

IMPROVING FUNGICIDE ACTIVITY WITH SACOA ADJUVANTS

TECH NOTE SERIES



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KEY POINTS

- Fungicide activity can be increased with the use of adjuvants by improving coverage, droplet survival and increasing leaf surface penetration.
- As a general rule, protectant fungicides should be matched with adjuvants that improve leaf surface coverage, whilst curative fungicides work best with penetrant type adjuvants.
- Using low quality mineral oils or low quality methylated seed oils with fungicides can increase the risk of damage to plant tissue.
- **CROPSHIELD®** and **ENHANCE®** provide excellent efficacy and safe delivery of systemic fungicides such as Tebuconazole (Folicur®) and Propiconazole (Tilt®).
- **PLANTOCROP®** is an esterified seed oil with penetrant properties which can improve fungicide activity, through increasing plant uptake.
- **BIOPEST®** is synergistic with fungicides such as Prosaro® due to its spreading and protectant properties and has the additional benefit of providing aphid knockdown and anti-feed effects.

Adjuvants can play an important role in improving fungicide coverage on the target disease, particularly with aerial application and they assist the active ingredient to enter the plant.

As with herbicides however, it is important to match the adjuvant to the fungicide type;

Protectant fungicides including actives such as azoxystrobin and chlorthalonil, are best used with adjuvants that improve leaf surface coverage.

Curative fungicides such as the triazoles, can be assisted by more penetrant-type oils but respond well when used with high emulsifier loaded mineral oils.

However, as most fungicides are applied at important yield generating timings, ie flag leaf emergence, preventing leaf surface damage should always be the priority.

SACOA's **CROPSHIELD®**, **ENHANCE®** and **PLANTOCROP®** have unique characteristics making them ideal for use with fungicides, whilst **BIOPEST®** has the additional benefit of providing sucking pest control as well as improving fungicide coverage without the risk of crop damage.

Some adjuvants can cause phytotoxicity problems to maturing winter cereal crops when used with late applications of crop protection products (see Figure 1).

Adjuvants designed particularly for pre-emergent and knock-down herbicides are not intended to be used with post-emergent crop protection products.



Figure 1: Plant damage caused by poorly selected adjuvants when used with a triazole fungicide (Source: SACOA).

This is because of their inherent risk of plant tissue damage caused by the impurities they contain oxidising and forming acids on the leaf surface.

Similarly, the reacted alcohol base in esterified seed oils and their ability to dissolve and penetrate rather than passively solubilise the protective cell waxes, can expose or penetrate the epidermal membranes. This results in an uninterrupted diffusion site between the underlying tissue and the spray material.

This localised cell damage may then be an entry point for secondary infection of other normally benign pathogens.

Therefore the use of low quality mineral oils designed for fallow/knockdown herbicides or methylated seed oils should be avoided because of their aggressive nature on plant tissue.

Since the outbreak of widespread cereal diseases over a decade ago, SACOA has commissioned several independent trials investigating the role of crop oils and adjuvants in enhancing the activity of cereal fungicides.

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S A C O A

IMPORTANCE OF PLANT STRUCTURE AND CELL FUNCTION ON FUNGICIDE MOBILITY

As annual plants grow and move from vegetative growth and rapid cell multiplication to laying down carbohydrates for seed formation, plants stop replacing soft cell protective epicuticular waxes.

Normally if damaged by external occurrences the plant will try and replace exposed cells with new protective material.

The epidermal tissue functions to prevent water loss and acts as a barrier to fungi and other invaders. Thus, epidermal cells are closely packed with little intercellular space.

To further cut down on water loss and protect internal cells, epidermis cells secrete a cuticle waxy layer on top of all the epidermal cells like an uninterrupted film.

As the plant matures, it starts to rely on more permanent physical barriers. The rod and plate cells bind and harder cuticle waxes and hairs are developed by the plant to protect itself from moisture loss caused by climatic conditions - particularly as temperatures increase in September.

Fungal hyphae penetrate the plant tissue through wounds of the cuticle, wounds of the epidermal tissue or open stomata. Stripe Rust *Puccinia* spp. have extensive mycelium, which spread through the intercellular spaces of the host plants, therefore fungicides aimed at controlling rust need to be placed into these intercellular spaces.

This can be done with adjuvants in a few ways

- By passive diffusion using high grade paraffinic oils such as ENHANCE® or BIOPEST® to help move fungicides through the external waxes into the internal tissue.
- By prolonging leaf contact with the fungicide solution and hence prolonged osmotic exchange.
- By creating the phenomena known as 'stomata flooding' with specially designed super wetters, which drop the contact angle of the solution.

Fungicide movement in the plant

Fungicides are generally absorbed by plant surfaces in one of two methods, by passive diffusion (osmosis) or actively by electron transport systems (ATP and ADP) along cell membranes.

The membrane contains specific transport or carrier proteins, with active transport of Demethylation- Inhibiting (DMI) fungicides only occurring in intact, closed membranes.

DMI fungicides do not enter the protoplasm but only the apoplast, moving within the xylem, cuticle, cell walls/membrane and intercellular spaces. Agricultural chemical manufacturers describe them as Casual Systemic.

Therefore it is optimal to passively transport the fungicide through the plant waxes and into the intercellular spaces rather than cause tissue damage to create a site of entry.

Seed oils will place the active ingredient into the epidermal cells, due to their ability to volatilise, rather than into intercellular spaces. There is a risk of causing physical injury, and interfering with plant metabolism and hence absorption of the fungicide (see Chart 1).

% Leaf damage following application with Tebuconazole and a range of adjuvants to control Stripe Rust (*Puccinia* spp.) in wheat B - 21 DAA

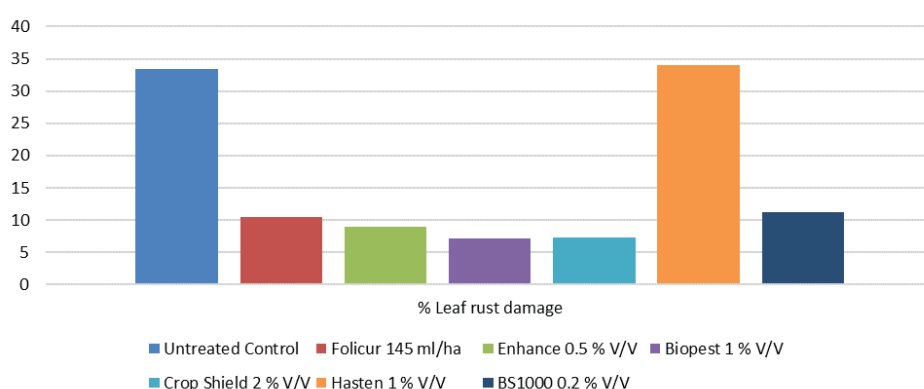


Chart 1: Leaf damage in the treatment of Tebuconazole with methylated seed oil was equivalent to the UTC. (Source: Agritech AGRO3-055, Pingrup, November 2003).

Yellow spot leaf control in wheat with Folicur and a range of adjuvants (T/Ha)

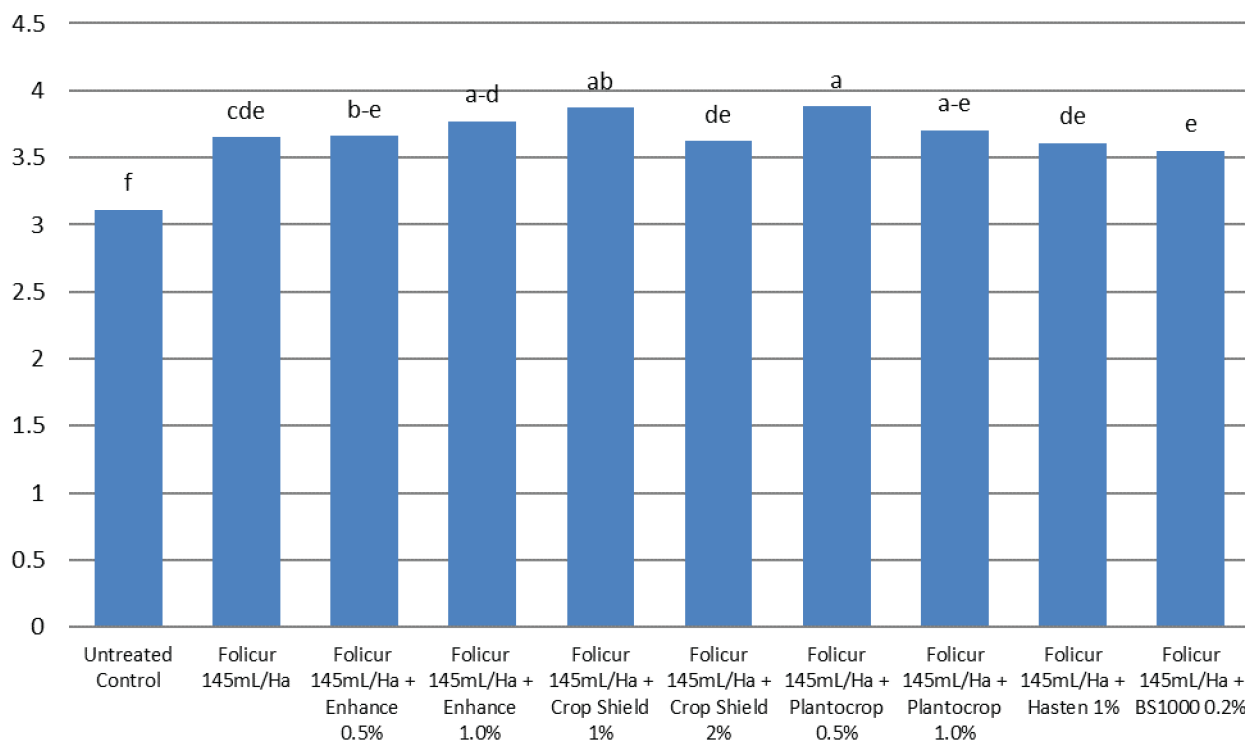


Chart 2: The high quality phytoabland, paraffin based mineral oils CROPSHIELD® and ENHANCE® provided excellent efficacy and safe delivery of the casual systemic fungicide Tebuconazole. (Source: Kalyx WA-W07-342, Cunderdin, Aug 2007). (Means followed by the same letter are not significantly different.)

MATCH THE CORRECT ADJUVANT TO THE FUNGICIDE PATHWAY

High quality mineral oils (e.g. CROPSHIELD® or ENHANCE®) have provided the best efficacy and safest delivery of casual systemic fungicides such as Tebuconazole (Folicur®) and Propiconazole (Tilt®) (see Chart 2). The paraffinic based BIOPEST® has proven to be synergistic with fungicides such as Prosaro® due to its spreading and protectant properties, acting as a leaf surface coating.

In situations where the risk of crop damage is low, the use of a high quality esterified seed oil with lower levels of methylated esters, such as PLANTOCROP® can improve fungicide activity (see Chart 2 and 3).

While PLANTOCROP® can improve fungicide activity, if the conditions at application mean that leaf burning is more likely, there is a greater risk of leaf damage when using PLANTOCROP® compared to both CROPSHIELD® and ENHANCE®.

Yellow leaf spot control in wheat with Prosaro

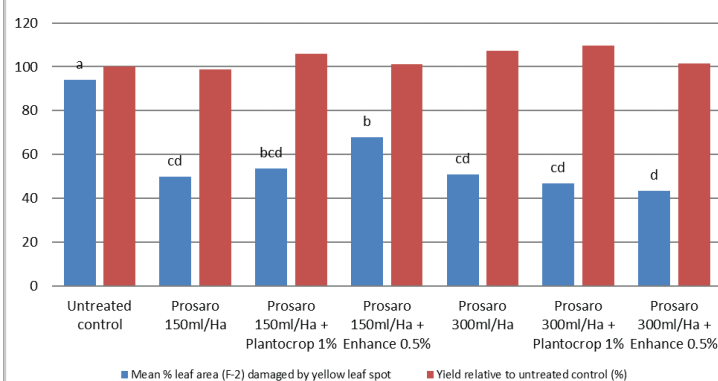


Chart 3: PLANTOCROP® with Prosaro® provided excellent control of yellow leaf spot without causing leaf burning. (Source: Kalyx WA-W07-342, Cunderdin, Aug 2007). (Means followed by the same letter are not significantly different.)

IMPORTANCE OF SPRAY COVERAGE

One standalone spray of 2% Good spray coverage is essential to provide the effective dose of fungicide needed to protect susceptible leaf surfaces. Emulsified mineral oils play a role in improving coverage by increasing the droplet size, particularly in aerial applications and are essential to ensure adequate coverage on the middle and lower canopy. A recent aerial application using BIOPEST® resulted in the equivalent coverage in the middle canopy in canola to an additional 10L/Ha of water (see Chart 4).

Application methods and adjuvants greatly influence fungicide coverage; by emulsifying the active ingredient using specialised micro emulsions to improve leaf deposition, rain fastness, droplet formation and most importantly tissue absorption. When applying fungicide it is important to consider where in the canopy the disease is located – stem rust is generally found in the middle canopy, whilst leaf diseases such as yellow leaf spot or net blotch infect the flag leaf and upper canopy. Ideally, fungicides should be applied as close as possible to the infected area.

Canola leaf surface coverage in the top, middle and bottom canopy with BIOPEST

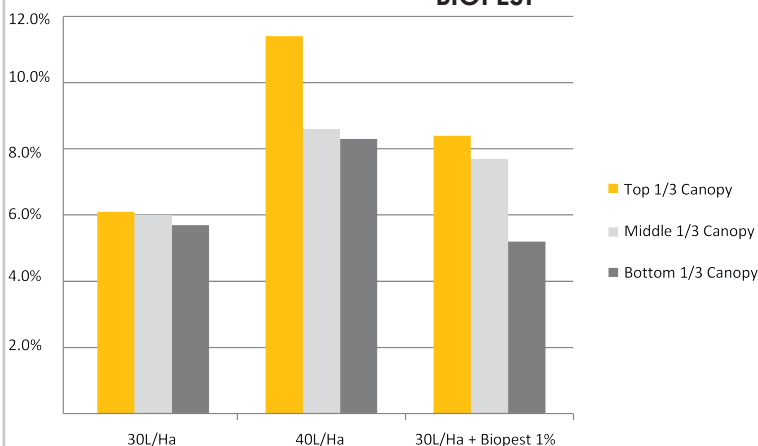


Chart 1: Increase in canola leaf surface coverage with the addition of Biopest®.
(Source – Agvivo demonstration trial June 2014)

REFERENCES

- Agritech AGRO3-055, Pingrup, November 2003
- Agvivo demonstration trial, June 2014
- Kalyx WA-W07-342, Cunderdin, Aug 2007

FIND OUT MORE

Further information is available at www.sacoa.com.au or by contacting SACOA on 08 9386 7666 or contact your local SACOA representative;

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