



ARMA™ ADJUVANT HANDBOOK

STRENGTHEN PROTECTION, SECURE SUCCESS

2021



Stability at high pH



Improved coverage



Higher uptake



May increase crop yield

Weak spots exist in the spray delivery process

Keeping crops free from early weed competition and disease infection is crucial to protect yield and profitability. Weeds can easily smother the crop, competing for light, water and nutrients, and disease can trigger significant biotic stress limiting performance and yield. Post-emergence herbicides and fungicides are key to protecting crop potential but even the best products and formulations require assistance to reach their target site inside leaf tissue. Understanding the issues is key to appreciating the need for an effective adjuvant to optimise crop protection and cropping success.

The challenges

High pH can lead to crop protection breakdown

The pH of water indicates its acidity or alkalinity and is measured on a scale of 1 to 14. A neutral pH is 7. Most water has a pH between 6.5 and 8. Water above 7 is alkaline and water below 7 is acidic. Alkaline water can break down some chemicals through a process called alkaline hydrolysis. The longer a mixed chemical is left in the tank prior to spraying, the greater the breakdown – it is not recommended to leave spray mixes overnight. Reduced product performance may not be obvious. In some cases, the influence of water on the crop protection product reduces its effectiveness only slightly, yet enough that tolerant or tough-to-control weeds, insects and diseases aren't well controlled.

Water beading limits coverage and retention across the leaf

As the crop increases in size, the delivery of post-emergence herbicides to target weeds becomes more tricky. Weeds can become shaded and herbicide intercepted by the crop, leading to poor coverage and a significant reduction in the control of target weeds – also now larger and more difficult to control by this stage. Weed control can also be particularly challenging with spring germinating weeds such as fat-hen and sowthistle that have hairy/waxy leaves which reduce the herbicide:leaf contact required for effective coverage across the whole leaf. This is because both hairy and waxy leaves reduce the ability of the herbicide to spread out and be retained on the leaf.

When it comes to fungicides, coverage is vital to prevent disease infection but often compromised without the use of a suitable tank-mix adjuvant to reduce surface tension and facilitate full spreading across the leaf/ear. Multisites act as a protectant but do not move on the leaf – this means they can only protect the parts of the leaf that the spray covers. Azoles and SDHIs have acropetal movement, so will move from where they land towards the end of the leaf. So if the base of the leaf doesn't receive adequate coverage, the fungicide will not move in a downwards direction and that part of the leaf will either be completely unprotected or have received a sub-lethal dose of active ingredient. Whilst in-can adjuvancy can help, it is often insufficient as the adjuvant rate is fixed by the crop protection rate per hectare, whereas tank-mix adjuvants can be adjusted to fit the water volume being used.



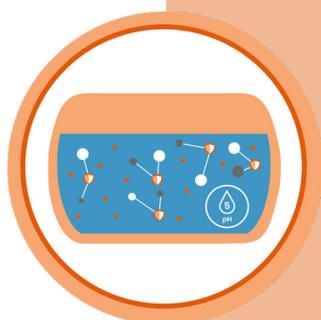
The leaf cuticle is the biggest barrier to crop protection applications

Once the herbicide has spread out on the leaf it must penetrate the leaf cuticle and the living tissue inside. The cuticle, on the upper and lower surfaces of the leaf, to protect against water loss and desiccation, is the biggest barrier to effective weed control. Weeds which are particularly waxy such as fat-hen, are also more hardened to herbicide so uptake can be slow. With the resulting poor coverage and uptake into weeds, a significant reduction in weed control can be of real threat to the crop. With the exception of protectant fungicides that are adsorbed to the outside of leaf surfaces to protect it, systemic fungicides (and PGRs) need to penetrate the leaf cuticle and living tissue inside. Fungicides & PGRs can normally penetrate the cuticle by simple diffusion through the waxy components but can be slow under suboptimal conditions e.g. cold temperatures. A suitable tank-mix adjuvant, such as Arma™, can improve the speed of penetration into the leaf, which is particularly useful in curative situations where speed of uptake is key to limit the spread of disease.



Arma™ action secures protection

Arma™ is a tried and trusted activator adjuvant designed to strengthen the performance of herbicides, fungicides and PGRs in a wide range of crops.



Stability at high pH

Reduces spray water pH

Arma™ reduces spray water pH, preventing the alkaline hydrolysis of crop protection products when added to high pH water in the spray tank. Chemicals remain stable in the tank and effective in the field.

Critical for:

- Spray water >pH7
- Spray water from bore holes
- Low application rates of crop protection
- Crop protection products which are weak acids



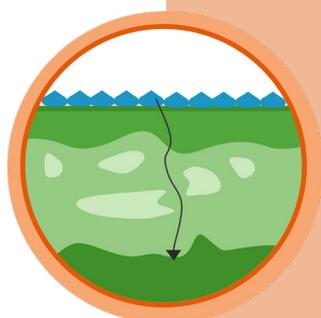
Improved coverage

Improves spreading & retention

Arma™ lowers surface tension, allowing spray droplets to spread out, cover the leaf and be retained. Increasing herbicide / fungicide contact across the target leaf surface is critical to getting the coverage needed for effective weed / disease control.

Critical for:

- Grass-weeds
- Large broadleaf weeds
- High water volumes
- Multi-site fungicides
- Fungicide applications to the ear



Higher uptake

Increases cuticle penetration

Arma™ helps most fungicides, plant growth regulators and herbicides enter leaf cuticles more easily, increasing uptake for fast and effective control.

Critical for:

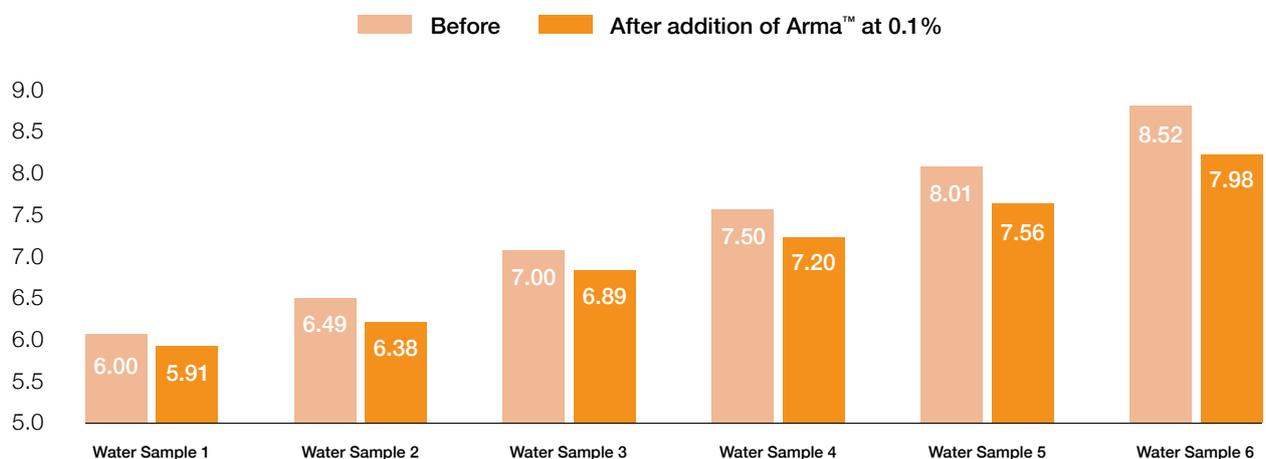
- Curative disease control
- Products that are metabolically activated such as chlormequat and prothioconazole
- Crops/weeds with thick waxy cuticles

Proven improvements in spray water quality

The effect of Arma™ on pH reduction was assessed at Alliance Technical, UK in 2020 by testing 6 different water samples with different starting pH. Arma™ reduces spray water pH, preventing the alkaline hydrolysis of crop protection products when added to high pH water in the spray tank. Chemicals remain stable in the tank and effective in the field.



Effect of Arma™ on pH reduction

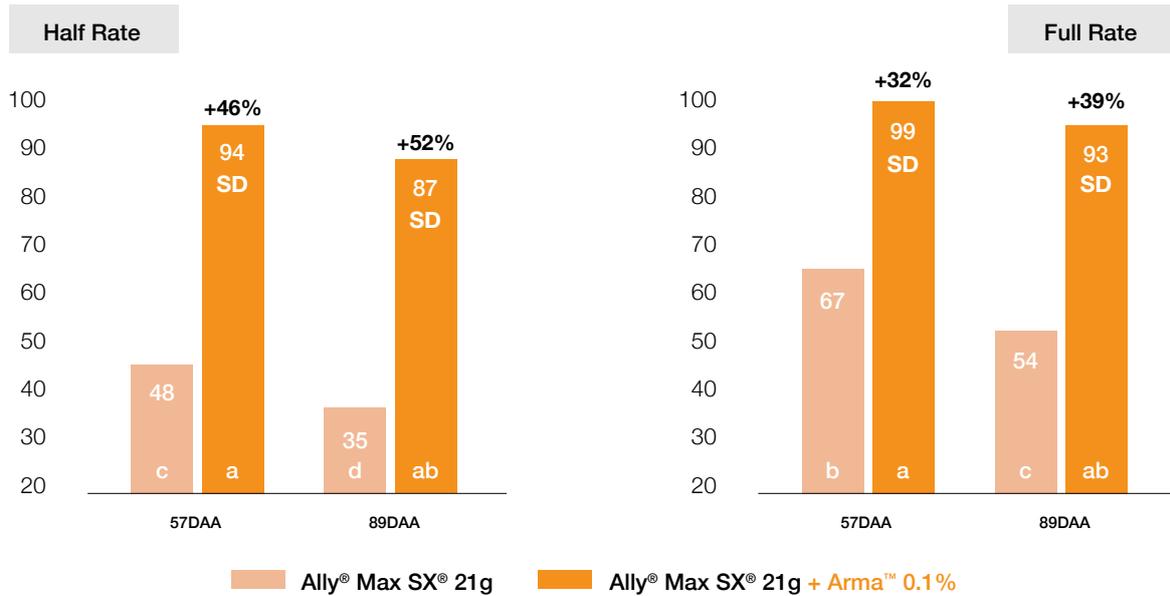


Alliance Technical, UK Aug 2020. Ca 147, Mg 11mg/litre. This gives a total hardness of 165 as Ca, 413 as CaCO₃ (Very Hard)

Optimised performance, higher weed control

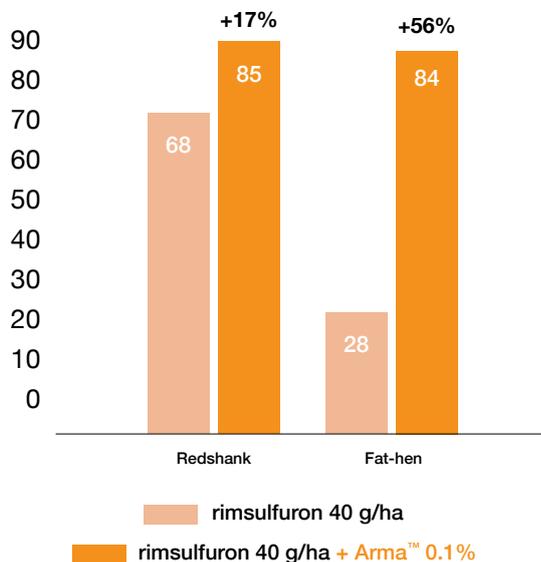
Significant improvements with contact herbicides post-emergence

Effect of Arma™ on Common Fumitory control in Spring Barley with Ally® Max SX® (21g and 42g)

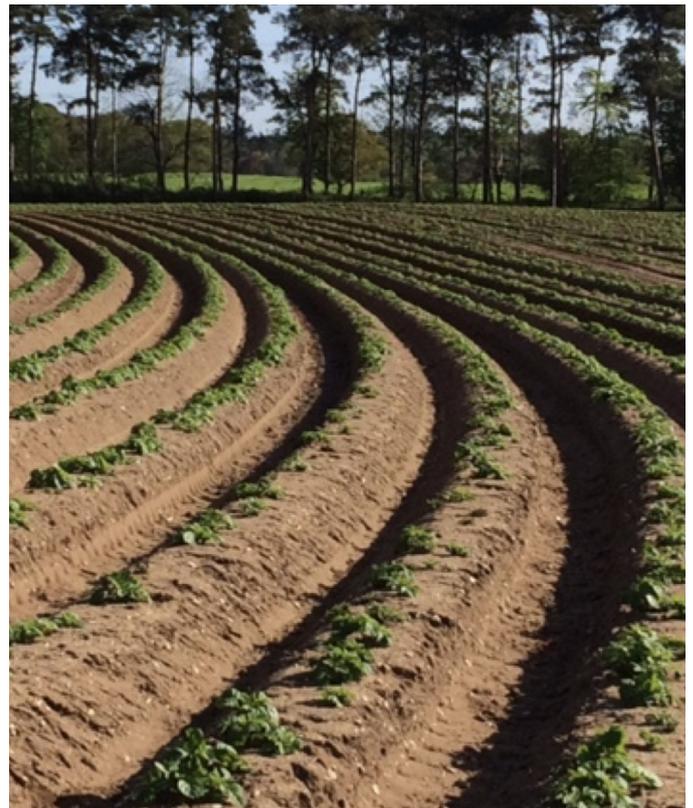


Crop Plot 2016, Ireland. Common Fumitory control in Spring Barley. Treatments applied on 26th May 2016. Untreated Fumitory population at spraying: 68 plants per sqm. GS 2-6 leaf & 2-8cm. SD = significant difference. Ally® Max SX® contains metsulfuron methyl + tribenuron methyl

Effect of Arma™ on Willow Weed & Fat-hen control in Potatoes (%)



OAT - Oxford Agricultural Trials UK. Dry conditions. Applications made post-em



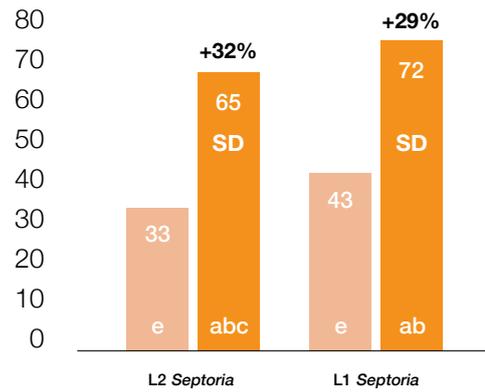
Higher levels of disease protection & higher yields

Key Takeaways

- Replicated UK fields trials have shown that Arma™ can add significant improvements in disease control, green leaf area and yield.
- Right: In this particular high disease pressure trial, the addition of Arma™ to the fungicide programme at T1 and T2 helped to optimise coverage and uptake into the leaf and led to significant increases in *Septoria* control and yield.
- Below: In a different variety, cv Barrel, Arma™ again delivered valuable yield benefits over the fungicide programme alone.

Improved protection against *Septoria*

Effect of Arma™ on % *Septoria* control on Leaves 1 & 2

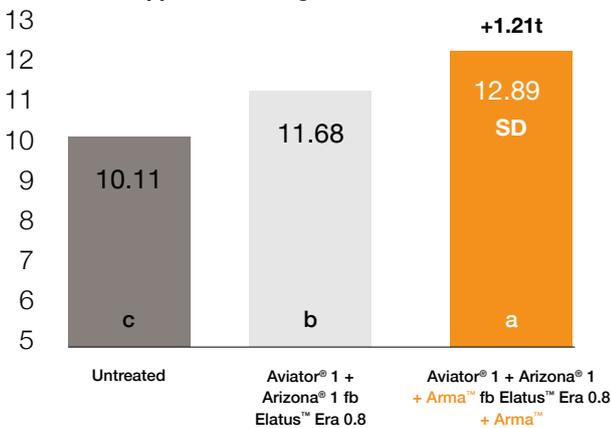


■ Aviator® 1 + Arizona® 1fb Elatus™ Era 0.8
■ Aviator® 1 + Arizona® + Arma™ fb Elatus™ Era 0.8 + Arma™

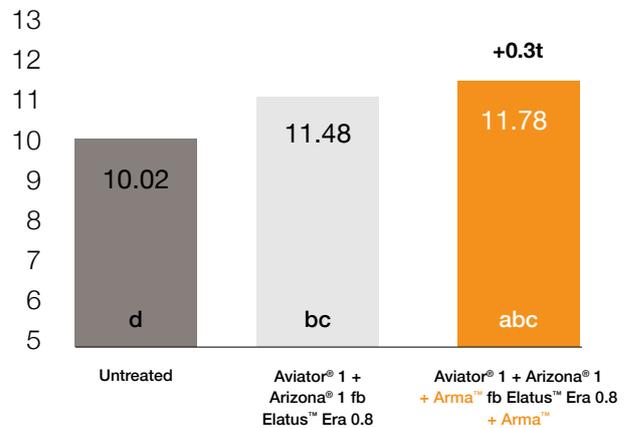
Prime Crop Research, UK 2019. Otley Suffolk, Winter Wheat, c.v. Basset. Applications at T1 and T2. SD = Significant difference. Untreated *Septoria* infection: L2 91%; L1 84%. Assessed 7th July 2019. Aviator® contains bixafen + prothioconazole. Elatus™ Era contains benzovindiflupyr + prothioconazole. Arma™ applied at 0.1% v/v

Higher yields. Prime Crop Research, UK

Effect of Arma™ on yield t/ha Applied with fungicides at T1 & T2



Effect of Arma™ on yield t/ha Applied with fungicide at T1 & T2



Prime Crop Research, UK 2019. Sawbridgeworth, Winter Wheat c.v. Barrel. Applications at T1 and T2. Aviator® contains bixafen + prothioconazole. Elatus™ Era contains benzovindiflupyr + prothioconazole. Arma™ applied at 0.1% v/v



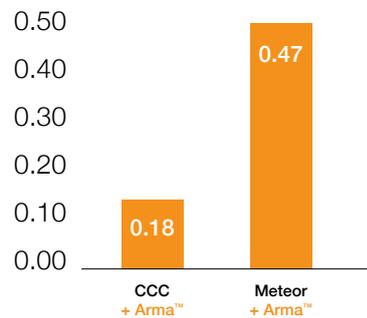
Effective with PGRs and the latest fungicides

Key Takeaways

- Right: Replicated UK field trials over the years have re-enforced Arma™'s proven ability to optimise the performance of both early and late season PGRs resulting in reduced lodging and brackling.
- Below: Replicated UK field trials have shown that Arma™ is beneficial with the latest fungicides on the market such as Revystar® XE, helping to optimise disease control, green leaf area and yield.

Improved lodging protection secures yields

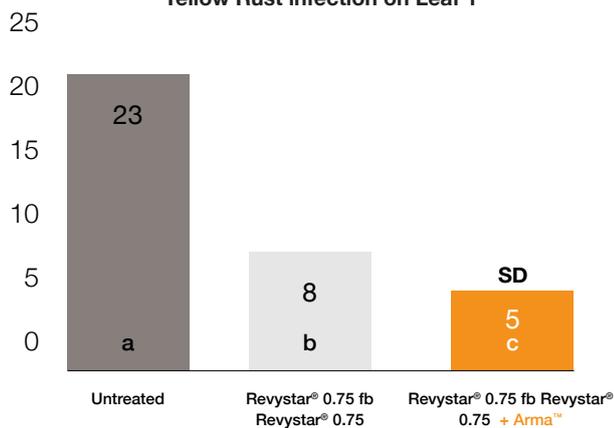
UK trials covering 55 Winter Wheat comparisons over 7 years
Average yield benefit from addition of Arma™ (t/ha)



Range of trials. CCC = chlormequat. Meteor = chlormequat + imazaquin

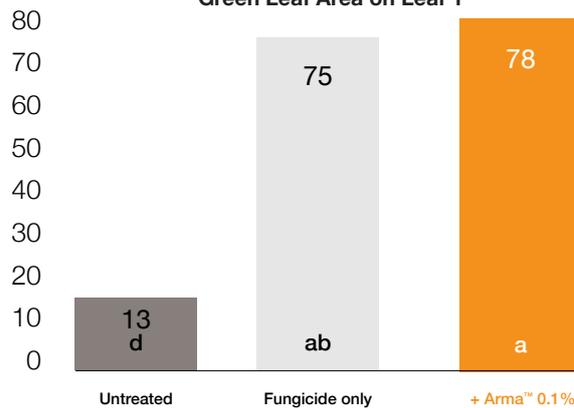
Significant reduction in Yellow Rust infection with Revystar® XE

Effect of Arma™ on % Yellow Rust infection on Leaf 1



Increased Green Leaf Area with Revystar® XE

Effect of Arma™ on % Green Leaf Area on Leaf 1



Prime Crop Research, UK 2020. Eau Brink KL, Winter Wheat c.v. Gleam Applications at T1 and T2.
SD = Significant difference. Assessed 29th June. Revystar® XE contains fluxapyroxad + mefentrifluconazole



Arma™	Product Information
Classification	Adjuvant
Composition	A blend of patented modified alkyamine polymer, sugar based surfactant and buffering agent
Recommended use	With insecticides, fungicides, plant growth regulators, post-emergent herbicides and foliar fertilisers
Crop type	Arma™ is ideal for use on a wide variety of crop types such as cereals, arable crops, pasture and vegetable crops
Rates of use	0.1% - 0.15% (i.e. 100 - 150 mL/100L) of the final spray volume
Mixing	Add to the spray tank first before adding crop protection products
Pack size	3 litres
Key features / benefits	<ul style="list-style-type: none">• Reduces spray water pH, preventing agrichemical breakdown at high pH• Improves spreading & retention across the leaf/ear, for optimum coverage & protection• Increases cuticle penetration, resulting in higher uptake into the leaf• May increase yield



Arma™ is distributed in New Zealand
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