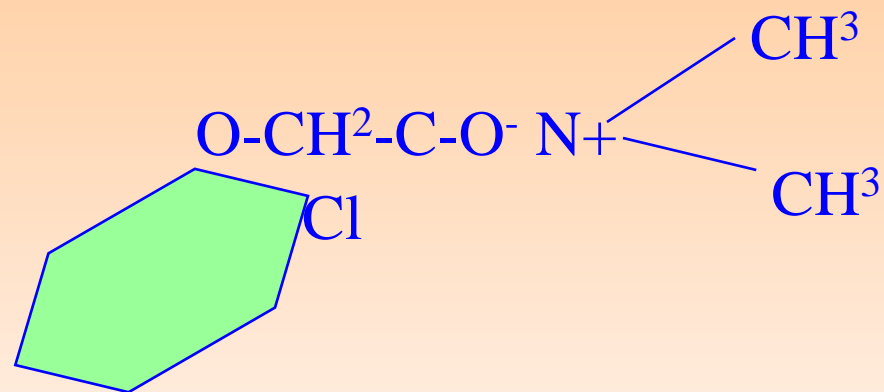
- **Hard water contains calcium, magnesium, iron**
- **Can deactivate pesticides or cause them to fall out of solution**
- **Water conditioners lower pH & tie up hard water ions**
- **Hard water ions can replace pesticide ions.**
- **2,4-D**



An Amine Salt of 2,4-D

Calcium replaces the sodium





**A diethylamine salt or ester of 2,4-D.
Less susceptible to hard water ions**

**Key Point: Be wary of sodium salts in
hard water situations. Use water
conditioner if necessary**

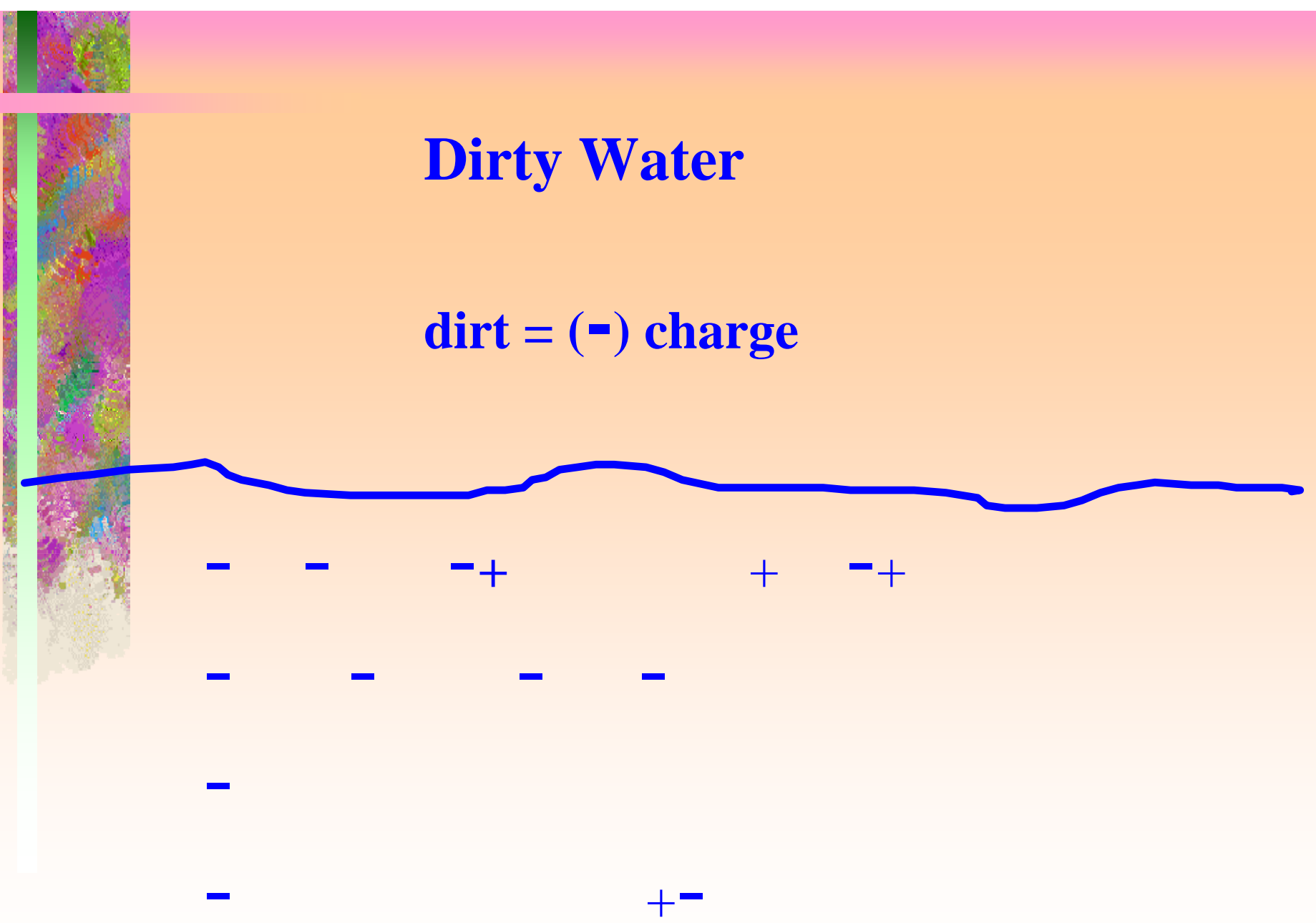
Different 2,4-D's & Hard Water

<u>Form of 2,4-D</u>	<u>Stability in Hard Water*</u>
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- | | |
|------------------|------|
| • Di-ethyl amine | Fair |
| • K, Na salts | Poor |
| • Esters | Good |

Dirty Water

dirt = (-) charge





To choose the best adjuvant:

Read the Label



Tips When Choosing Adjuvants

- Use an MSO if its on the label and you are spraying grass weeds..EXCEPT when tank mixing a grass herbicides with a broadleaf herbicide (post-emergent) unless MSO is specified on both labels.
- If the label gives you a choice between MSO or a NIS, choose NIS under “normal” weather conditions and MSO is weeds are drought stressed.
- Don’t add fertilizer unless specified on label. Conduct a jar test if you want to try it.

Compatibility Test

- Wear your PPE.
- Obtain a clear, clean 1 quart jar.
- Use the same diluent (usually water) & mix in same proportions as you use in the field (1 teaspoon = 1 quart of pesticide added to 50 gallons of water).
- Add half of diluent to jar then add pesticide according to W-A-L-E plan.
- Add Wetttable & other powders & Water-dispersible granules
- Agitate and add remaining diluent
- Add the Liquid products, such as solutions, surfactants and flowables.
- Add Emulsifiable concentrates last.
- Shake jar vigorously and feel sides of jar for heat. Check for lumps, scum and clumps



Practical Solutions If Water Quality Is A Concern

- **Test your water source.**

Is it suitable for spraying pesticides?

- **Reduce water volume to minimum required for good coverage & performance. Check label for volume specs.**
- **Use a pesticide that is least affected by water quality.**

Seek alternative water source

- **Spray ASAP after adding the pesticide to the sprayer tank.**
- **Ammonium sulphate fertilizer (21-0-0-24) is registered for use with some glyphosate herbicides (rate: 7 lbs/27 gallons of water) to minimize the detrimental effects of hard water.**



Questions to ask when considering a surfactant

- **What are the environmental conditions before application?**
 - Hot/dry?
 - Surfactant may help under less than ideal conditions
- **What conditions follow an application?**
 - Max rainfastness: esterified seed oils, organo-silicones, nitrogen surfactants
 - Not all surfactants have the same amount of rainfastness



Questions to ask when considering a surfactant

- **What are the pest characteristics that may affect pesticide uptake?**
 - **Leaf surface, narrow or wide**
 - **Insect contact time**
- **Costs**
 - **Generally, non-ionic surfactants and crop oil concentrates are the least expensive**
 - **Nitrogen surfactants, esterified crop oils, organo silicones (most expensive)**