

Correct use of adjuvants

Nicholsons, The Park, North Aston, Bicester, Oxfordshire OX25 6HL

Tuesday 9th July 2024



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Commonly used adjuvants with different crop protection product types insecticides, fungicides, herbicides.	
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Agenda



Content				
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Coffee, tea, and refreshments				
	Selchuk Kurtev, Zest			
when integrating them with crop protection	Sustainable ICM			
products				
Types of adjuvants and their properties	Selchuk Kurtev, Zest			
	Sustainable ICM			
Coffee, tea, and refreshments				
Influence of plant and leaf structures, crop	Wayne Brough, HTA			
canopies and densities and crop situations				
(protected vs outdoor) and water quality used				
for spraying.				
Commonly used adjuvants with different crop	Selchuk Kurtev, Zest			
protection product types - insecticides,	Sustainable ICM			
fungicides, herbicides.				
How to choose the correct adjuvant and when	Selchuk Kurtev , Zest			
you should consider use of adjuvants. Correct	Sustainable ICM			
tank mixing sequences.				
Lunch buffet				
Practical session				
Comparison work on adjuvant performance	ALL delegates			
on different plant structures using different				
adjuvants and water volumes.				
Summary quiz for the learning from the day –	ALL delegates			
delegates will be involved in completing a 25-	_			
question quiz with multiple choice questions.				
Wrap up and depart				
(Types of adjuvants and their properties Coffee, tea, and refreshments Influence of plant and leaf structures, crop canopies and densities and crop situations (protected vs outdoor) and water quality used for spraying. Commonly used adjuvants with different crop protection product types – insecticides, fungicides, herbicides. How to choose the correct adjuvant and when you should consider use of adjuvants. Correct tank mixing sequences. Lunch buffet Practical session Comparison work on adjuvant performance on different plant structures using different adjuvants and water volumes. Summary quiz for the learning from the day – delegates will be involved in completing a 25-question quiz with multiple choice questions.			

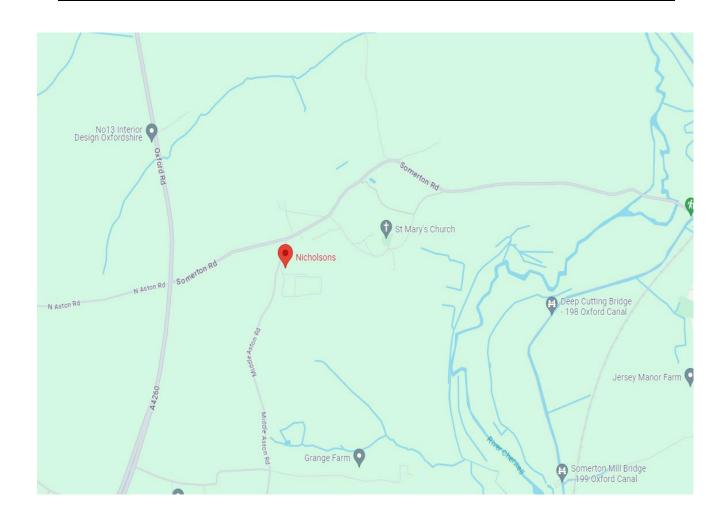
BASIS and NRoSO continued professional development points will be available on the day of the workshop.

Location



Addresses and locations:

Nicholsons, The Park, North Aston, Bicester, Oxfordshire OX25 6HL What3words: ///twitches.pounces.defenders



What are adjuvants and regulatory position when integrating them with crop protection products



Selchuk Kurtev, Zest - Sustainable ICM

Decreased tank mix foaming

✓ Field marking

Notes What are adjuvants and regulatory position when integrating them with crop protection products Selchuk Kurtev, Zest Sustainable ICM HTA What I will cover ➤ What is an adjuvant > Adjuvants definition > Regulatory around adjuvants > Examples of products without the need for approval zest' What are adjuvants > Adjuvants (taken from the Latin, "adjuvare," meaning "to help" > 'Products' in various formulations and containing active substances with no 'Pesticidal' activity but perform one or several functions: \checkmark Improved pesticide coverage, adherence and penetration to a pest or into crop tissue Water conditioning Increased water droplet size Additional stability, solubility and compatibility of a solution



Definition of an adjuvant



Adjuvants are authorised under **Regulation (EC) 1107/2009** which defines 'adjuvants' as being:

'substances or preparations which consist of co-formulants or preparations containing one or more co-formulants, in the form in which they are supplied to the user and placed on the market to be mixed by the user with a plant protection product and which enhance its effectiveness or other pesticidal properties, referred to as 'adjuvants'.

Adjuvants are **NOT** plant protection products (PPPs); but, as they influence the way PPPs behave and the effects they have, they are subject to regulatory control.

Regulatory

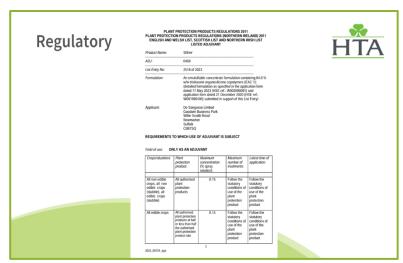
- The Official List of Adjuvants Adjuvant Search (pesticides.gov.uk)
- Crop specific approvals be aware!
- Phytotoxicity claim not possible if used on unauthorised crop
- Spray records must highlight its use
- Possible dose rate reduction of certain products and crops
- Must carry out COSHH assessment
- Storage conditions

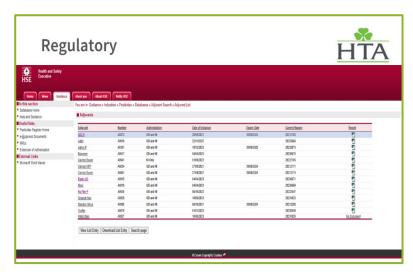


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HSE Health and Safety		
Home News Goots		
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Help and Guidance	■ The Official List of Adjuvants; adjuvants for use in GB and M, GB or M	
Useful links Pesticides Register Home	The Official List of Adjusants includes at List Entries for use in GB and M, GB or NI. It is the user's responsibility to check individual List Entries to determine the extent of use permitted by each specific List Entry	
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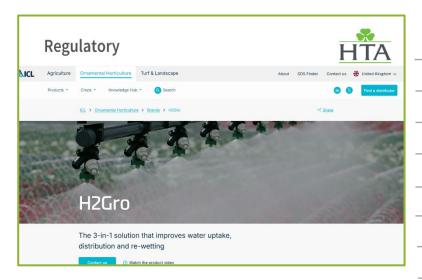


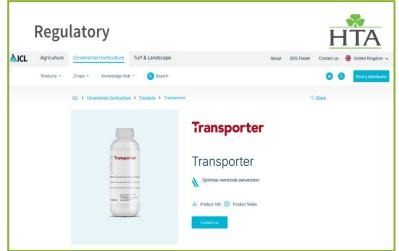


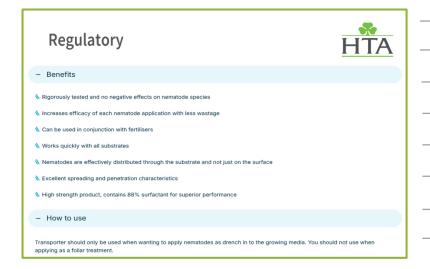














SUMMARY



- > Adjuvants are regulated products!
- **➤** Must comply with pesticide statutory labels
- > Strict use according to specific product recommendations
- > Adjuvants cannot claim pesticidal activity
- ➤ Some products do not require entry into 'Official list'
- COSHH assessments are important
- > On edible crops when using adjuvants often at half or lower rate

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THANK	
Zest [®] Sustainable ICM	Zest

Types of adjuvants and their properties

Selchuk Kurtev, Zest - Sustainable ICM



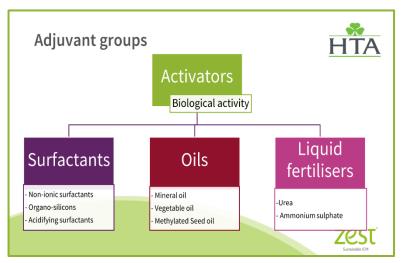
Notes

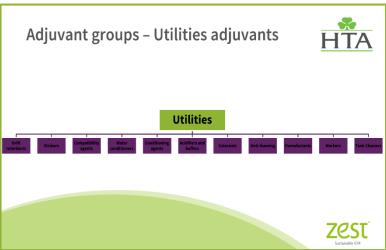


- > Adjuvant groups and types
- > Adjuvant properties and adjuvant tree
- > Surfactants and Oils
- > Examples of Utilities adjuvants



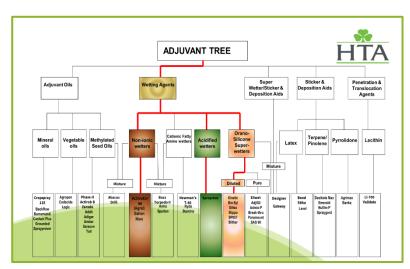


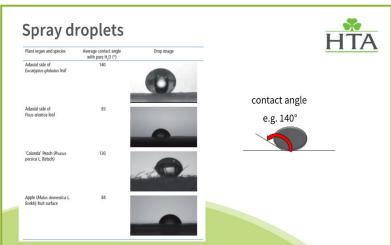


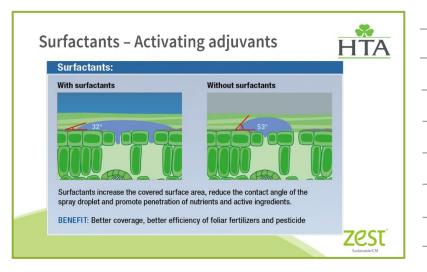


Adjuvant properties Drift retardants - aid droplet size control Stickers - improve retention and could aid with anti-transpiration Compatibility agents - enables uniform mixing of liquid fertilisers and pesticides mixtures Water conditioners - used to adjust water parameters according to pesticide needs, ion control Conditioning agents - help pesticides with key physical parameters e.g. solubility, stability etc. Acidifiers and buffers - reduce lock up of pesticides in hard water Colorants - neutralise colouring potential of active substances Anti-foaming - prevent foaming in tank and reduce diffusion at spraying nozzles Humefactants - reduce evaporation from sprayed surface to retain activity for longer Markers - help with recognition of sprayed vs unsprayed areas as well as identify coverage Tank Cleaners - prevent active substance binding to sprayer parts











HTA Surfactants – Activating adjuvants ZEST

Surfactants – Activating adjuvants

■ Ryda



Non-ionic

- Activator 90
- Transact
- Mixture B NF
- Intracrop Questor
- Intracrop Saturn
- Planet
- Solar
- Spraymac and X-Wet

Cationic Organo-silicones Jogral

- Kinetic
- Bio Syl
- Siltex
- Slippa
- SP057
- Slither
- Silwet L77
- AdjiSil
- Admix-P
- Break-thru Paramount
- SAS 90



Surfactants – Organo silicones





Can you explain this? time for an experiment....







HTA **Adjuvant Oils** Mineral Vegetable Methylated ■ Cropspray 11E ■ Phase-II Agropen ■ Newman Cropspray Oil 11 E Actirob B Codacide ■ BackRow Zarado ■ Barramundi Addit ■ Contact Plus Adigor Grounded ■ Amber ■ Sprayprover Saracen ■ Toil ZEST









Utilities Adjuvants

- Addressed towards the sprayer operator
- These tend to be forgotten but make a huge difference to product performance
- Knowledge is required to utilise their
- Most commonly used are Markers, Antifoaming agents, Tank cleaners
- Not recommended by agronomists often
- In ornamentals concerns over the phytotoxicity



When adding a water conditioning agent such as AMS, the sulfate in ammonium sulfate ties up hard water ions, allowing the glyphosate to be free, attaching to a nitrogen, creating glyphosate N, and easily taken up by the plants.



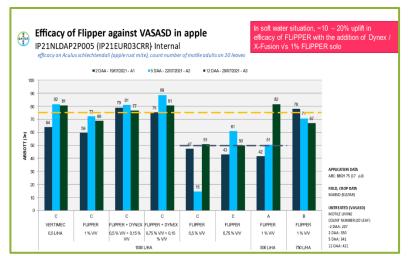
calcium, sodium, iron and magnesium ions are tied up with the glyphosate, rendering the glyphosate useless.



HTA Utilities Adjuvants - water conditioners Dissolved Minerals in Hard Water Hard water has a high concentration of dissolved minerals. Water gains the property of hardness as it percolates through the soil profile and its parent material dissolving the minerals present into their constituent ions.







SUMMARY



- There is no magic adjuvant for every purpose!
- Testing adjuvants on small scale is important
- Read product labels and adjuvant advise
- Correct use of adjuvants require knowledge
- Know the chemical characteristics of the water used for spraying
- Regular checks with monitoring tools is essential to choose correct adjuvant
- Many adjuvants combine more than 1 benefit but not necessarily safe to crops
- Adjuvants are there to help you



Influence of plant and leaf structures, crop canopies and densities, cropping situation, and water quality used for spraying

Wayne Brough HTA

Notes



Influence of plant and leaf structures, crop canopies and densities, cropping situation, and water quality used for spraying Wayne Brough, HTA

What I will cover



- > Plant and leaf structures and shapes
- > Crop canopies and densities
- > Cropping situation (protected vs outdoor)
- > Impact of water quality used for spraying

Plant structure (phytomorphology)



- > Plant architecture varied and complex
- Designed to maximise leaf area exposed to light and support mode of growth
- > Often designed to shed excess rainfall
- > Roots important for uptake of PPPs applied
- > Stems can be target for uptake of PPPs (e.g. paclobutrazol)
- Leaves main target for PPP uptake, getting
 PPP underneath leaves problematic

	111/1
floral unit (Fl terminal (apical) bud stem pedicel	generative shoot system
axial (lateral) bud terminal bud on secondary shoot secondary shoot	vegetative shoot system
leaf blade peticle adventitious roots hypocotyl main root (taproot) lateral roots	root system
lateral roots	



Leaf structure

- > Generally, a large surface area to absorb light
- ➤ Its upper surface is protected from water loss, disease and weather damage by a waxy layer
- > Veins for structure and water/nutrient distribution
- Adapted to climate/stresses where the plant originates from



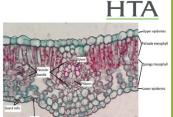
Leaf structure



Plant adaptation	Function
Broad leaves	Provide a large surface area to absorb as much sunlight as possible.
Thin leaves	Provide a short diffusion 1 pathway for gases to move into and out of cells.
Network of tubes (xylem and phloem)	To transport water, mineral ions and glucose (food) around the plant.
Lots of chloroplast	Contain a green substance called chlorophyll, which traps energy from the sun for photosynthesis.
Stomata	Tiny holes found mainly underneath the leaf to allow gases to diffuse into and out of the leaf. Each hole is a single stoma.
Guard cells	Controls the opening and closing of stomata.
Midrib	Provides strength throughout the leaf, keeping it upright and sturdy in the wind.
Petiole	Attaches the leaf to the stem.

Leaf structure (internal)

- > Upper epidermis and cuticle layer- protection
- ➤ Palisade layer photosynthesis
- > Mesophyll gas exchange into leaf from stomata
- \nearrow Xylem and phloem transport system











Leaf surface



- All aerial plant parts are covered by a hydrophobic cuticle that limits the bidirectional exchange of water, solutes and gases between the plant and the surrounding environment.
- Epidermal structures such as stomata, trichomes or lenticels may occur on the surface of different plant organs and play important physiological roles.



(Micrographs by V.Fernández, 2010) Adaxial surface of: (A) soybean; (B) maize; and (C) cherry leaf

Leaf cuticle - wax layer



> The cuticle is a protective layer that covers the plant and separates it from the environment. In leaves this layer is hydrophobic and consists of an insoluble membrane submerged in solvent-soluble waxes. The cuticle of leaves is thought to have evolved as an adaptation during the transition from aquatic to terrestrial habitats, with its main function being to prevent excessive tissue water loss, but it also provides protection against UV radiation, being eaten, heat, mechanical stress, and pollution. Epicuticular wax is a waxy coating which covers the outer surface of the plant cuticle and is thicker in plants from arid climates.



Leaf shapes







Crop canopies

- **≻** Flat
- ➤ Vertical/erect
- ➤ Row crop
- **≻** Bed formation
- > Leaf wall area







HTA







Pot thick vs spaced plants HTA

Cropping situation - Glasshouse



- High PAR
- Little to no diffusion
- Low natural air movement
- · Quick cell division
- Softer cell walls
- Thinner cuticle layer
- Rapid soft growth
- Stomatal activity is much slower
- Potassium pump often is compromised due to humidities



Cropping situation - Tunnel



- Cover material matters
- Good diffusion
- More air movement
- Thicker cuticle layer
- Lower PAR
- Some far-red light excluded
- Wax layer often much less prominent
- Stomatal activity better
- Potassium pump more regulated but still an issue

	X	X	A No.
X			



Cropping situation

- Maximum PAR
- · Air movement
- Thick cuticle layer
- Morphological changes based on abiotic pressure
- Stomatal activity is fully activated
- Potassium pump working to its maximum
- Red light exposure maximum



Water quality and plant protection products



Water Hardness

- The alkalinity of hard water can influence the efficacy of products
- Wettable powders, mineral based and biopesticides can be affected
- Translocation of systemic products can be affected by hard water
- The ideal pH of a spray solution to get maximum leaf absorption is to make it the same as the leaf pH 5.5-6.5

Water Temperature

- Do not use water less than 10°C for spraying on plants
- Using warm water for mixing improves dissolvability but may not be best for the product

Water parameters affecting PPP performance



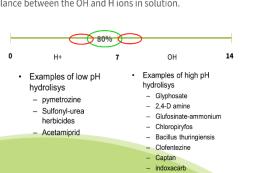
- Hq٠
- Alkalinity OH
- Acidity H⁺
- Carbonate CaCO₃ /bicarbonate HCO₃-
- Electrical Conductivity
- Turbidity



What is pH?

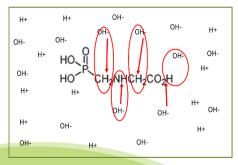


• The balance between the OH and H ions in solution.



How does it work?





Carbonate/bicarbonate



- Water hardiness
 - Temporary HCO3
 - Constant CaCO3 and other positively charged metals (Mg, Fe)
- · Actives affected by total hardiness
 - 2,4 D amine
 - Glyphosate
 - Fatty Acids
 - Clethodim
 - Iron more than 400ppm dissolves most actives
 - Optimum hardiness below 150ppm



Electrical conductivity



- Salt formulated products:
 - Fatty acids
 - Salts of glyphosate
 - Amonium salts glufosinate ammonium
- Positive (cations) Negative (anions)

Calcium (Ca++) Sulphate(SO₋--) Magnesium (Mg++) Chloride(Cl-) Sodium (Na+) Bicarbonate (HCO₃-)

• EC< 0.5 mS no effects

Turbidity



- Haziness of the water
- Related to high organic matter and soil content
- Active ingredient with soil/organic matter binding potential:
 - Glyphosate
 - Diquat
 - Pyrethrins
 - Sulfunyl Urea herbicides(Chikara, Eagle and others)

Compromised performance



- ➤ Mode of action
- > Penetrating the insect cuticules
- ➤ Penetrating leaf structure
- ➤ Coverage
- ➤ Reduced persistence
- ➤ Slow activity



How to maintain performance?



- Water source knowledge
- Monitoring water parameters regularly
- Knowledge of active substances and reading product labels
- If it doesn't look right, its not right!









| Active ingredient | 2,4-d | Command | Comman

Commonly used adjuvants with different crop protection product types – insecticides, fungicides, herbicides.

Selchuk Kurtev, Zest Sustainable ICM



Zest



Insecticides - oils

- Oil adjuvants carry a risk
- Mainly used in autumn winter time
- Pest morphology changes
- Some anecdotal evidence of virus reduction
- Mainly with contact mode of action
- Can leave oily deposits
- High concentrations



Insecticides – super spreaders

- Pure and diluted versions
- Many of the diluted can have phytotoxic effects
- Cost indication provides clues about the purity
- Many adjuvants not on the list entry!
- Many claim insecticidal effect
- Some can cause foaming





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Insecticides – water conditioners and stickers

- Weather conditions related
- Some anti-transpirant effect
- Water conditioning adjuvants are mostly safe
- More expensive but effective
- Can have issues with incompatibilities









Insecticides - non-ionic and

- Mostly safe with some concerns over tank cleaning effects
- Use in main season when soft growth present
- Do not leave overnight in tank



Fungicides



- Many DO NOT require adjuvants, especially liquid formulations
- Contact mode of action products will need an adjuvant unless otherwise stated
- Water conditioners are not popular but are very useful
- Tank mixture issues with fungicides is a big problem
- Non-ionic wetters and supper spreaders are recommended
- Plant leaf morphology is very important
- Root zone applications often fail due to target zone moisture levels
- Water volumes are crucial in here, especially where high water volumes are used
- Many fungicide groups require adjuvant at all time to aid penetration CAA fungicides



Fungicides – go to products ACTIVATOR 90 ACTIVATOR 90



Herbicides



- Most unknown area of all PPP in ornamentals
- Mainly water conditioners and spraying aids stickers, acidifiers, markers, drift reducers
- For applications over crops DO NOT USE ADJUVANTS!
- Pre-emergent herbicides on seed beds benefit from a sticker adjuvant
- Total weed control products MUST always be with an adjuvant
- Where volatile active substances are used stickers can reduce volatility and crop damage
- Oil based adjuvants tend to be used mostly as enchancers



Herbicides – go to products











Herbicides – glyphosate!



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Zest



PGRs

- Mostly all with adjuvants, especially those applied to crop canopy
- Avoid using silicon based adjuvants due to phytotoxicity
- Avoid using oil formulations
- Penetrats and spreaders are advisable to use
- For outdoor use consider using stickers and penetrats



General guidelines

I WANT TO SPRAY	ANSWER
Herbicide Groups	
A, B, C, G, M	Adjuvants frequently recommended for most products in these group
F, H, I, J, L, N, Q, R, Z Some adjuvants required for some products	
D, E, K, O, P No adjuvants recommended	
Insecticide Groups	
1A, 1B, 2B, 3A, 5, 6, 7, 10, 11, 12, 13, 1B, 22A, 28	Adjuvants required for some products in some applications
2A, 7, 8, 15, 16, 17, 19, 20, 21, 24, UN	No adjuvants recommended
4A, 9B	Adjuvants mostly recommended
Fungicide Groups	
1, 2, 4, 9, 11, 33, M1, M2, M7, M9	Adjuvants required for some products in some applications
3, 40, M3	Adjuavnts recommended in many situations
5, 7, 8, 12, 13, 14, 17, 20, 28, 29, M, M6, M7	No adjuvants recommended
Plant growth regulators	Adjuvants recommended in many situations
Harvest aid products	Adjuvants recommended in many situations
Foliar nutrients	Adjuvants sometimes recommended





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General guidelines

Adjuvants

PRODUCT	CLASSIFICATION	ATTRIBUTES	EXAMPLE USAGE	RATE OF USE
ABATE	Silicon based anti- foaming agent,	Tank foaming reduction.	Where high levels of foam are produced in the tank solution.	50-250 ml / 1000 lt. Use low rate to start with and increase as required
ACTIVATOR 90	Non ionic wetter.	Drift reduction. Spreads up to 7 times more than water. Use where surface wetting is desirable.	Contact insecticides. Broadleaved herbicides. Contact herbicides such as Diquat.	1 lt / 1000 lt Add to tank last.
ALL CLEAR EXTRA	Balanced formulation of sequestrants and surfactants.	Tank cleaner.	After tank use. Good at removing difficult residues like the SU herbicides.	5 lt / 1000 lt Avoid contact with the concentrate on metal.
CROPSPRAY 11E	Mineral oil adjuvant.	Weed control improvement. Reduces drift.	Difficult to control weeds. Difficult spraying conditions.	Max rate 25 it / 1000 it Normal rate 7.5 it / 1000 it Can have insecticidal use
ENVIROWET	Silicon based non- ionic wetter and spreading agent.	Drift reduction 'super wetter'.	Improve uptake of foliar nutrients. Improve coverage on difficult targets such as waxy or hairy leaves.	1-2.5 lt / 1000 lt
GATEWAY	Silicone and latex-based sticker, extender and wetter.	Improves wetting, coverage and rainfastness. Increases uptake of systemic products and nutrients. Drift reduction. Frest protection.	Use in difficult weather conditions. On waxy or hairy leaved weeds. Anti transpirant. Difficult target coverage.	1.25 lt / 10 00 lt Add to tank last.
KANTOR	Penetrant wetter and spreading agent.	Improved coverage. Aids systemic product uptake. Mix compatibility.	Reduces the risk of tank mixing issues. Aids difficult canopy management.	1.5-10 lt / 1000 lt

Zest

-	•	0	×	



SUMMARY



- > READ THE LABELS PESTICIDES AND ADJUVANTS!
- ➤ Using lower concentrations of adjuvants poses lower risk
- ➤ Always test on small plots first
- ➤ Single purpose adjuvants tend to be safer to crops
- > Caution with distributor agronomist
- ➤ Adjuvants are there to aid not to perform MAGIC!
- Do not use aged stock adjuvants for over top of crop applications



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NURSERY PRODUCTION













How to choose the correct adjuvant and when you should consider use of adjuvants. Correct tank mixing sequences



Notes

Selchuk Kurtev, Zest - Sustainable ICM

	zest
	Sustainable ICM

How to choose the correct adjuvant and when you should consider use of adjuvants. Correct tank mixing sequences. Selchuk Kurtev, Zest Sustainable ICM

What I will cover



- > Adjuvant purpose Utilities or Activating?
- > Plant morphology and crop growth
- > PPP specific adjuvant needs
- > Utilities adjuvant choice
- > Tank mixing and sequence



Adjuvant purpose



- ✓ Most important consideration
- ✓ Legality of the use of the adjuvant with the PPPs
- ✓ Crop risk considerations
- ✓ Spray equipment, water volumes and spray quality
- ✓ Water quality and spraying conditions

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IS MY	
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Plant morphology and crop growth



- ✓ Most important consideration
- ✓ Legality of the use of the adjuvant with the PPP
- ✓ Crop risk considerations
- ✓ Spray equipment, water volumes and spray quality
- ✓ Water quality and spraying conditions







PPP specific needs ✓ READ THE LABEL AND OFF LABEL! ✓ Formulation of the product ✓ Active substance nature! ✓ Mode of Action and Group





PPP specific needs

- √ Water conditioning
- √ Know your water parameters
- √ Stability and miscibility



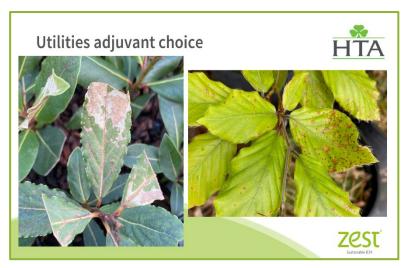
Utilities adjuvant choice

- ✓ Single purpose adjuvants are easy to use
- ✓ Multi-purpose adjuvants are risky
- ✓ Often too many benefits = poor result
- ✓ Many require good knowledge of chemistry

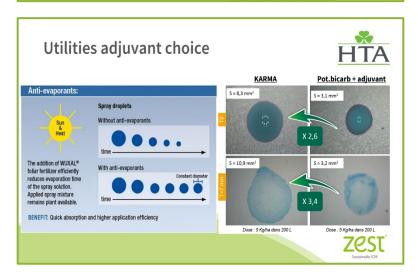




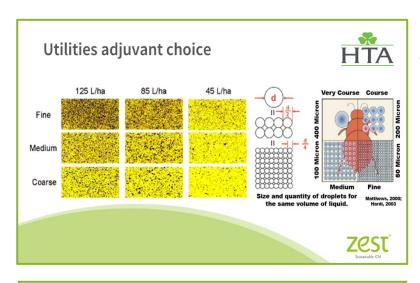


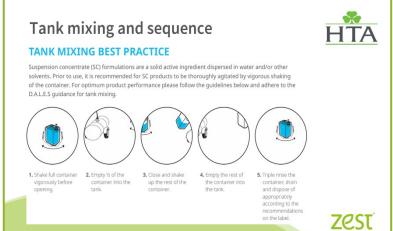
















SUMMARY



- **▶ PURPOSE?**
- > LOCATION OF TARGET?
- > PLANT MORPHOLOGY AND CROP GROWTH?
- > CROP SITUATION?
- > PLANT PROTECTION PRODUCTS?
- > TIMING OF APPLICATION AND WEATHER CONDITIONS
- > WATER QUALITY AND SPRAY QUALITY
- > TANK MIXING AND SEQUENCE
- > APPLICATION AND WATER VOLUME





Appendix

- 1. Adjuvant Search (pesticides.gov.uk)
- 2. <u>De Sangosse Slug Experts Complementary chemistry and molluscicides</u>
- 3. Master tank mix adjuvants to push pesticide performance » Interagro (UK) Ltd
- 4. Attune Agriculture: Water vs. Surfactant vs. Ampersand Adjuvant (youtube.com)
- 5. Introducing Elasto G5 how adjuvants can work for you (youtube.com)
- 6. WhatAreAdjuvants.pdf (apparentag.com.au)
- 7. Agricultural Adjuvant & Spray Additives Intracrop
- 8. AdjuvantWhitepaper.pdf (chsagronomy.com)



