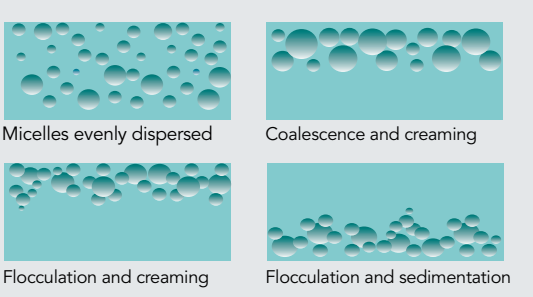
How adjuvants can affect herbicide performance

The six stages where adjuvant choice can affect the spray process

1 Tank mixing

Tank mix compatibility optimises herbicide performance

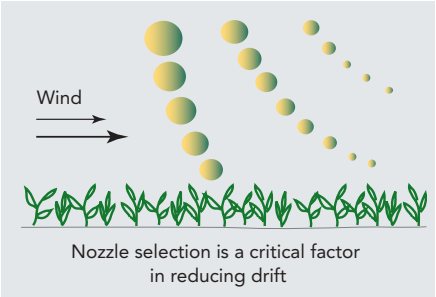
Symptoms of physical incompatibility can be excess foam or the aggregation of particles, which then either form a cream at the top or sediment at the bottom of the tank, or gelatinous, gluey residues.



2 Spray droplet production

The predominant influence on spray droplet production is spray rig setup

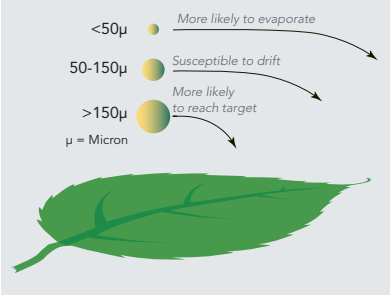
Nozzle type, droplet size, spray pressure, boom height, use of shields and of course weather conditions all have more impact on droplet drift reduction than tank additives.



3 Spray droplet flight

Tank mix additives have limited effect on in-flight evaporation of droplets

In-flight evaporation is influenced largely by droplet size; the bigger the droplet the more likely it is to reach its target without evaporating.



Adjuvant type	Effects on tank mix	Effects on droplet production	Effects on spray droplet flight
Buffers/ acidifiers	maintain or reduce pH of the water for the prevention of salt formation by certain herbicides such as glyphosates. Can also increase herbicide activity, eg. 2,4-D.	–	–
Drift retardants	refer to herbicide label for tank mix compatibility effects.	tend to increase the average droplet size which can reduce spray drift risk under some circumstances.	tend to increase droplet size, thus can reduce the risk of in-flight evaporation.
COCs	enhance cold water mixing properties but can be incompatible with certain herbicide formulations like water-dispersible granules (WDGs).	high surfactant level reduces droplet size and can increase spray drift risks.	tend to reduce droplet size due to their high surfactant content, thus can increase the risk of in-flight evaporation.
Surfactants	can lower the surface tension of water, increasing flowability. Allow oil solubles and water to mix effectively but can sometimes cause foaming.	lower surface tension and can reduce average droplet size, which increases spray drift risk.	reduce droplet size, thus can increase the risk of in-flight evaporation.
Spray oils	require constant agitation of the tank mixture. Are usually compatible with emulsifiable concentrate (EC) formulations but not recommended for use with WDGs, especially in cold weather.	generally increase the average droplet size, which can reduce spray drift risk.	tend to increase droplet size, thus can reduce the risk of in-flight evaporation. Don't directly impact evaporation at less than 20% spray volume.

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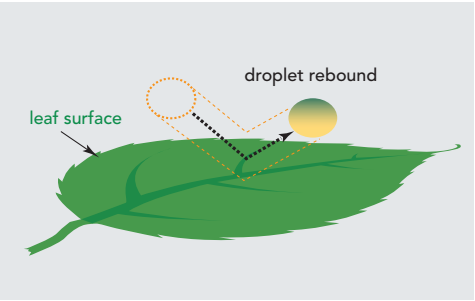
Droplet leaf contact

Minimising droplet rebound reduces herbicide wastage

Larger droplets, such as those generated by coarse spray nozzles, can bounce off the leaf surface causing significant wastage. Both surfactant and spray oil adjuvants can reduce droplet rebound by acting as shock absorbers.



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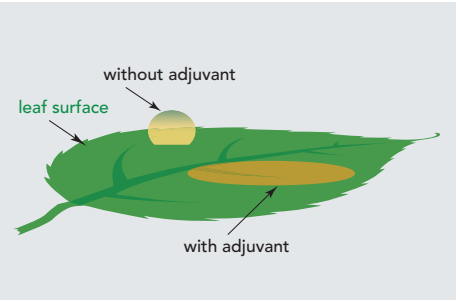
Droplet leaf coverage

Maximising droplet leaf coverage generally increases herbicide performance

Spray adjuvants can reduce the antagonism between the droplet and the leaf so the droplet sits in the cuticle rather than on it.



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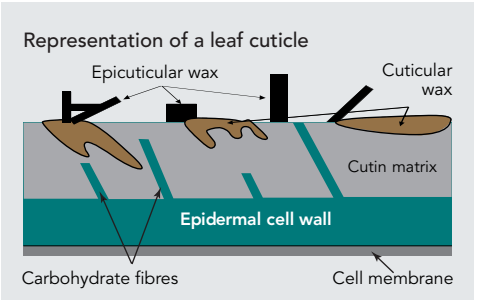
Leaf penetration

Some adjuvants contain surfactants that maintain the a.i. in a liquid state which is important for rapid cuticle penetration

Softening of the cuticle by some oils and surfactants will assist transfer of the a.i to the plant cells. Assisting rapid entry into the leaf also avoids wash-off and UV degradation.



Effects on droplet leaf contact	Effects on droplet leaf coverage	Effects on flowability and leaf penetration
–	–	–
increase droplet size which can contribute to droplet rebound.	should be used in conjunction with adjuvants that also have wetting and spreading surfactants.	–
can lower dynamic surface tension by forming micelles and can aid droplet adherence to leaf surfaces.	contain high levels of surfactants and therefore act to reduce the droplet/leaf antagonism.	retain the deposit in a flowable state after evaporation of water from the droplet and both the oil and the surfactants can help ease the passage of active ingredients into the leaf.
can lower the dynamic surface tension of water which aids droplet adherence to the leaf.	can reduce droplet/leaf antagonism so droplets can spread. Organosilicone superwetters are extremely efficient at lowering surface tension but can interfere with the activity of certain herbicides.	don't maintain the deposit in a liquid state on evaporation of the water from the droplet but dissolve protective leaf waxes on certain plant surfaces.
the more oil present in the tank mixture, the better the leaf adherence effect but not as effective as COCs and surfactants. Formation of micelles in the tank mixture can have a cushioning effect on droplet impact.	oil has a low surface tension so after the water evaporates from the droplet, the oil is able to spread over a wider area.	retain the deposit in a flowable state after evaporation of water from the droplet so the oil can help ease the passage of active ingredients into the leaf.

All surfactants are adjuvants, but not all adjuvants are surfactants