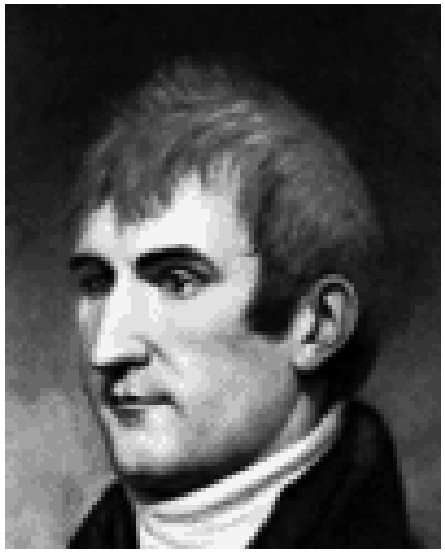


CURR AHEE

PESTICIDE FORMULATIONS, COMPATIBILITY & ADJUVANTS

What is a Formulation

- **How a pesticide is packaged.**
- **Contains:**
  - **Active Ingredient**
  - **Inert Ingredient**

Two types of formulations

- **Wet**
- **Dry**

Types of formulations

- **Wet**
  - **More easily absorbed**
- **Dry**
  - **More easily inhaled**

Liquid Formulations

- **EC –Emulsifiable Concentrate**
- **S - Soluble**
- **ULV – Ultra Low Volume**
- **F or FL - Flowables**
- **ME – Micro-Encapsulated**
- **RTU – Ready To Use**

Dry Formulations

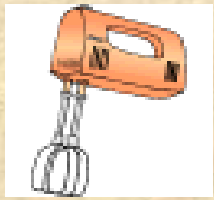
- **WP – Wettable powder**
- **DF – Dry Flowable**
- **WDG – Water Dispersable Granule**
- **D - Dust** ✓
- **P or G – Pellets or Granules** ✓
- **M or ME – Micro-Encapsulated**

RTU's ?

Effects of Different Formulations

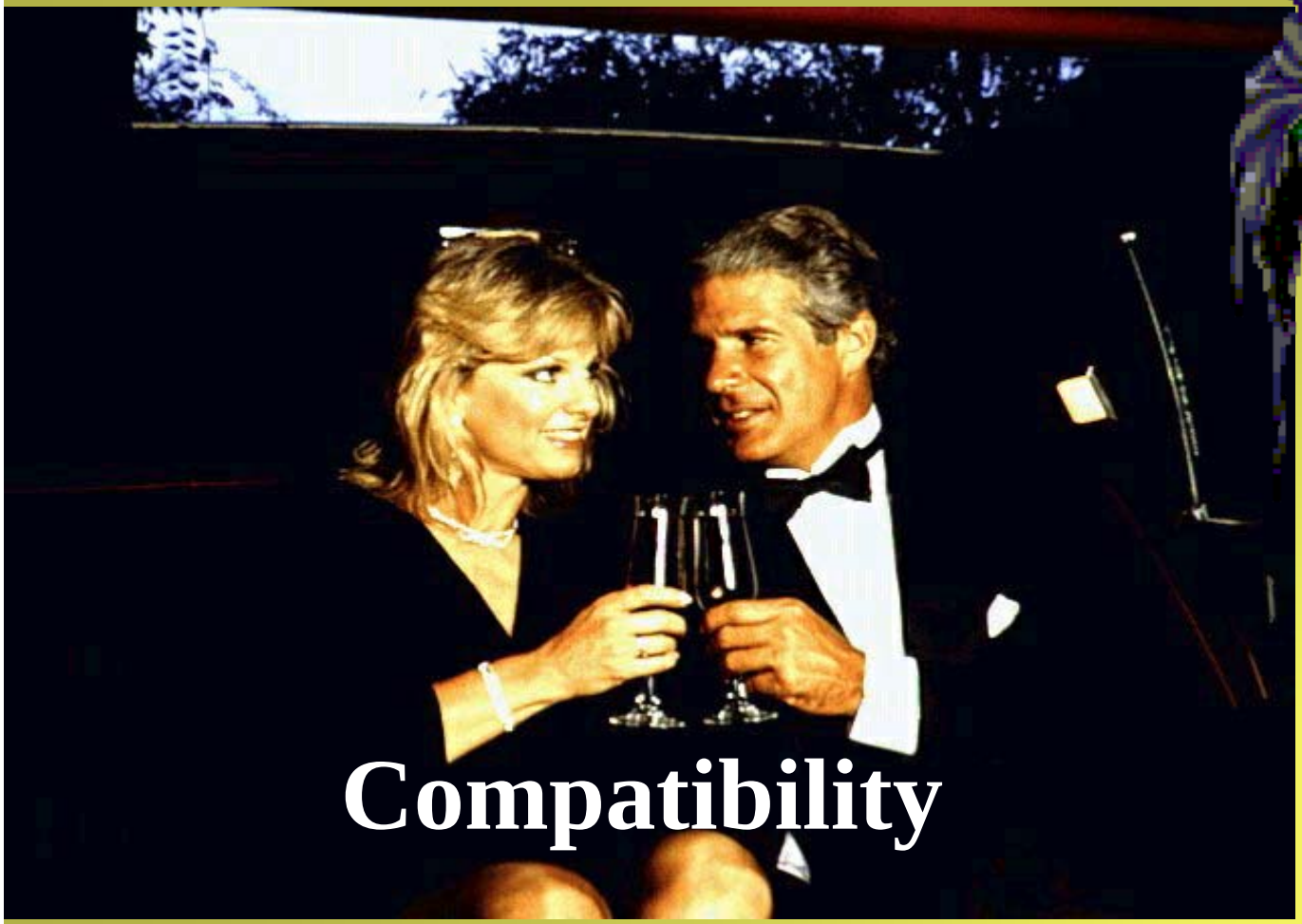
Formulation	Hazards	Phytox	Equipment	Agitate	Compatible
WP	Inhale	Safe	abrasive	Yes	High
DF/WDG	Safe	Safe	abrasive	Yes	Good
SP	Dusts	Safe	Non-abrasive	Some	Fair
G or P	Inhale	Safe	NA	NA	NA
F or FL	Dermal	Maybe	abrasive	Yes	Fair
S	Dermal	Safe	Non-abrasive	No	Fair
D	Inhale	Safe	NA	NA	NA
EC	Dermal	Maybe	Seals, gaskets	No	Fair
M or ME	Dermal	Safe	Generally ok	Yes	Fair

Mixing Order



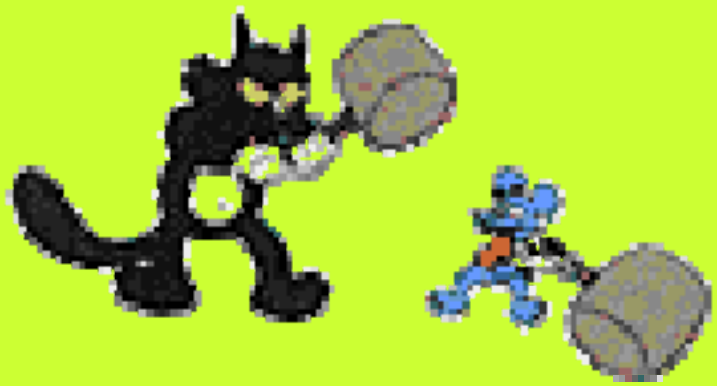
- **Fertilizer based surfactants first and compatibility agents**
- **Wettable Powders, Dry flowables**
- **Agitate**
- **Liquid formulations, Solubles**
- **Emulsifiable concentrates**
- **Soluble powders & Remaining Surfactants**

Pesticide Interactio



Compatibility

Read the Label



Four Types of Interactions

- **Additive effects**
- **Synergistic responses**
- **Antagonism**
- **Enhancement**

1. Additive Effects

- **Mixing of 2 or more pesticides**
- **Same response when used alone**
- **Ease of mixing**
- **Reduces # of field passes**
- **Example: root absorbed herbicide with a foliar absorbed.**

2. Synergistic Response

- **Confused with Additive effects**
- **Greater response when mixed.**
- **True interaction between chemicals**
- **Example:**

  Piperonyl butoxide and pyrethrums

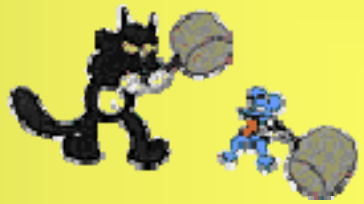
  2,4-D and glyphosate

3. Antagonism

- **Less control when 2 or more chemicals are mixed**
- **May also increase phytotoxicity**
- **Example:**
  - **mixing of some grass and broadleaf herbicides (Diclofop and 2,4-D)**
  - **Assert and Curtail**

Antagonism - pH Effects

- **Mixing Assert and Curtail**
  - **Assert works best at pH 4**
  - **Curtail is an amine; raises the pH to 7 when mixed with Assert**
  - **Assert precipitates out**
  - **Use Curtail M (an ester)**



4. Enhancement

- **When a pesticide is mixed with an additive to provide greater response.**
- **Crop Safeners**
  - **Everest & phenoxys**
- **Adjuvants**

Two Types of Incompatibility
1. Physical
2. Chemical

- **Physical - inert** ingredients.
  - Flaking, crystals form sludge, clogs equipment. EC with WP, oil based surfactant and WP
- **Chemical -** deactivation of active ingredient due to pH, temperature, pesticide chemistries

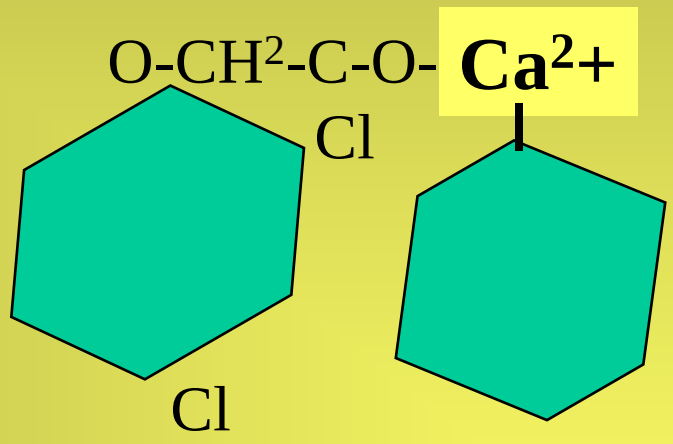
Water Quality-Minerals & pH

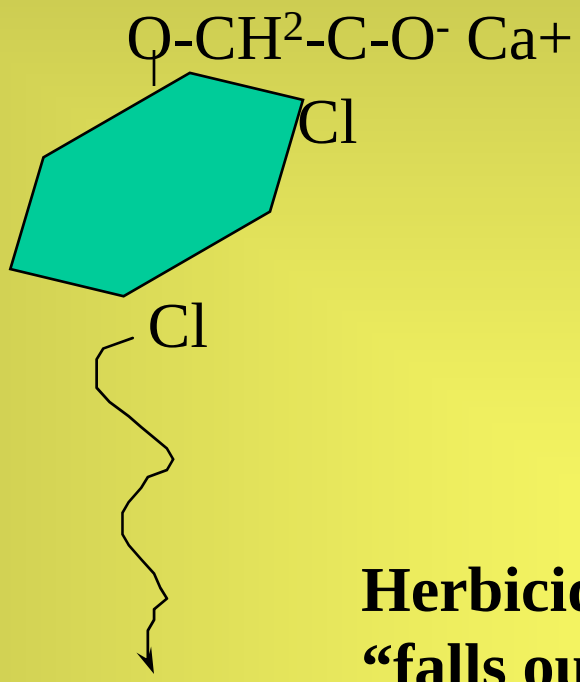
- **Hard Water**
- **Soft Water**
- **Other Minerals**

Water Quality – Hardness

- **Hard Water –Ca+ and mg+**
  - **ppm or grains**
  - **Affect salt-based herbicides – Roundup, 2,4-D.**

Salt-based herbicide or a surfactant
Calcium replaces the sodium





Herbicide “falls out”

Water Quality – Hardness

- **Use max rate or reduce carrier volume**
- **Severe hard water (Roundup) - add ammonium sulfate (AMS) or spray-grade water conditioner**
- **Severe hard water (2,4-D & other salt based herbicides**
  - **adjuvants**
  - **Avoid salt based herbicides**

Water Quality

- **Alkaline Hydrolysis – effect of high pH**
- **Organophosphate and carbamate pesticides degrade in pH >7.**

Organophosphates	Carbamates
• Malathion/Parathion	• Sevin
• Dorsban/Lorsban	•Lannate
• Diazinon	

pH and Pesticides

Trade name	Common name	pH	Half-life
Furadan	Carbofuran	9.0 6.0	78 hours 8 days
Sevin	Carbaryl	9 7	24 hours 24 days
Malathion	Malathion	7.0 8.0	35 days 9.0 hours
Imidan	Phosmet	4.5 7.0	13 days < 12 hours

Water Quality – Low pH

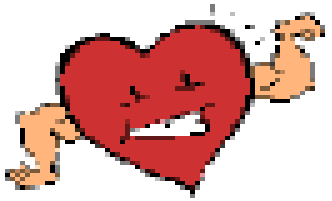
- **pH 5-7 is optimum for most herbicides.**
- **Acid Hydrolysis**
- **Sulfonyl Urea herbicides degrade in acidic environments.**
  - **Ally and Escort**
- **Most sulfonyl ureas are stable in pH > 7.9**

Timing of application

Timing (or lack of) is another form of incompatibility

Compatibility Test

- **A small scale test using a 1 quart jar**
- **Proportions**
  - **1 teaspoon per pint = 1 pint per 100 gallons of water**
- **Check for lumps, clumps, gunk, goop, glop, heat**



Adjuvants

Additives that improve performance or offset problems

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**
- **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, spreading, sticking, wetting and penetrating properties of pesticides.**
- **Most pesticides like Roundup Pro already have surfactants added. (14.5 %)**
- **Generally used for less than optimum conditions**

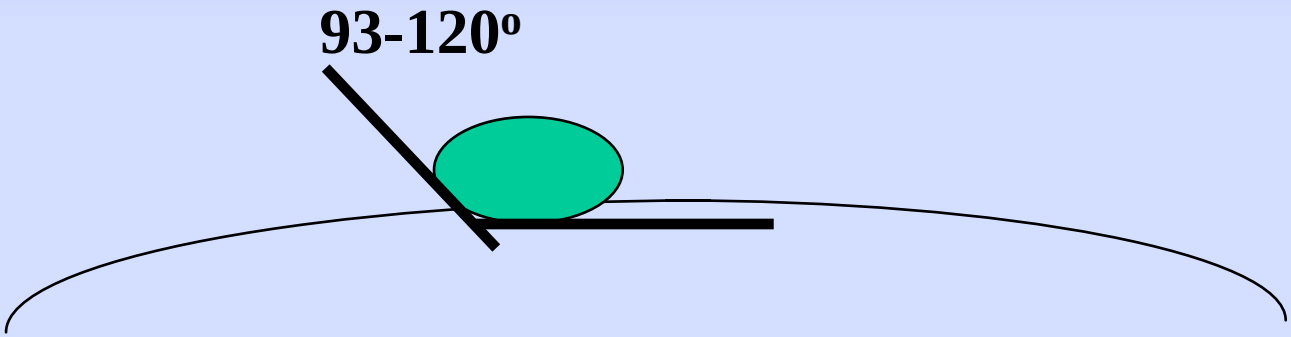
Why Surfactants?

- **Breaking surface tension**
- **Penetration and absorption**

Contact Angle of water alone

* **93 to 120 degrees**

* **Water has a high surface tension**

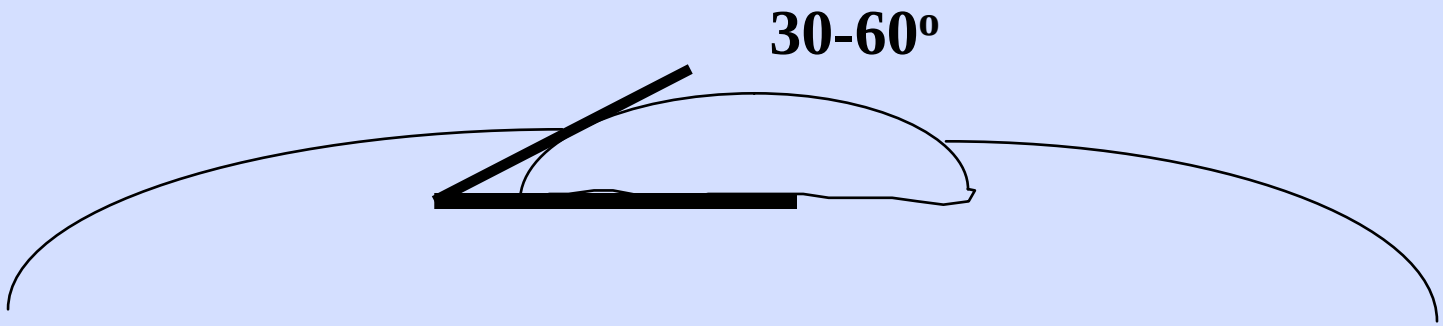


* **Droplets tend to “stand” up**
* **Less absorption, more degradation**

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**
- **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 –too fast??**

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**
- **Can cause crop damage - stress**

2. Esterified Seed Oils (ESO)

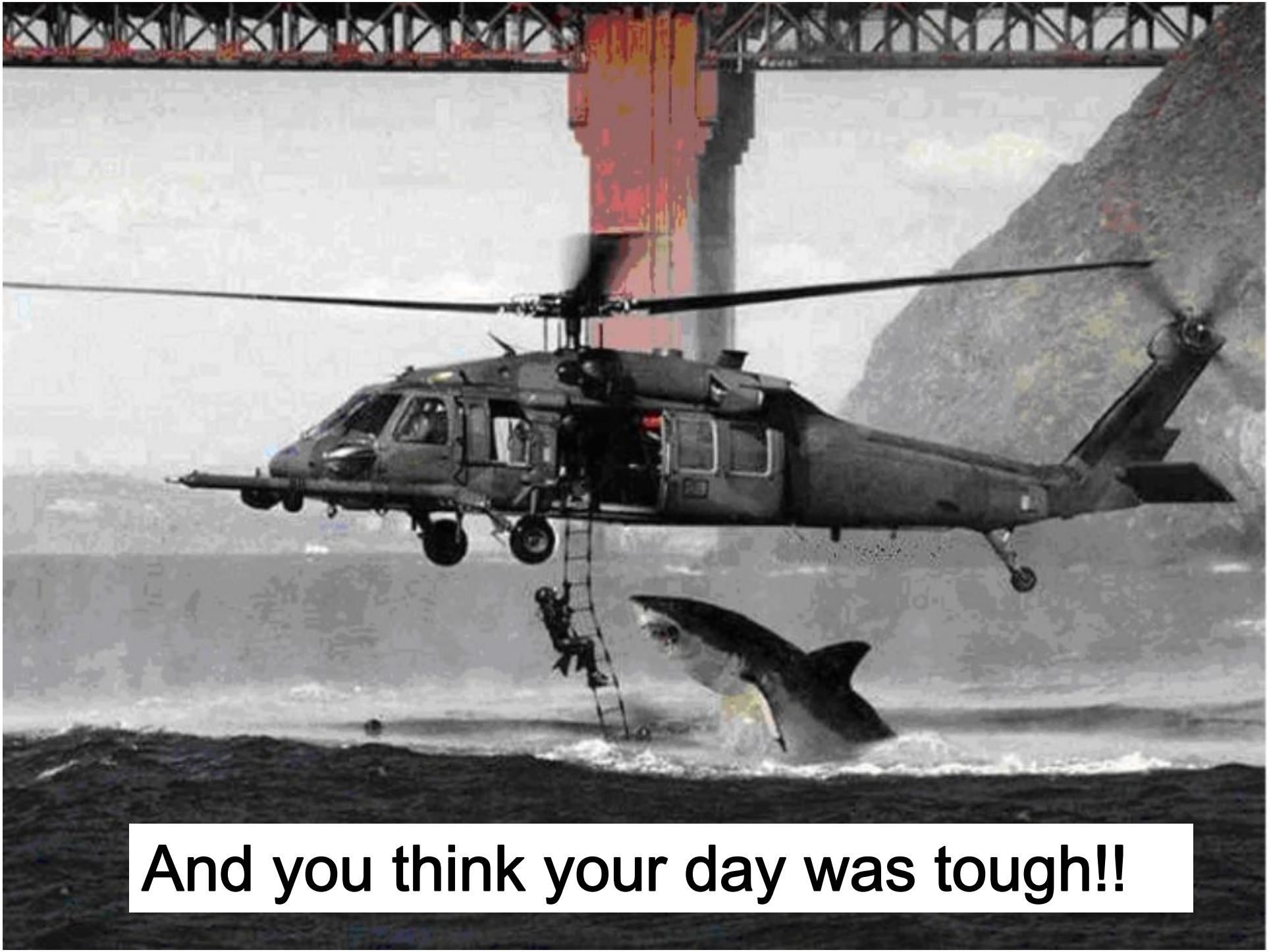
- **Seed oils - corn, soybean, canola**
- **Methylated esters (MSO). Helps a herbicide penetrate the waxy plant surface.**
- **Better crop tolerance**

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**
  - **promote the uptake of weak acid herbicides such as 2,4-D, Pursuit (imazethapyr), Poast (sethoxydim) 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.**


And you think your day was tough!!