DECISION®

TECHNICAL GUIDE

For the control of annual ryegrass in wheat.

Bayer CropScience

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INTRODUCTION

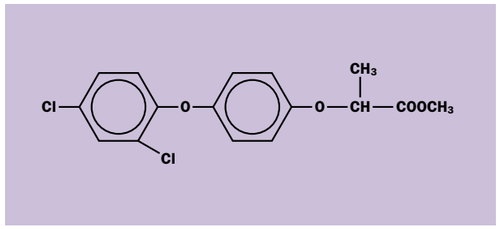
Decision® Selective Herbicide is an innovative solution to the problem of controlling annual ryegrass in Australian wheat crops. Decision uses a mixture of 'fop' and 'dim' Group A herbicides with a leading crop safener to ensure acceptable crop safety. Decision consistently outperforms Hoegrass® in controlling annual ryegrass and will become the new industry standard for annual ryegrass control.

PRODUCT FORMULATION

Active ingredients:

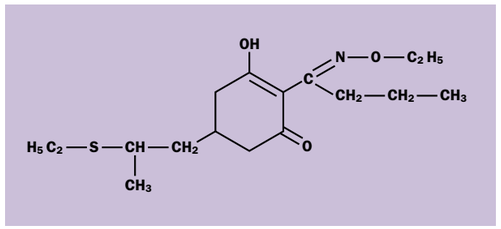
Trade name: Decision
Active constituent: 200 g/L diclofop-methyl
Chemical name: 2-[4-(2,4-dichlorophenoxy)-phenoxy] propanoic acid methyl ester

Structural formula (diclofop-methyl)



Active constituent: 20 g/L sethoxydim
Chemical name: IUPAC: (+)-(EZ)2-(1-ethoxyiminobutyl)-5-[2-(ethylthio) propyl]-3-hydroxycyclohex-2-enone
CA: (+)-2-[1-(ethoxyimino) butyl]-5-[2-(ethylthio) propyl]-3-hydroxy-2-cyclohexen-1-one

Structural formula (sethoxydim)



Formulation type: Emulsifiable concentrate (EC)

Physical properties

Formulated product (Decision):

Physical state: Liquid
Colour: Clear amber
Odour: Aromatic hydrocarbon
Flash point: >63˚C (closed cup)
Corrosiveness: Not corrosive to glass bottles & steel containers with polyethylene coating inside.
Specific gravity: 0.997 at 20˚C
pH: 5.0–6.0 (1% in water)
Dangerous good class: Not classified as a dangerous good for road and rail transport.
Poison schedule: 6
Solubility in water: Emulsifies in water

TOXICOLOGICAL PROPERTIES

Oral LD_{50} (rat): 512 mg/kg (diclofop-methyl)
Oral LD_{50} (rat): 2676 mg/kg (sethoxydim)
Dermal LD_{50} (rat): >2000 mg/kg (diclofop-methyl)
Dermal LD_{50} (rat): >5000 mg/kg (sethoxydim)
Inhalation LC_{50} (rat) (4-h): >1.36 mg/L (diclofop-methyl)
Inhalation LC_{50} (rat) (4-h): >6.28 mg/L (sethoxydim)
Skin irritation: Non-irritating (rabbit)
Eye irritation: Non-irritating (rabbit)

RESISTANCE MANAGEMENT

Resistant weeds warning

GROUP **A** HERBICIDE

Decision Selective Herbicide is a member of the aryloxyphenoxypropionate and cyclohexanedione group of herbicides. Decision is an inhibitor of acetyl-CoA carboxylase. For weed resistance management, Decision is a Group A herbicide. Some naturally-occurring weed biotypes resistant to Decision and other Group A herbicides may exist through normal genetic variability in any weed population. The resistant individuals can eventually dominate the weed population if these herbicides are used repeatedly. These resistant weeds will not be controlled by Decision or other Group A herbicides. Since occurrence of resistant weeds is difficult to detect prior to use, Bayer CropScience Pty Ltd accepts no liability for any losses that may result from the failure of Decision to control resistant weeds.

BIOLOGICAL PROPERTIES

Mode of action

Decision is a combination of diclofop-methyl and sethoxydim which are both Group A compounds.

Diclofop-methyl – activity
Diclofop-methyl is primarily taken up through the leaves and is very quickly transformed to the more phytotoxic diclofop. The active ingredient is also translocated in this form in the plant. Penetration and uptake through the roots is also possible, provided the soil is sufficiently moist and the application rate relatively high.

The actual site of action is the growing point where the apical meristem cells are damaged. It is therefore desirable that the herbicide is deposited near the growing point.

Diclofop-methyl and diclofop alter the cell membrane functions, prohibiting the translocation of assimilates. Lipid biosynthesis in the chloroplasts is blocked, which inhibits plant growth. The chlorophyll content is also reduced, because the damage to the chloroplast inhibits photosynthesis.

Diclofop-methyl – uptake and translocation
Diclofop-methyl is absorbed by the leaves and, to some extent, by roots. Up to 90% of the product can be absorbed by the leaves within 24 hours. There is virtually no translocation from sprayed leaves to new leaves, and very little from roots to leaves. Translocation from sprayed leaves to the meristematic area does occur, but is limited (approximately 95% can still be found at the site of application after 96 hours).

In the field, light rain at the completion of spraying has not led to any reduction in weed control, probably because of:

- the product being washed down to the meristematic area at the base of the leaves;
- absorption by the roots; and
- the low water solubility of the active ingredient.

Sethoxydim – activity
The primary mechanism of action of sethoxydim is by interfering with the lipid metabolism within the plant. Lipid biosynthesis in the chloroplasts are blocked, inhibiting growth. The resulting chloroplast damage inhibits photosynthesis and reduces chlorophyll.

Sethoxydim – uptake and translocation
Sethoxydim is absorbed by the leaves of the emerged grassweeds and, once inside the plant rapidly translocates both acropetally and basipetally throughout the meristematic region (or growing point). Negligible amounts of sethoxydim are translocated to the roots.

Symptoms

After application of Decision, grassweeds cease growth after 2–3 days and chlororis is observed in the new leaves. Yellowish/purplish patches appear after 7–10 days (depending on temperature) because of the chloroplast damage (reduced chlorophyll content) and the accumulation of anthocyanin pigments. Transport of assimilates (e.g. carbohydrates) to the roots is inhibited and the growth of the plant stagnates. After 14–21 days, all the grassweed tissue is damaged and complete necrosis occurs. Grassweeds can be easily pulled from the ground because the roots have stopped growing and the growing point is dead.

The efficacy of Decision is related to growing conditions. Results under poor growth situations (e.g. low or excess moisture, temperatures not favourable to weed growth or poor nutrition) may be inferior to those achieved under good conditions. High temperatures (≥25˚C) do not favour the growth of ryegrass, so the herbicidal effect may be reduced. The effect on young plants is always better than on old plants.

Mild, wet weather encourages plant growth and increases the activity of Decision. Hot, dry or excessively cold weather slows activity.

BEHAVIOUR IN THE ENVIRONMENT

In crop

Diclofop-methyl: After adsorption of the substance by the green tissue, diclofop-methyl is hydrolysed to the free acid diclofop, which is then converted into hydroxylated metabolites and further metabolised by the plant.

Sethoxydim: Breakdown in plants follows a similar path as in soil and animals, where the active is broken down rapidly into metabolites. Sethoxydim degradation is particularly enhanced by ultra-violet light, mixing with water, and adsorption onto solid surfaces such as soil.

In soil

Diclofop-methyl: During periods of warm weather and with adequate soil moisture, diclofop-methyl is quickly converted to the free acid diclofop (DT_{50} <4 days). Further degradation takes somewhat longer, depending on soil type and weather conditions. Field dissipation studies yielded DT_{50} times of 23–75 days.

The free acid is strongly bound to the soil, which prevents the substance leaching from the seed-bed into lower layers of the soil profile or into the groundwater. Adsorption to the soil is followed by subsequent mineralisation into CO_2 during periods of normal microbial activity. Neither diclofop-methyl itself nor any metabolite presents any risk to groundwater or succeeding crops.

Susceptible plants have been sown 25 days after diclofop-methyl application with no effect where soil is moist and well aerated. Under very dry conditions, and where soil is not disturbed (i.e. nil or very little microbial activity), breakdown may be slower.

Sethoxydim: Metabolism of sethoxydim involves molecular rearrangement, oxidation and conjugation process. Sethoxydim has relatively short soil persistence (DT_{50} in soil <1 day at 15˚C). The extent of persistence depends on soil type (loamy soils have higher capacity for persistence than sandy soils), soil moisture (rapid decomposition in moist soil; trace levels of sethoxydim 24 hours after being applied to dry soil) and the capacity for microbial breakdown (aided by aerobic conditions).

In water

Diclofop-methyl: Slowly hydrolysed. Breakdown in water is dependent upon pH, microbial content, oxygen, light and suspended particles. The purer the water, the slower the breakdown.

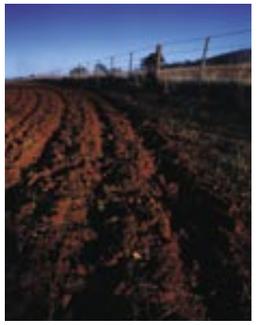
Sethoxydim: Has a short half-life at low pH levels (acidic conditions), but is very stable in alkaline conditions. Photolysis in water occurs in less than one hour.

In animals

Diclofop-methyl: After oral uptake by rats, diclofop-methyl is rapidly excreted via the faeces and urine (89% within 2 days). The excretion takes place in the form of the unchanged active ingredient (up to 20%) as well as conjugated metabolites.

Diclofop-methyl does not accumulate in animal tissues.

Sethoxydim: Degradation in animals follows similar paths to degradation in soil and plants, where the active is broken down rapidly into metabolites.



EFFECTS ON FAUNA AND FLORA

Environment

Decision is dangerous to fish and other aquatic organisms. It is of low toxicity to birds, bees and earthworms.

DO NOT contaminate streams, rivers or waterways with Decision or the used containers.

Fish

Acute tests were performed with a warm and a cold water fish species. All studies indicate that the active ingredients are relatively dangerous to fish.

	Species	Study type/duration	LC_{50} (mg/L)
Diclofop-methyl	Bluegill sunfish (*Lepomis macrochirus*)	Static acute (96-h)	0.24 mg/L

	Species	Study type/duration	LC_{50} (mg/L)
Sethoxydim	Carp (*Barbodes*)	Static acute (48-h)	153 mg/L
	Rainbow trout (*Oncorhynchus mykiss*)	Static acute (48-h)	38 mg/L

Fish-food organisms (invertebrates)

In acute as well as prolonged studies, the active ingredients proved to be toxic to Daphnia.

	Species	Study type/duration	EC_{50} (mg/L)
Diclofop-methyl	Water flea (*Daphnia magna*)	Static acute (48-h)	0.23 mg/L

	Species	Study type/duration	LC_{50} (mg/L)
Sethoxydim	Water flea (*Daphnia magna*)	Static acute (3-h)	1.5 mg/L

Effects on birds

On the evidence of the acute tests undertaken, Decision has low toxicity to birds.

Acute oral toxicity

	Species	Study type/duration	LD_{50} (mg/kg b.w)
Diclofop-methyl	Japanese quail (*Coturnix japonica*)	14-day acute oral	>10000 mg/kg

	Species	Study type/duration	LD_{50} (mg/kg b.w)
Sethoxydim	Japanese quail (*Coturnix japonica*)	14-day acute oral	>5000 mg/kg

Wild mammals

Acute oral toxicity

	Species	Study type	LD_{50} (mg/kg b.w)
Diclofop-methyl	Rat	Acute oral	512 mg/kg

	Species	Study type	LD_{50} (mg/kg b.w)
Sethoxydim	Rat (M)	Acute oral	3200 mg/kg
	Rat (F)	Acute oral	2676 mg/kg

Effects on bees

Decision is of low toxicity to bees.

Effects on earthworms

Decision is of low toxicity to earthworms.

DIRECTIONS FOR USE

Restraints

DO NOT apply to wheat that is physically damaged (e.g. by hail, wind, insect attack)
DO NOT allow spray overlap or double spraying of corners
DO NOT apply to weeds under stress due to for example, very dry, very wet, nutrient–deficient, frosty or diseased conditions, or as the result of a previous herbicide treatment (see also General Instructions)
DO NOT apply if rainfall is expected within 2 hours

Crop	Weed	State	Weed stage	Rate (ha)	Critical comments
Wheat	Annual ryegrass (*Lolium rigidum*)	NSW, ACT, Vic, Tas, SA & WA only	2-leaf to one tiller (Z12 to Z14, 21)	1.0 L	Apply generally 3 to 6 weeks after sowing, when wheat is usually 2-leaf to 1-tiller (Z12 to Z14,21). Add the crop oil Hasten® at 1% v/v (i.e. 1.0 L per 100 L of spray mixture) when Decision is being applied alone. When Decision is to be tank-mixed with a compatible product, refer to **Use of a crop oil/wetting agent** under GENERAL INSTRUCTIONS.

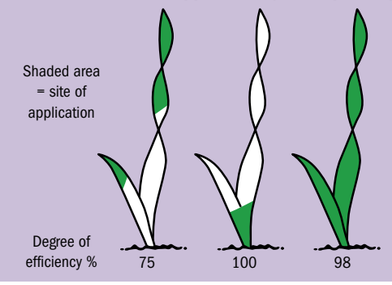
Withholding periods

Harvest: NOT REQUIRED WHEN USED AS DIRECTED
Grazing: DO NOT GRAZE OR CUT FOR STOCKFOOD FOR 7 WEEKS AFTER APPLICATION

Application

Application of Decision should be directed at the base (meristematic tissue or growing tip) of the weed for good results (as shown in the diagram below). It is also important to use the right combination of type and size of nozzle, and correct droplet size, with adequate spray volume and pressure. Careful calibration of the spraying equipment is essential for successful control. Use small droplets (200 to 300 microns) and aim for a droplet density of approximately 25 to 50 droplets per cm^2.

Influence of site of application (diclofop-methyl)



Water quality

Diclofop-methyl is unstable in alkaline conditions, while sethoxydim is unstable in acidic conditions. Clean water with water hardness of 1000 ppm or less with a neutral pH (pH 7) is ideal. Do not leave Decision mixed in the tank for prolonged periods (greater than 6 hours).

Rainfastness

This depends upon drying time – i.e. temperature and relative humidity. The drying time may vary, but DO NOT apply Decision if rainfall is expected within 2 hours.

Ground-rig application

Only standard boom sprays are recommended and they must be fitted with by-pass or mechanical agitation. Do not apply with boomless jets or misters.

Trials over past years have clearly shown which conditions produce more consistent and reliable results:

- Higher water volumes (i.e. 60 to 100 L/ha) were more consistent than 30 to 40 L/ha.
- Slower speeds (i.e. 10 to 15 km/hr) were more consistent than faster speeds (18 to 24 km/hr).
- Wide-angle nozzles (i.e. 110˚ flat-fan jets) were more consistent than 80˚ jets.

On the basis of this work, and experience with the product, we strongly suggest the following:

Nozzles: Use 110˚ nozzles set up as the manufacturers recommend, i.e. Spraying Systems nozzles 11002 or 11003 at 50 cm spacings for single overlap, or at approximately 25 to 30 cm for double overlap. **Air induction nozzles are not recommended.**

Speed: Maximum 16 km/hr to avoid excessive boom instability.

Pressure: 280 to 300 kPa (approx. 40 to 43 psi).

Water volumes: Minimum 50 L/ha up to 150 L/ha.

Aerial application

Decision is not recommended for aerial application, because of the high risk associated with overlap.

WEED CONTROL - EFFICACY

Annual ryegrass

Decision is an excellent herbicide for control of annual ryegrass. Decision has a unique combination of 'fop' & 'dim' Group A chemicals to provide this control in wheat. Trials show that once fop resistance is high in a ryegrass population, Decision will not control ryegrass and will only provide small improvements in weed control.
The graphs below show that Decision is not a suitable herbicide where resistance levels are high to Group A products, with Decision showing only a slight improvement over Hoegrass alone (Graph 1).

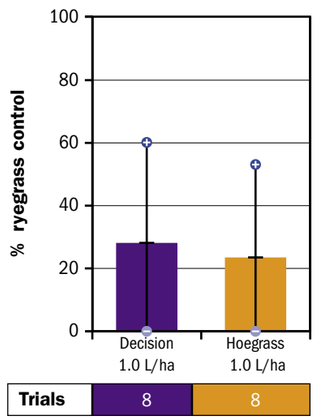
Where ryegrass resistance is beginning to develop, Decision provides a clear benefit over Hoegrass alone, showing almost 10% weed control improvement (Graph 2).

Where ryegrass is still susceptible to the Group A chemicals, Decision is shown to be a more robust herbicide, with a 9% improvement on Hoegrass alone (Graph 3).

Overall, as the graph shows, Decision is a superior herbicide to Hoegrass (Graph 4).

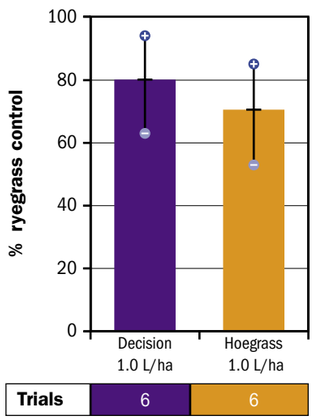
***Hoegrass comparisons are made with the Hoegrass 375 g ai/L formulation with BS 1000® at 0.1% v/v.
Decision was used with Hasten at 1% v/v.**

GRAPH 1: Resistant ryegrass



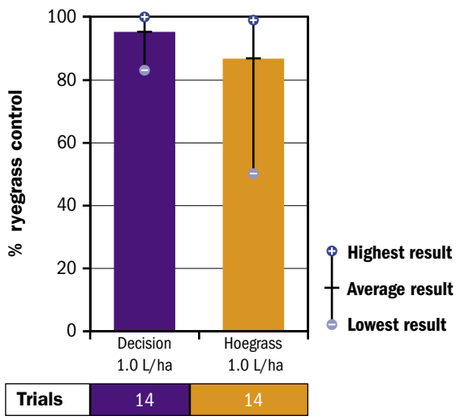
Trial ID: 99NW25, 02NW20, 02SA13, 02SA14c, 00SA08, 02SA14b, 01NW22, 02SA14

GRAPH 2: Developing resistance



Trial ID: 02NB19, 02VB04, 99WA26, 02WA18, 01SA17, 02WB18

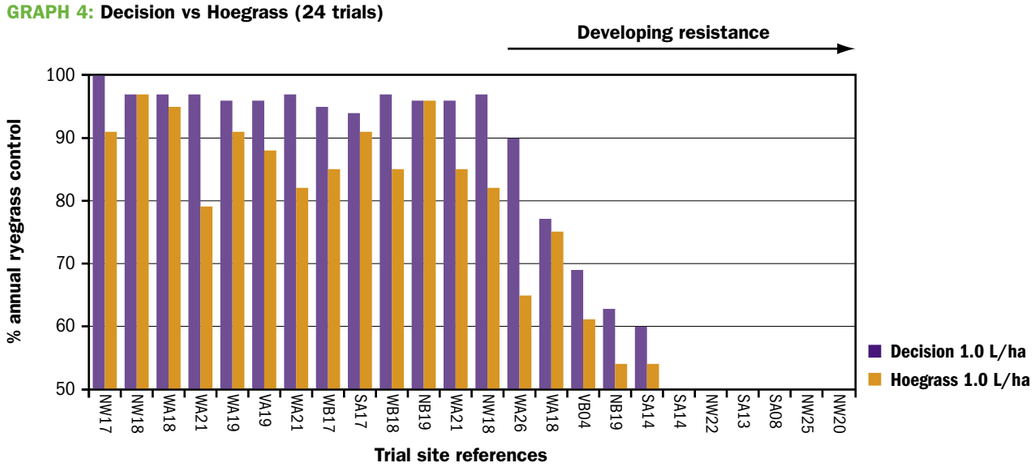
GRAPH 3: Susceptible ryegrass



Trial ID: 02NW18b, 02WA21b, 01WA21, 02WB17, 02WA21, 02VA19, 03WA01, 03WB10, 02NW17, 02WA19, 02WA21c, 00NB19, 00WA18, 02NW18

The resistance categories above were determined from researcher experience and paddock history rather than resistance tests.

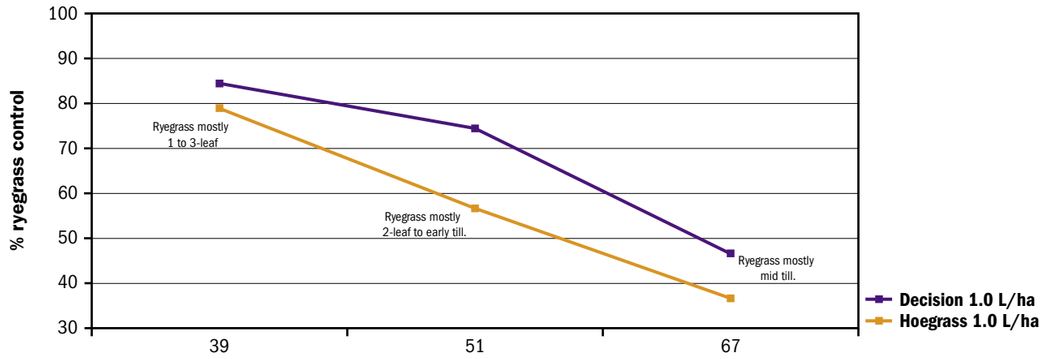
GRAPH 4: Decision vs Hoegrass (24 trials)



Ryegrass timing

Applying Decision early is the best way to maximise its weed control. The graph below shows that the efficacy of both Hoegrass and Decision is reduced as the weed size increases. Timing 1 was applied at 39 DAS (days after sowing), timing 2 was 51 DAS and timing 3 was 67 DAS. The reduction in efficacy over time is shown clearly in the graph below. While Decision may be more robust than Hoegrass, the data shows that a delay in application can result in poor weed control. An ideal application is 4–6 weeks after sowing.

GRAPH 5: Decision timing – annual ryegrass efficacy

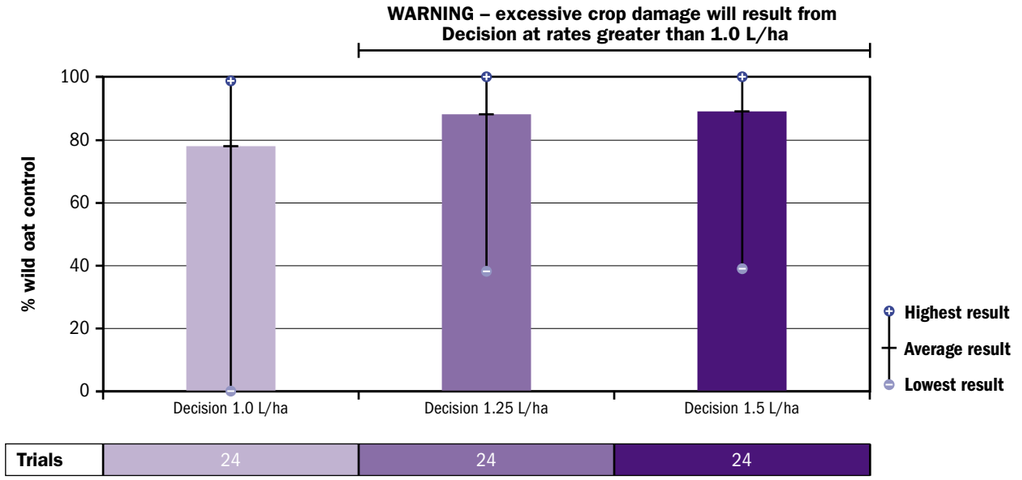


Trial ID: 03NW18, 03SA14, 03WA21

Wild oats

In many cases where annual ryegrass is present, a number of wild oats may also appear in the weed mix. The graph below shows that Decision does have an effect on wild oats, but the registered rate of 1 L/ha is not sufficient to provide consistent wild oat control to an industry standard and would regularly fail. On the other hand, at rates of 1.5 L/ha Decision causes too much crop damage to be considered.

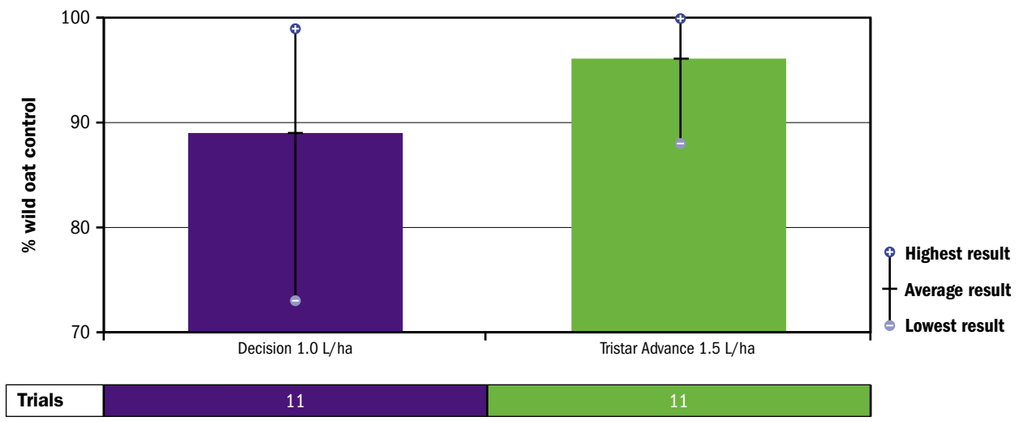
GRAPH 6: Wild oat control



Trial ID: 02NB19, 02SA13, 03NW17c, 03WA19, 03NW15, 03WA19b, 02WA18, 03NW19, 03WA19c, 03ND14c, 03VB07, 03WB09, 03NW16, 03VB04, 03ND13, 03ND14, 03NW17, 03WB07, 03NW17b, 03ND16, 03ND14b, 03VA22, 02VB04, 03WA18

When Decision is compared to Tristar® Advance, the benchmark product for wild oat control, it is clear that Decision does not meet the industry standard and is not suitable for the control of wild oats. Given the competitive nature of wild oats and their staggered germination profile, Decision will not be registered for suppression of wild oats.

GRAPH 7: Wild oat control – Tristar Advance vs Decision

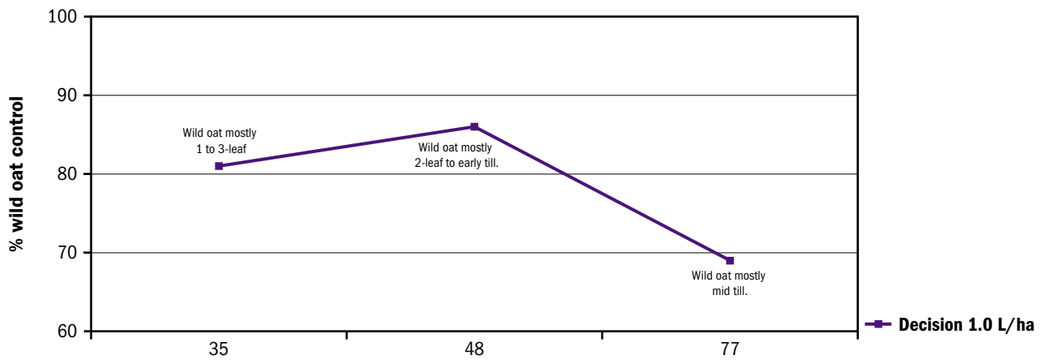


Trials ID: 03NW15, 03NW19, 03VB07, 03WB09, 03VB04, 03NW16, 03ND13, 03WB07, 03ND16, 03VA22, 03WA18

Wild oat timing

The graph below shows the problem with using Decision for wild oat control. Wild oats have staggered germination over time, so a very robust herbicide is required to control the large, early-germinated wild oats. The data shows that efficacy declines rapidly past 48 days after sowing and early applications are not commercially acceptable. Decision also shows reductions in efficacy as the weeds get larger. While Decision may be more robust than Hoegrass, the data shows that a delay in application can result in poor wild oat control. If wild oats are present in a ryegrass mix, Tristar Advance should be used.

GRAPH 8: Wild oat control at different timings



Trial ID: 03ND14, 03NW17, 03WA19

COMPATIBILITY

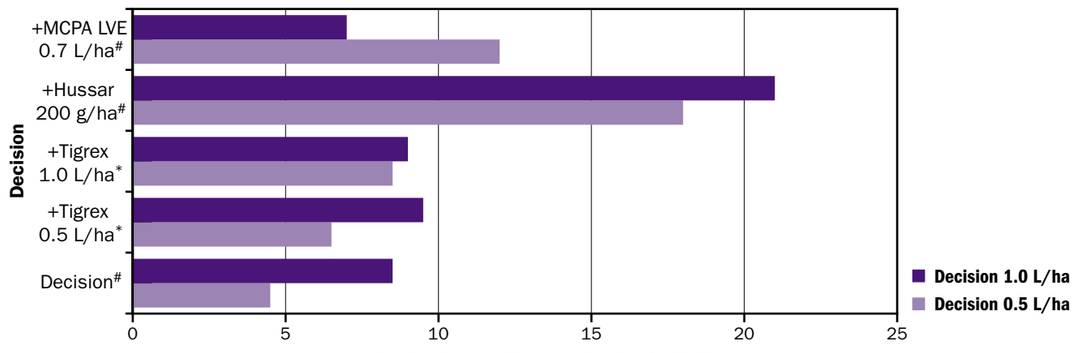
Broadleaf herbicides

When considering Decision's compatibility with other herbicides, there are three key factors that need to be considered to ensure recommendations can be given with confidence:

- crop safety and selectivity,
- weed control antagonism, and
- physical mixing compatibility.

The addition of broadleaf herbicides can cause an increase in crop effects. The trial results in graph 9 below show the impact on biomass. Both Tigrex® and MCPA LVE at the rates used in the trial showed slight increases in crop biomass reductions when mixed with Decision at either the full rate or half rate. The addition of Hussar,® however, increased effects beyond an acceptable level.

GRAPH 9: Decision plus broadleaf herbicide – maximum biomass reduction

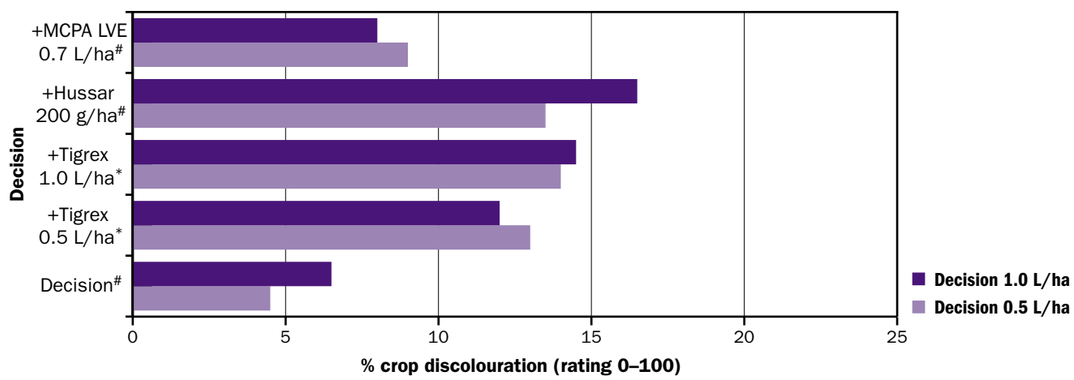


Trial ID: ND15, NW18, VA21, VB03, WB08, WA20/2003
* Treatments included BS1000 at 0.1% v/v
# Treatment included Hasten at 1.0% v/v

The same treatments were also rated for crop discolouration. Based on the results presented in graph 10, Tigrex at 500 mL/ha and MCPA LVE at 700 mL/ha were both acceptable from a crop discolouration perspective.

The higher rate of Tigrex – 1 L/ha – and the mixture with Hussar both caused too much discolouration to be recommended.

GRAPH 10: Decision plus broadleaf herbicide – maximum discolouration



Trial ID: ND15, NW18, VA21, VB03, WB08, WA20/2003
* Treatments included BS1000 at 0.1% v/v
# Treatment included Hasten at 1.0% v/v

Crop selectivity

The only broadleaf herbicides that are suitable for use with Decision and provide adequate crop safety are Tigrex at 500 mL/ha and MCPA LVE at 700 mL/ha. Tigrex at 1.0 L/ha provides acceptable crop biomass reduction, but the crop discolouration is not acceptable. Hussar and the tank-mix of MCPA LVE and Ally® were not safe enough on wheat to recommend in a mixture with Decision.

	Crop biomass – Decision 1.0 L/ha	Crop effect – Decision 1.0 L/ha
Tigrex 0.5 L/ha*		
Tigrex 1.0 L/ha*		
Hussar 200 g/ha*		
MCPA LVE 0.7 L/ha#		
Ally 5 g/ha + MCPA LVE 0.5 L/ha#		

Trials indicate significant crop effects at the rates used.

Trials indicate little or no change in crop selectivity compared to the herbicide alone.

Trials indicate increases in crop response. Expect less than 10% increase in crop effects compared to the herbicide alone.

Grassweed efficacy

For ryegrass control, Tigrex at 500 mL/ha and 1.0 L/ha showed negligible reduction when mixed with Decision at full rates and acceptable reduction levels with half rates. Tigrex at both rates with either half or full rates of Decision showed unacceptable reductions in wild oat control. Only Tigrex at 500 mL/ha provided adequate crop safety data, with Tigrex at 1.0 L/ha showing unacceptable crop discolouration, in a mixture with Decision.

Hussar improved ryegrass and wild oat control because it has such good activity on both those grass species. However, Hussar is not recommended due to poor crop selectivity data showing unacceptable reductions in crop biomass and significant increases in crop discolouration.

The addition of MCPA LVE up to 700 mL/ha showed negligible reduction mixed with Decision at full rates and acceptable reduction levels at half rates. MCPA LVE showed unacceptable reductions in wild oat control. The crop safety of this mixture was acceptable.

A mixture of Ally + MCPA LVE was unacceptable in all cases. It showed significant reductions in weed control of both ryegrass and wild oats and showed unacceptable crop damage and should not be used under any circumstances.

	Ryegrass control – Decision 0.5 L/ha	Ryegrass control – Decision 1.0 L/ha	Wildoat control – Decision 0.5 L/ha	Wildoat control – Decision 1.0 L/ha
Tigrex 0.5 L/ha*	11% reduction	6% reduction	37% reduction	23% reduction
Tigrex 1.0 L/ha*	17% reduction	0% reduction	35% red uction	37% reduction
Hussar 200 g/ha*	0% reduction	0% reduction	0% reduction	0% reduction
MCPA LVE 0.7 L/ha#	14% reduction	1% reduction	44% reduction	26% reduction
Ally 5 g/ha + MCPA LVE 0.5 L/ha#	35% reduction	20% reduction	39% reduction	41% reduction

Figures in box show the % by which the tank-mix reduced the weed control compared to Decision applied alone.
Trial ID: ND15, NW18, VA21, VB03, WB08, WA20/2003
* Treatments included BS1000 at 0.1% v/v
# Treatment included Hasten at 1.0% v/v

Trials at recommended rates indicate severe reduction in grassweed control.

Trials indicate little or no reduction in grassweed control when used as recommended.
Results at below recommended rates may indicate some reduction in some cases. Mixtures may be used with minimal loss of activity under good growing conditions, with all label recommendations followed.

Trials indicate some reduction in grassweed control at recommended rates, even under good growing conditions. Mixtures will usually result in reduced grassweed control and cannot be recommended unless such efficacy loss is accepted

CROP SAFETY

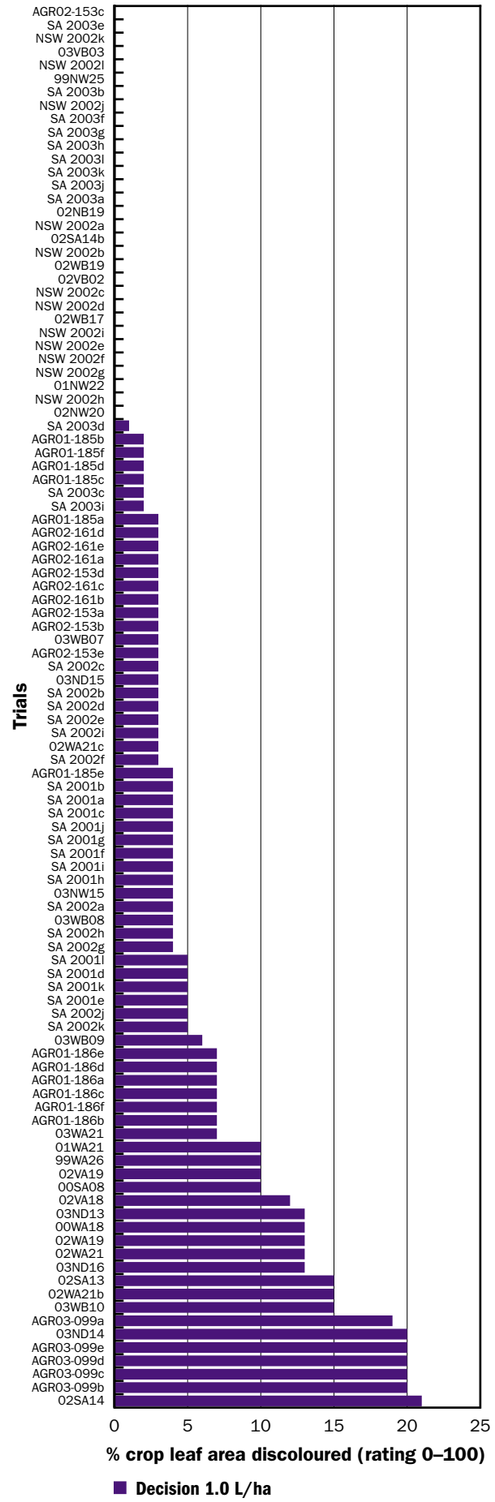
Crop discolouration and biomass reductions

Decision can cause crop discolouration shortly after application. The typical symptoms include yellowing of the plant material. Decision penetrates the cuticle and epidermis rapidly, but translocation in the phloem is relatively slow. Movement in the xylem is more rapid, leading to an accumulation of active at the leaf tips. This can result in burning of the wheat leaf tips. Transient whitening at the base of new leaf emergence may occur affecting new growth.

The trial results shown here confirm that these types of effects are common and that discolouration of up to 20% occurs.

Under cold, wet, waterlogged conditions or nutrient stress, the crop effects can be severe. Older leaves turn yellow and there is significant necrosis. New growth is generally unaffected and the crop recovers in about 4 weeks. In some cases new growth may show transient whitening and growth may be slowed. The maximum effect is 21–28 days after application, with recovery being 40–60 days after application. Double overlap in this situation may be noticeable up to harvest.

GRAPH 11: Maximum crop discolouration in wheat trials 1999–2003 Decision 1.0 L/ha



All Decision treatments include Hasten at 1% v/v

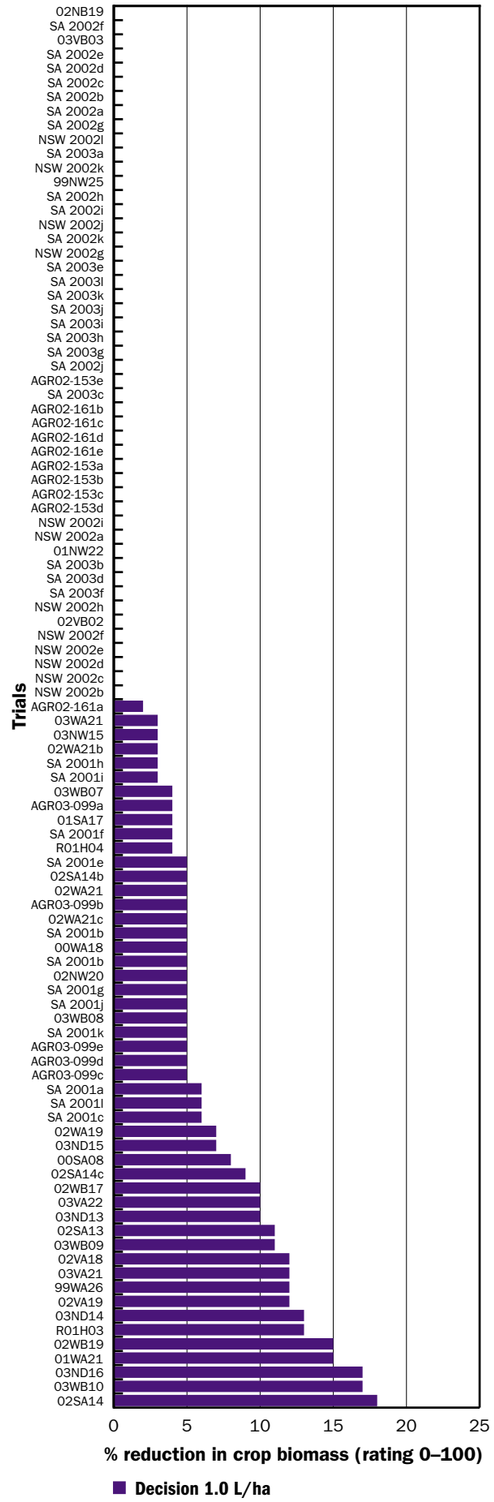
The pictures below demonstrate the sort of crop effects that can be seen, such as the yellowing and whitening of the new growth and at the base of new leaves.

While these visible effects can be worrying, results from trials show rapid recovery – with maximum effect being 21–28 days after application and full recovery being 40–60 days after application. Graphs 11 and 12 summarise a large number of tolerance and efficacy trials with Decision used at 1 L/ha. The conclusion is that around half of all Decision applications can be expected to produce a visible effect on the crop biomass, with up to 20% reduction in crop herbage, without loss of yield.

Varietal review

Since the trial data shows no significant varietal differences in wheat, there are no variety restrictions on the Decision label.

GRAPH 12: Maximum biomass reduction in wheat trials. Efficacy & tolerance 1999–2003 Decision 1.0 L/ha



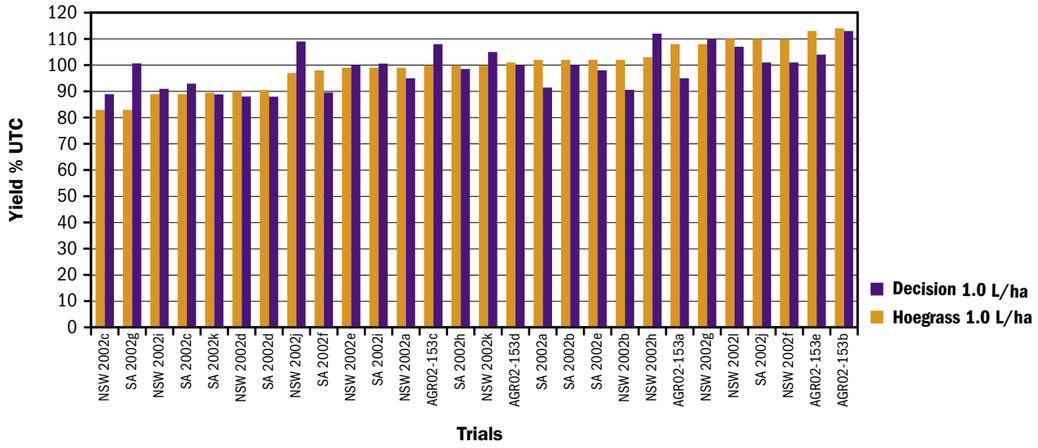
All Decision treatments include Hasten at 1% v/v

Crop yield

The crop's rapid recovery from effects such as biomass reductions and crop discolouration has already been mentioned. It is important to note that when Decision is used at the label rate (1.0 L/ha), it produces a very similar crop yield to that of the industry standard, Hoegrass.

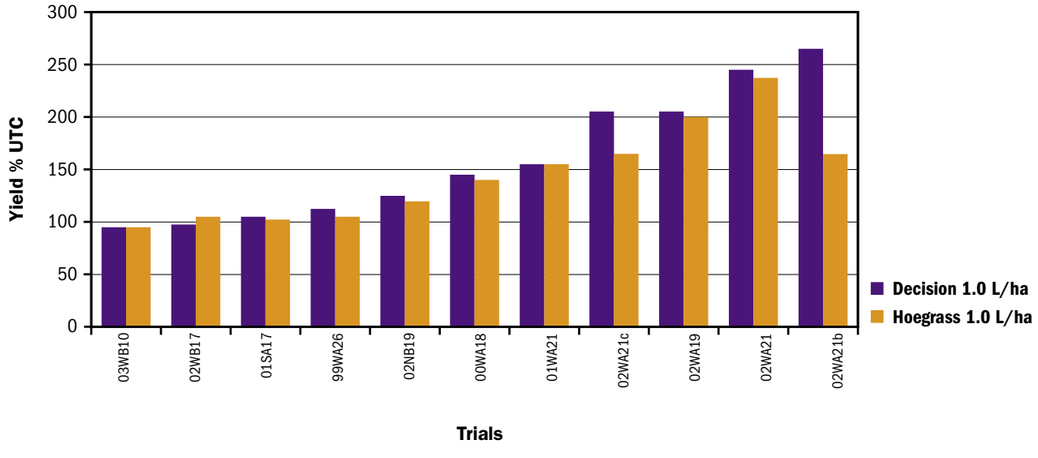
These graphs summarise a significant number of yielded cultivars designed to compare the yields of crops treated with Hoegrass and Decision without weeds present. They clearly demonstrate that the two products have very similar yield profiles.

GRAPH 13: Yield % untreated for Decision 1.0 L/ha vs Hoegrass 1.0 L/ha in tolerance trials (weed–free)



In trials where weeds are present, the advantage of using Decision is clear. Since Decision provides better weed control than Hoegrass, the combination of similar crop selectivity and superior weed control provide superior yields in the Decision treatments.

GRAPH 14: Yield % untreated for Decision 1.0 L/ha vs Hoegrass 1.0 L/ha in efficacy trials



CONCLUSION

There is no yield disadvantage when using Decision at label rate compared to Hoegrass, with Decision offering a small yield increase over Hoegrass.

When annual ryegrass is present it can be expected that a yield increase will be achieved with Decision versus Hoegrass, since Decision offers better annual ryegrass control.

Other factors influencing crop safety:

Research and development with Decision has led to some changes to application advice that may help reduce crop effects.

Addition of zinc oxide

If the crop is under low or marginal zinc nutritional status, the addition of zinc oxide can reduce the level of crop effects seen from Decision and will improve the crop recovery time. Paddocks may have an induced zinc deficiency during rapid growth early in a crop's life if the soil zinc status is marginal.

Glasshouse pot trials in Western Australia by Robson and Snowball (1989) demonstrated soil-incorporated diclofop-methyl (a key component of Decision) could induce zinc deficiency in wheat.

The addition of zinc oxide is recommended where you plan to apply Decision if the nutritional status may be marginal, or Hasten is used as the surfactant.

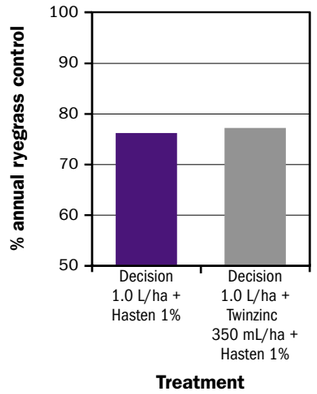
The trials below demonstrate the interactions between Decision and zinc oxide. The addition of zinc can reduce crop effects and accelerate crop recovery (graphs 18, 19 & 20).

Decision was used at double the recommended rate to demonstrate the effect that zinc can have on crop visual effects. Zinc oxide should be applied at rates of 350 mL/ha Twinzinc® equivalent.

Trial work also demonstrates that the addition of zinc oxide does not have a significant impact on Decision's activity against ryegrass (graphs 15, 16 & 17).

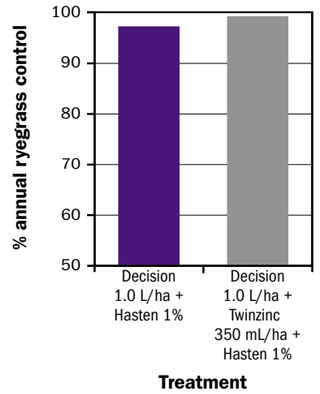
When Decision is applied to paddocks that have had recent zinc applied to soil to correct marginal or deficient status, zinc oxide should still be added to the Decision spray solution as zinc is not highly mobile in soil and may not be fully available in the first year.

GRAPH 15: Effect of Twinzinc on annual ryegrass



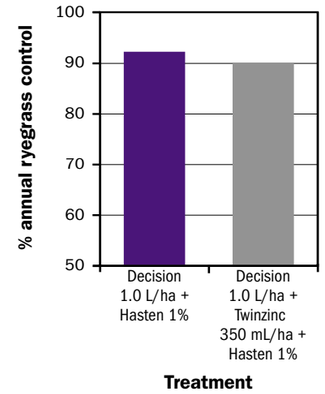
Trial ID: WA12

GRAPH 16: Effect of Twinzinc on annual ryegrass



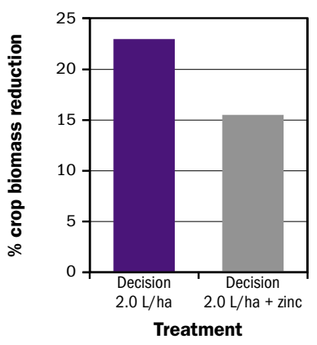
Trial ID: ND02

GRAPH 17: Effect of Twinzinc on annual ryegrass



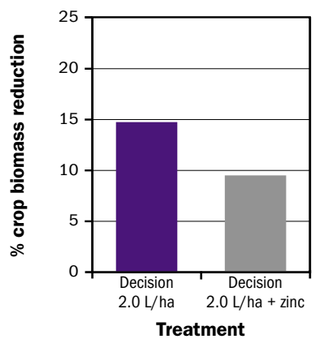
Trial ID: NW17

GRAPH 18: Effect of zinc addition to 26 varieties of wheat (22 days after application)



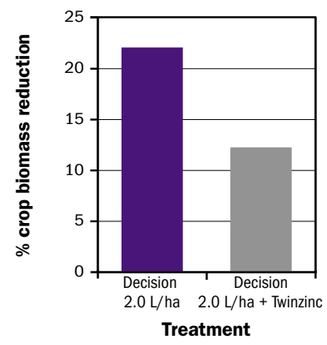
Trial ID: 03TC25

GRAPH 19: Effect of zinc addition to 26 varieties of wheat (75 days after application)



Trial ID: 03TC25

GRAPH 20: Foliar zinc addition to Decision



Trial ID: Clegg, Hyden, 2003

Surfactants/Adjuvants

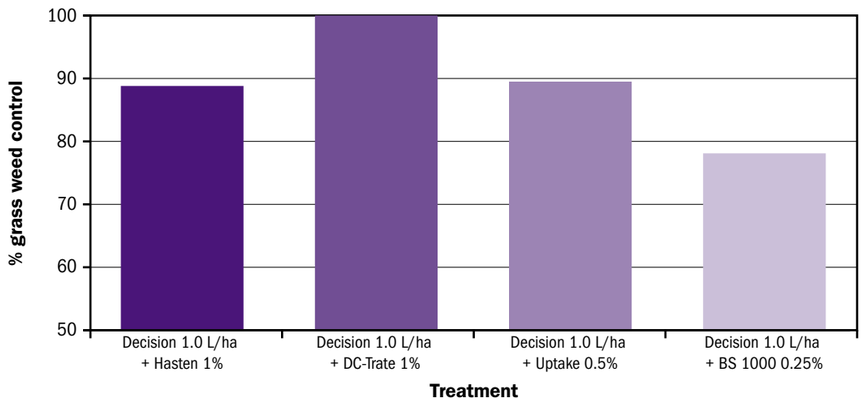
Decision currently has Hasten listed as the surfactant for use in wheat. Bayer CropScience has conducted a number of trials to determine the impact of using alternative surfactants.

The trial summary below demonstrates that although a wetting agent such as BS 1000 may show a reduction in crop effect, it also shows significant reduction in weed control – so it is not recommended.

The surfactant Uptake® at 0.5% shows similar weed control to Hasten, while the surfactant DC-Trate® shows slightly improved efficacy. If crop selectivity is expected to be a problem, DC-Trate or Uptake should be used in place of Hasten.

Decision should not be applied with liquid nitrogen fertilisers or if the effects of liquid nitrogen fertilisers are still present in the crop.

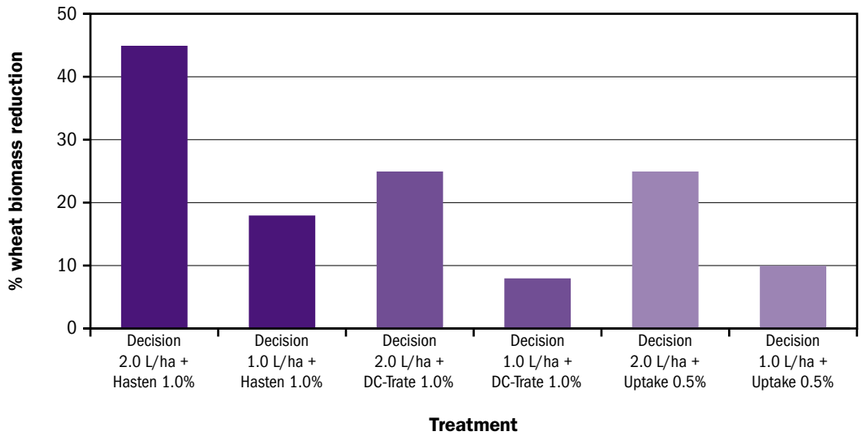
GRAPH 21: Grassweed control using different adjuvants



Trial ID: 03WA23, 03ND13, 03NW15, 03NW16, 03VB04, 03WA18, 03WB07

The trial below shows the improvement in crop selectivity with DC-Trate and Uptake compared to Hasten. Bayer CropScience recommends the use of DC-Trate or Uptake in preference to Hasten. If Hasten is used with Decision, it must be used in conjuction with zinc oxide at 350 mL/ha.

GRAPH 22: Effect on crop biomass with different adjuvants and Decision



Trial ID: 03ND02

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