



**The Leading edge of Oleo-Chemical
Technology for the Agricultural
Industry**

What are Adjuvants?

“A material added to a tank mix to aid or modify the action of an agrichemical, or the physical characteristics of the mixture.”

ASTM International Standard Terminology

What do they do ?

- Help deliver the Pesticide to the target
- Maximise the uptake of Pesticide into the target
- Protect against degradation

What types are there ?

There are 3 major chemical types of Adjuvants: Oils, Surfactants and Others

Oils

- Aid penetration through waxy surfaces
- Reduce evaporation of spray droplets

Surfactants / Wetting Agents

- Spread spray droplets to cover target effectively.
- Increase droplet adhesion to target

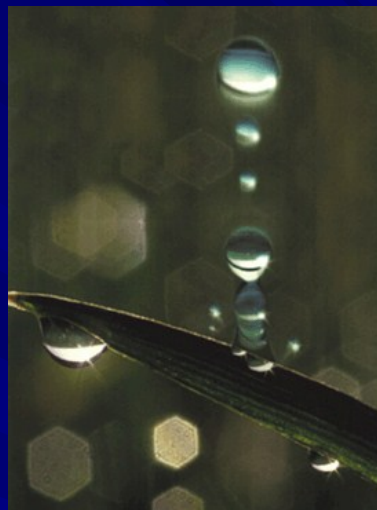
Buffers / Water Conditioners

- Prevent loss of active in the spray tank

How do Adjuvants Work?

Enhance efficacy

- help adhere to leaf surface
- help spread across leaf surface
- help penetrate leaf surface



Protect from losses

- prevent formation of insoluble complexes (eg with hard water ions)
- slow evaporation of droplets in-flight and deposit on leaf
- prevent chemical degradation (eg hydrolysis at high pH)

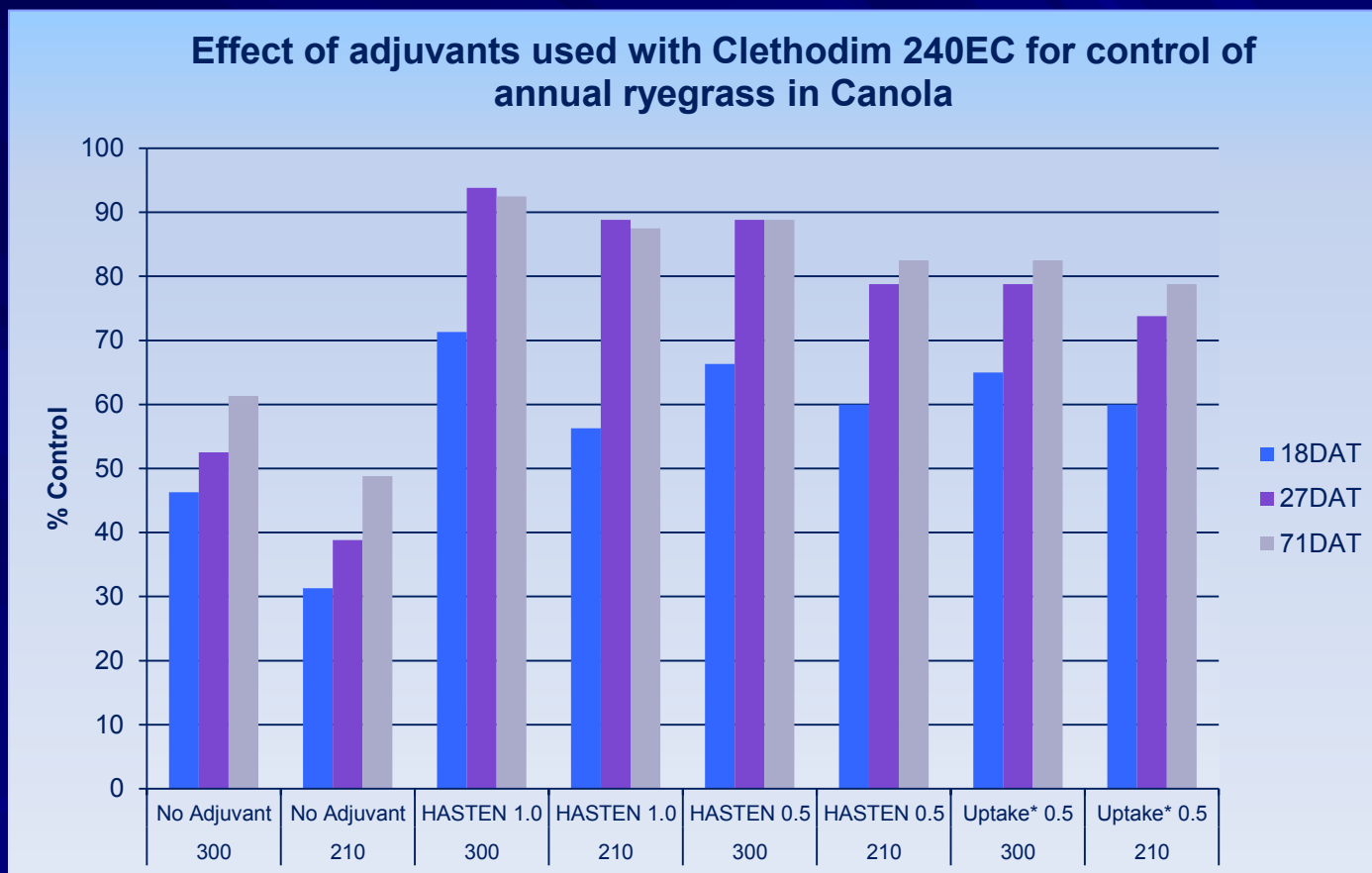
Do Adjuvants Work ?

Efficacy – Can adjuvants affect herbicide efficacy and does choice of adjuvant matter?



Do Adjuvants Work ?

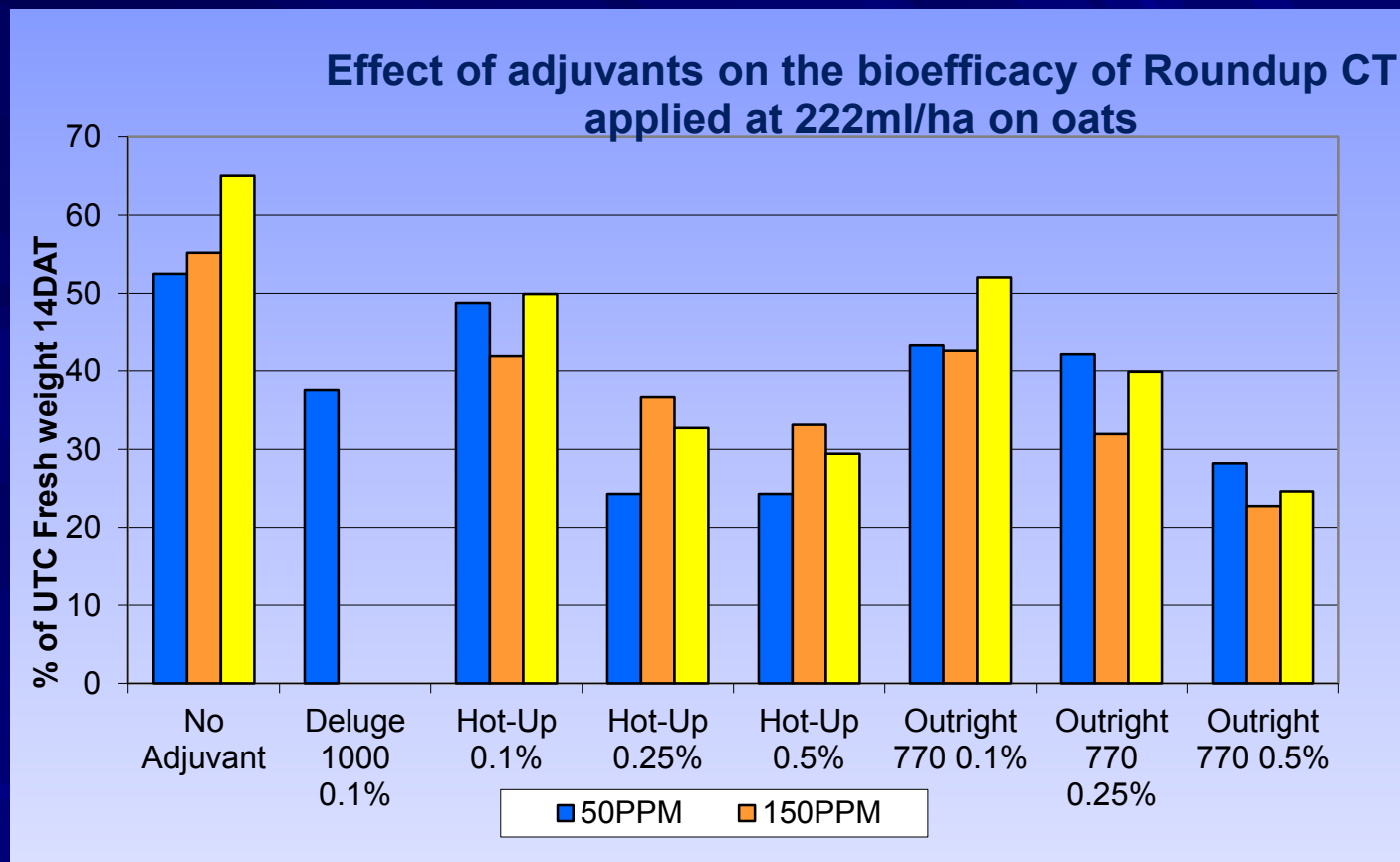
Oil Adjuvants for Clethodim



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Do Adjuvants Work ?

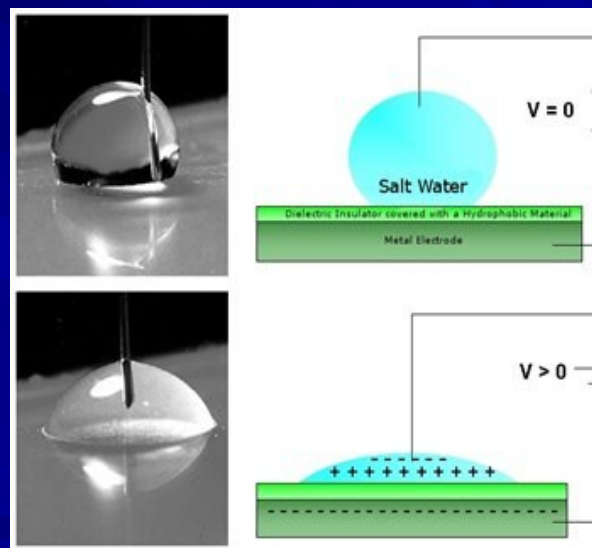
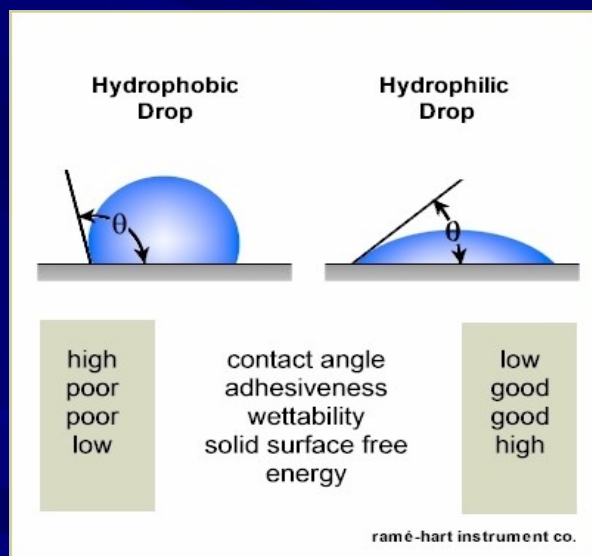
Adjuvants for Glyphosate in Hard Water



How do Adjuvants Work?

Increase Efficacy – adhere to and spread across leaf surface.

- Help adhere to leaf surface. Wetting agents reduce dynamic surface tension which helps a droplet adhere to the surface rather than rebound.
- Help spread across leaf surface. Wetting agents reduce the contact angle between the liquid and solid interface. Each droplet covers a larger surface area.
- Oil Adjuvants contain a small amount of wetting agent to assist adhesion and spreading.



How do Adjuvants Work?

Increase Efficacy – help penetrate the leaf surface.

Chemicals enter the foliage through 2 possible paths, the Lipophilic and Aqueous Pathways. Adjuvants can assist chemicals to penetrate foliage by both pathways. The type of the adjuvant determines which pathway.

Lipophilic – Oil soluble pathway (oil adjuvants).

Aqueous – Water Soluble pathway (wetting agents).

Oil soluble chemicals can enter a leaf via the **lipophilic** pathway and may be assisted by oil adjuvants.

Water soluble chemicals can enter a leaf via the **aqueous** pathway and may be assisted by water soluble adjuvants, particularly wetting agents.

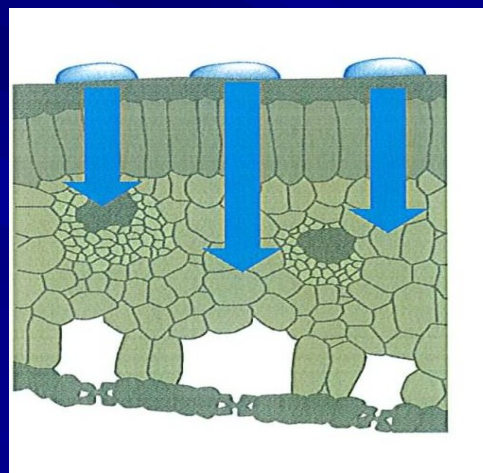
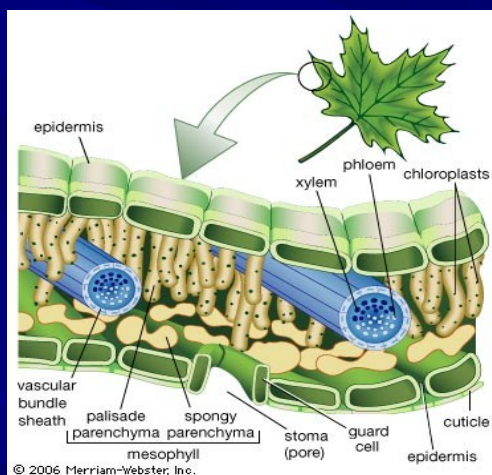
Lipophilic Pathway

A leaf surface is covered in a waxy layer which prevents water passing through.

Oils and solvents (lipophilic materials) can diffuse through this barrier.

Oils adjuvants such as Hasten have an ability to penetrate straight through in a very even, uniform way.

This is the **lipophilic pathway** or **lipophilic diffusion**.



Aqueous Pathway

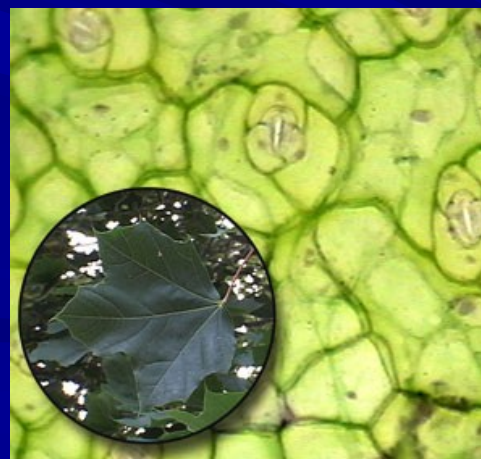
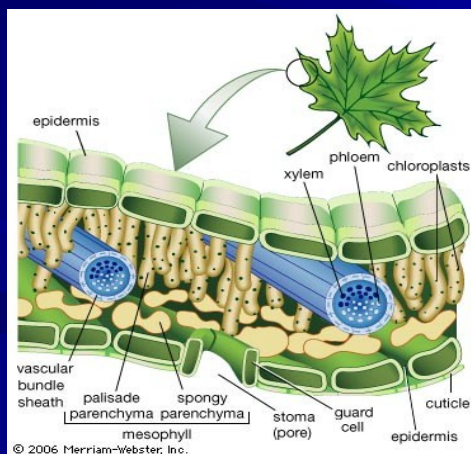
The Aqueous Pathway involves water and soluble material as penetrants.

A leaf surface is covered in a waxy layer which prevents water passing through.

The waxy layer is often an arrangement of waxy platelets or crystalline waxes.

Water and water soluble materials can only penetrate by finding gaps, cracks or holes. These gaps appear between the platelets or around the stomata.

Wetting agents enable water and water solubles to find these gaps and help force the water through. Water soluble herbicides such as glyphosate generally are very responsive to wetting agents.



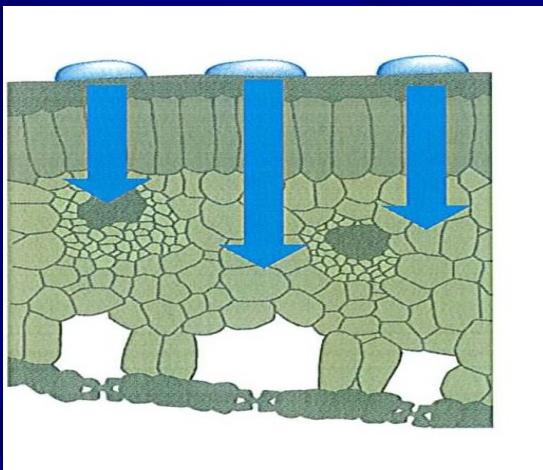
Aqueous & Lipophilic Pathways

Lipophilic Pathway

Oil Soluble Materials

Oils can diffuse through the waxy layer

Oil-based adjuvants such as Hasten can help carry oil soluble chemicals into the leaf via the lipophilic pathway.

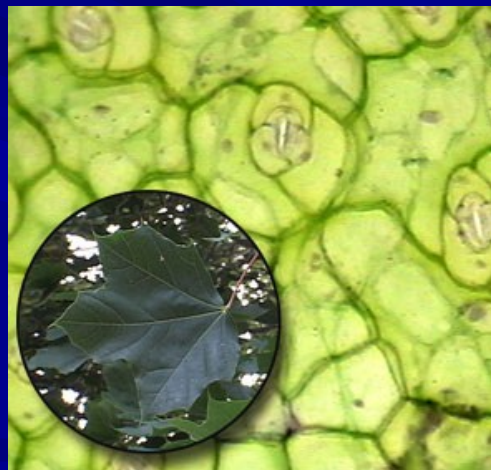


Aqueous Pathway

Water soluble Materials

Water can enter the leaf by finding gaps between waxy platelets or cells

Wetting agents help the water and water soluble chemicals to penetrate into the gaps.

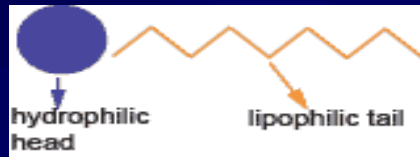


Differences between Oils used as adjuvants

Oil Type	Synonyms	Adjuvant Products	Properties		
			Penetration	Crop Safety	Droplet Size
Mineral Oils	Petroleum Oil Paraffin Oil White oil	Adhere InBound Uptake*	Fair	Good – pure oils	No effect
		Empower Anti-Evap*		Poor – crude oils	
Vegetable Oils	Canola Oil Seed oil Natural Oils	Nexus Synetrol*	Poor	Good	Increases
Esterified Oils	Methyl Oleate Methylated or Ethylated Seed Oil MSO / ESO Fatty Esters Vegetable esters	Hasten Infiltrator	Good	Generally OK	Increases

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Surfactants / Wetting Agents as adjuvants

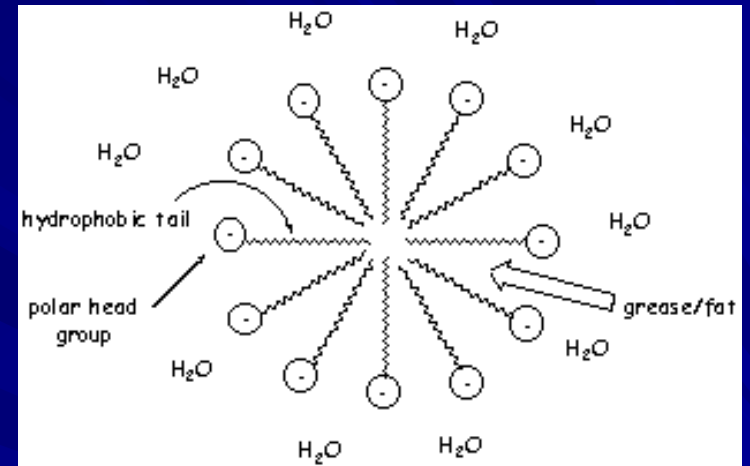
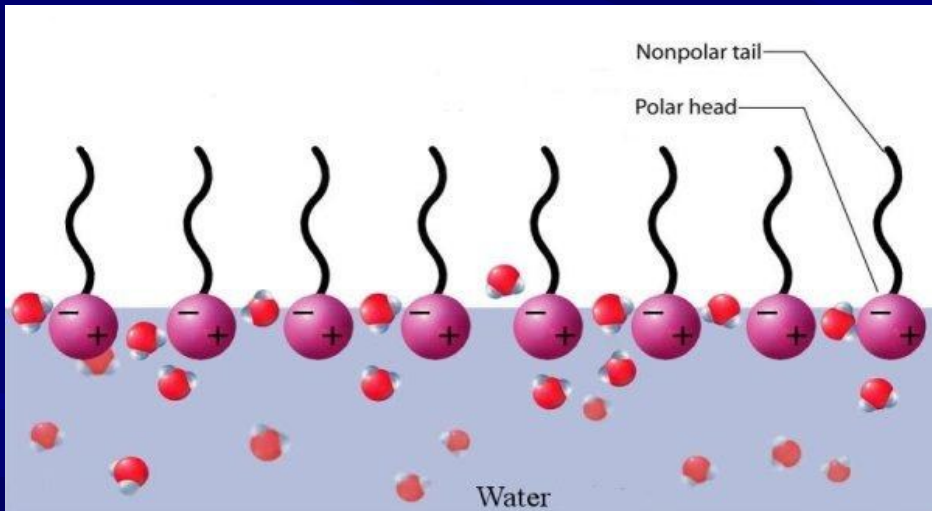


Wetting agents are surfactants (**surface active agents**)

They consist of 2 distinct parts

- water loving head
- oil loving tail

At an interface they tend to congregate and align.



The lipophilic tails face inward to form a ring around oil or grease with the hydrophilic head facing out toward the body of water.

Surfactants / Wetting Agents as adjuvants

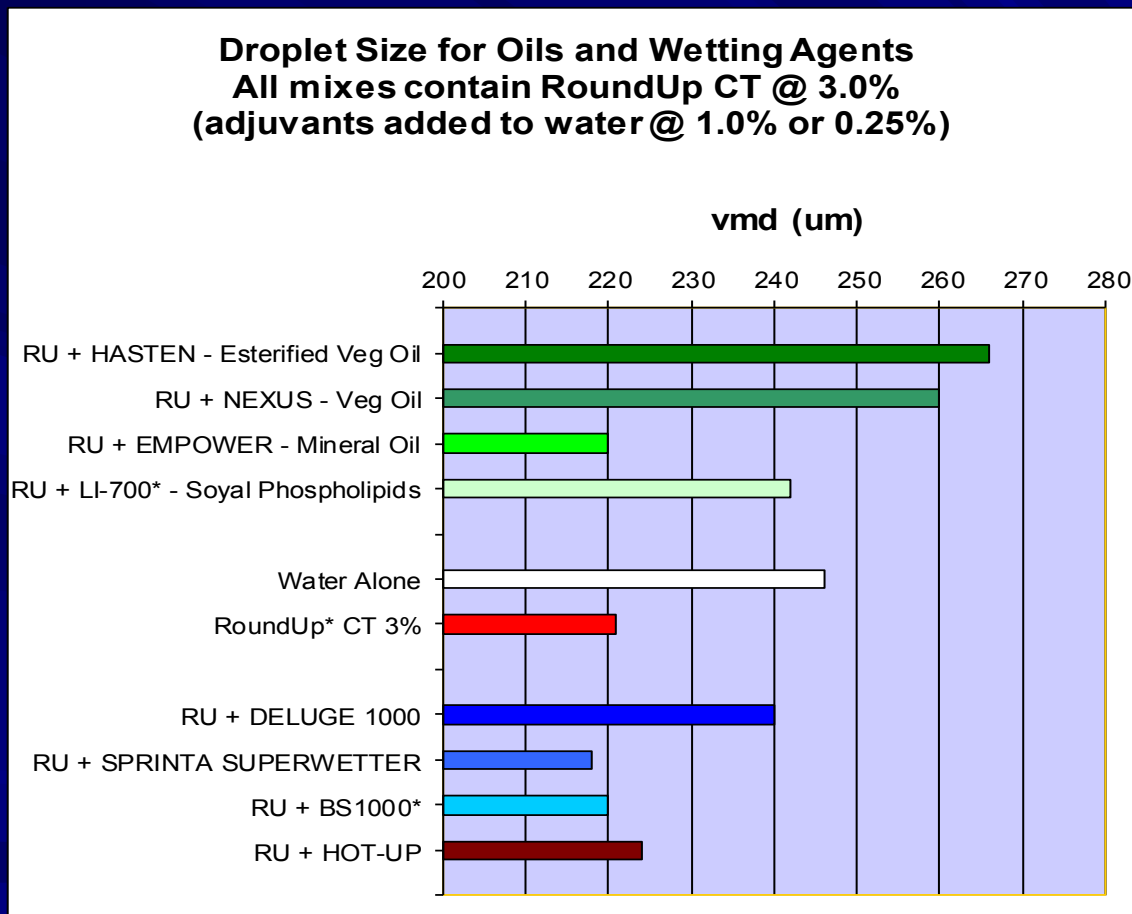
surface active agents

Surfactant Type	Chemical Description	Products	Properties
Anionic	Calcium Dodecylbenzene Sulphonate	No Adjuvant Products. Formulated in many herbicide products.	Incompatible with certain herbicides.
Nonionic	Alkylphenol ethoxylates	Spreadwet* Agral*	General Purpose
	Alcohol ethoxylates	Surewet1000 BS1000*	Better Wetting
	Fatty acid ethoxylates	Deluge1000	Better Crop Safety
'natural'	Alkyl polglucosides	Formulated in 'Frog Friendly' herbicide products.	Environmentally Friendly
	Fatty acid Sorbitan esters	Rarely used.	Environmentally Friendly
Superwetters	Organosilicone surfactants	Sprinta Pulse*	Superior Wetting

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Adjuvant effect on droplet size

Oil adjuvants tend to increase the droplet size.
Wetting agents tend to decrease the droplet size.



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Adjuvants for Agriculture - CONCLUSIONS

Adjuvants work by

- Help deliver the Pesticide to the target
- Maximise the uptake of Pesticide into the target
- Protect against degradation