Product efficacy is determined by many factors, and not just the active ingredients or formulation.

To get the best results from post-emergent herbicides, environmental conditions, application parameters and herbicide resistance should be considered.

With the appropriate monitoring of these factors, actions can be taken to minimise their impact on herbicide performance and maximise the result of the herbicide application.

ENVIRONMENTAL FACTORS
When plants are under stress, their ‘vascular’ (transport) system may be impacted meaning herbicides are not transported to the sites of activity in the plant.

All environmental stresses reduce translocation of herbicides, so ensuring that plants are actively growing and recovered from any stress event is key to maximising the likelihood of successful application.

There are a number of indicators that signify plant health issues. The main indicator is a lack of new growth. Secondary indicators can vary depending on the type of stress.

Drought/heat stress
- Causes the stomates to close and photosynthesis to slow or stop
- Secondary effects include: build up of reactive oxygen compounds (Ozone); reduction in production of ATP (plant energy source); decrease in plant growth (both roots and shoots)

Cold/frost
- Freezing of cells leads to the rupturing of cell walls
- Disrupts normal plant transport functions (transport of nutrients and water throughout the plant)

Waterlogging
- Causes anaerobic (oxygen free) conditions to develop in the root zone
- Roots have reduced ability to function in the absence of oxygen, so nutrient and water absorption is slowed dramatically and normal plant function is impacted

What to do in the case of drought or heat stress:
- Application of a herbicide during a drought period is likely to result in reduced efficacy and should be avoided until rain has fallen
- Monitor plant health after rain, as significant rain may be required to overcome drought stress sufficiently

What to do in the case of cold/frost:
- In the case of frost, monitor for new growth. Once the weed has recommenced growth, it will again be susceptible to herbicide applications
- The length of time that the weed will need to recover from frost events will vary significantly, so the best approach is to monitor for certainty

What to do in the case of waterlogging:
- Delay application until such time as the paddock has dried out sufficiently.

In all cases, delay the application of herbicides until such time that the plants – both crop and weed – are actively growing. This will maximise efficacy on the weed and minimise the risk of injury to the crop.

APPLICATION FACTORS

Boom height and target/false target
- Attention should be paid to the actual target to which the herbicide is being applied
- The true target – Wild Oats – is not necessarily at ground level
- The boom height should be adjusted to provide double overlap at the height of the Wild Oats

Application speed
- Variable ground conditions will necessitate a slower speed to ensure that even height across the width of the sprayer can be maintained
- Excessive speed can result in vortexing behind the sprayer which results in under and overdosing

Nozzles, droplet size and water volume
- AXIAL is not especially sensitive to droplet spectrum, as long as weeds are healthy and actively growing; acceptable water rates are used (60-80 L/ha) and speed and coverage are appropriate for the situation
Crop stage (shading)
- Only around 3% of the active ingredient applied to the leaf actually makes it to the site of action at the meristem – improving application quality marginally can have a dramatic impact!
- The more advanced the crop, the more likely shading is to occur
- Timely application will help to alleviate this problem, but care should be taken with Selective Spray Topping (SST) applications

Weed stage (dose rate)
- Select the dose rate that is appropriate for control of the weed spectrum you’re targeting
- Look to achieve very high levels of control on all cohorts of weeds, rather than selecting a dose that will provide good control of smaller weeds and average control of larger weeds
- High levels of control mean that minor genes conferring metabolic resistance will be overwhelmed and as such their carrier plants won’t set seed and the genes won’t be able to accumulate in the target population
- Keep in mind environmental conditions for the season to date – stressed, frosted weeds will have a thicker cuticle and as such, will need more herbicide than the same size weed under good growing conditions
- Importantly, dose rate can change from season to season as environmental impacts vary

Water quality and tank mixes
- While AXIAL has very good stability at all pH values, leaving a prepared tankful of AXIAL overnight in high pH (>pH 8) water will likely result in some degradation but it would be unlikely to be greater than 10%
- AXIAL can be safely held in a spray tank over night, so long as the pH of the water is acid to neutral

What to do to mitigate machinery factors:
- Ensure that boom height is correct to deliver double overlap at the height of the Wild Oats (generally 50 cm from the target)
- SST applications may require increased boom height to ensure double overlap at the true target
- Choose an appropriate water rate for the canopy size
- Select a nozzle that will ensure you minimise off-target drift while still ensuring a balanced droplet spectrum
- If in doubt, check it! Use water sensitive paper to better understand where the droplets are getting to

What to do in the case of tank mix issues:
- If the spray water has a pH greater than 7, an acidifying buffer should be considered
- ADIGOR provides the most reliable adjuvant option when using AXIAL, but also provides a high level of in tank stability
- AXIAL will not be adversely affected by high bicarbonates if the spray mix is held for 24 hours or less

What to do in cases of Group A resistance:
- If resistance is suspected, consider the use of a resistance test such as the Syngenta RISQ test to identify the products available for use
- Be aware of the likely patterns of resistance development so that if poor performance from a herbicide is identified, an accurate assessment of the likely cause can be undertaken
- Use alternative Modes of Action if possible. This may mean the use of pre-emergent herbicides to help prolong the life of in-crop herbicides

RESISTANCE FACTORS

Mechanisms of resistance to Group As

Metabolic resistance
- Metabolic resistance is a collection of non target site mechanisms including reduced translocation, sequestration, and the plants ability to denature the herbicide etc.
- The more common form of resistance – many genes can confer metabolic resistance
- Will commonly confer a level of resistance to fops

Target site resistance
- Plant alters the enzyme to which the herbicide would normally bind, meaning it can’t engage and is therefore inactive
- The less common form of resistance – less genes confer target site resistance
- Generally the reason for resistance to dims and dens
- Fop resistance can develop as a result of a number of common metabolic mutations that don’t necessarily cause dim or den resistance

Patterns and indicators of resistance development
- Avena spp. are predominantly inbred
  - They are self pollinating, and as a result very little gene transfer occurs with other plants in a given area
  - As a result resistant populations are slow to develop and spread because the only source of seed is from the resistant individual
- Annual Ryegrass (ARG) is predominantly outcrossing
  - Ovules are predominantly fertilised by pollen from other plants, meaning gene transfer is rich
  - As a result, resistant populations develop in a short time period because resistance genes are shared throughout the ARG plants in a given area (up to 12 km) and as such it’s likely that multiple individual resistance mutations can be combined in single plants