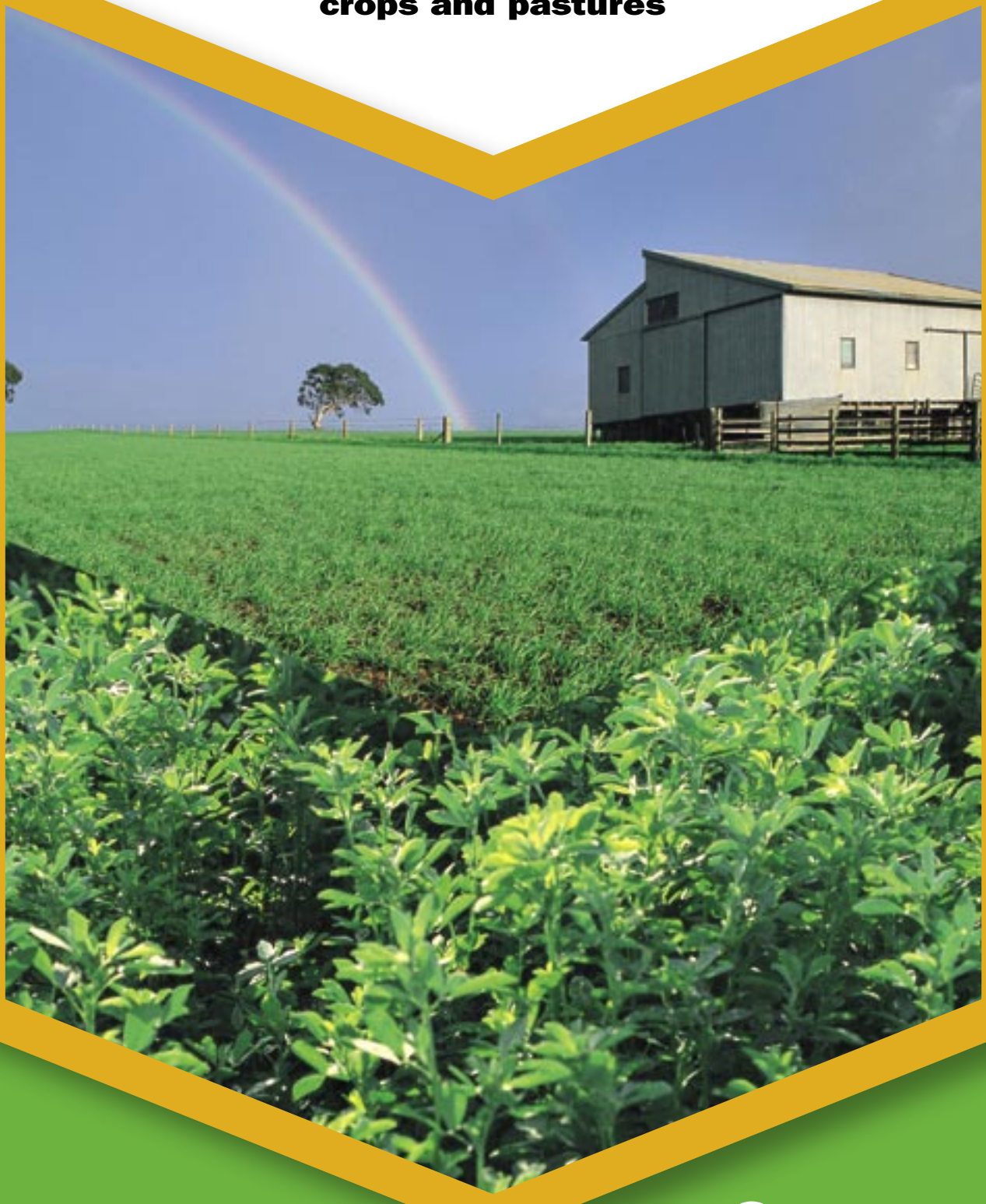
JAGUAR®

TECHNICAL GUIDE

For the selective control of a broad range of weeds in cereal crops and pastures



Bayer CropScience

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INTRODUCTION

Jaguar is a post-emergent herbicide from Bayer CropScience, released after an intensive development program spanning 6 years. Jaguar offers a number of unique benefits to cereal farmers right across Australia. It can be applied very early to control weeds before they compete with the crop. It controls an extensive range of broadleaf weeds and can also be tank-mixed with a wide range of grass herbicides for effective one-pass control of grass and broadleaf weeds.

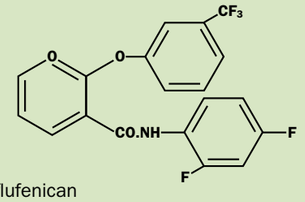
PRODUCT FORMULATION

Active ingredient

Trade name: Jaguar Selective Herbicide
Active constituent 1: 25 g/L diflufenican
Chemical name: N–(2,4–difluorophenyl)–2–(3–trifluoromethylphenoxy) Pyrimidine–3–carboximide
Active constituent 2: 250 g/L bromoxynil
Chemical name: 3,5–dibromo–4–hydroxybenzonitrile

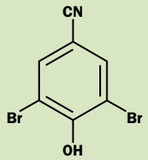
Structural formula

1.



Diflufenican

2.



Bromoxynil

Formulation type

Formulation: Emulsifiable concentrate (EC)

Physical properties

Appearance: Translucent brown liquid
Density: 1.08 at 20˚C
Odour: Aromatic, sweet ester
Flashpoint: 66˚C
Boiling point: Not determined
Corrosiveness: Non-corrosive to glass and epon-lined metal. The spraying solution is non-corrosive to brass and other metals.
Miscibility: Miscible with most water quality types available for spraying. Avoid muddy water, or water with high organic matter.
Stability: Stable for a minimum of two years if stored in the unopened original container, in a suitable storage area out of direct sunlight and extremes of temperature.
Solubility: Miscible in water
Poison schedule: 6
Hazchem code: Not classified as Dangerous Goods for transport by road or rail.

TOXICOLOGICAL PROPERTIES

Oral LD_{50} (rat): 1113 mg/kg
Dermal LD_{50} (rat): >2000 mg/kg
Inhalation LC_{50} (rat): 2.34 mg/L air (4hr) (diflufenican)
Inhalation LC_{50} (rat): >0.41 mg/L air (4hr) (bromoxynil)

BIOLOGICAL PROPERTIES

Mode of action

Jaguar is a combination of diflufenican and bromoxynil, each of which has its own distinctive mode of action.

Diflufenican – activity
Diflufenican is a potent and specific inhibitor of phytoene dehydrogenase, a key enzyme of carotenoid biosynthesis. The yellow carotenoid pigments perform several functions in plants, particularly in the absorption of light for photosynthesis. They also protect the plant from photo-oxidation caused by a surplus of light energy accumulated by chloroplasts. In their absence, chloroplast development and chlorophyll biosynthesis are inhibited. Since carotenoids are synthesised in the apical meristems (growing points), these areas are the preferential target for diflufenican.

Diflufenican – uptake and translocation
Following application, the foliage of the weeds absorbs diflufenican. However, good coverage is essential because the translocation of the product is limited. It causes extensive bleaching, and diflufenican's speed of activity is greatest under warm, high light-intensity conditions. Diflufenican should be applied to young, actively growing weeds. Weed tolerance to the herbicide increases rapidly with age.

Pre-emergent – weed activity
Following foliar application, diflufenican also forms a continuous film on the soil surface. This film is resistant to leaching and persists through **the vegetative stage of the crop**. As weeds germinate and pass through this residual layer (the top few millimetres of soil) they absorb the herbicide through both shoots and roots. The herbicide is then diffused the short distances to the meristematic tissues. **Good coverage of the soil surface and rainfall after application are desirable** to achieve optimum residual activity.

Weeds germinating deeper in the soil profile are less likely to be controlled, as the roots are outside the herbicide layer.

Post-emergent – weed activity
When diflufenican is applied to germinated weeds, it primarily affects new and developing leaf tissue. Old leaf tissue may eventually die as a result of photosynthetic inhibition in the new leaves. Weeds at an advanced stage of growth at the time of treatment will show the symptoms but may not be adequately controlled. Diflufenican is not readily translocated in the phloem from leaves to meristematic tissues and roots. However, because of its very high potency on phytoene

dehydrogenase and metabolic persistence in plants, very little diflufenican is required to accumulate at the target site. Sufficient diflufenican may be phloem-mobile to exert phytotoxicity. In addition, a direct interception of spray deposit can occur at the meristematic regions, particularly in dicotyledonous species. Such tissues are relatively exposed and this 'contact' activity with subsequent short-distance diffusion will certainly contribute to overall phytotoxicity. Diflufenican also has limited xylem mobility and, with species where the root systems are near the soil surface and in contact with the diflufenican, accumulation through root uptake and subsequent translocation through the xylem will contribute to phytotoxicity.

Bromoxynil – activity
At a biochemical level, bromoxynil has been shown to inhibit the second light reaction of photosynthesis and also uncouple oxidative phosphorylation of respiration. It therefore acts on electron transport inhibitors and uncoupling agents.

Bromoxynil – uptake and translocation
Bromoxynil acts primarily as a contact foliar herbicide, with virtually no soil residual activity. There is limited herbicide movement within the plant and good coverage over the leaf area is imperative, particularly at the growing point. Translocation can play a significant role in the effectiveness of this herbicide. Uptake is greatest under conditions of low light intensity, high humidity and low wind speed. Application under conditions of high temperature and high light intensity may result in rapid localised burning of the plant tissue, but a reduction in the final level of weed control.

It has been shown that weeds that have been actively growing in the period prior to application are much more susceptible to bromoxynil than those whose growth has been slowed by forms of stress (e.g. frost).

Jaguar – symptoms
Typically, Jaguar is a very fast-acting herbicide. Symptoms usually appear within 2–7 days. The plant will usually develop blisters or necrotic areas on older leaves, and bleaching and burning on new leaves and the growing point. Later, extensive destruction of the entire leaf tissue occurs, leading to plant death. This can sometimes occur within 3 days, given ideal conditions and adequate application rates.

Resistant weeds warning

GROUP C F HERBICIDE

Jaguar Selective Herbicide is a member of the nicotinanalide group of herbicides. Jaguar is a herbicide which inhibits carotenoid biosynthesis and the second light reaction of photosynthesis. For weed resistance management, Jaguar is a Group C + F herbicide. Some naturally-occurring weed biotypes resistant to Jaguar, and other herbicides which inhibit production of carotenoid biosynthesis, and the second photosynthesis, 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 Jaguar.

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 Jaguar to control resistant weeds.

BEHAVIOUR IN THE ENVIRONMENT

In crops

Diflufenican: Metabolism of diflufenican has been studied in crops after pre and post-emergent treatment in the greenhouse.

A maximum of 2% of diflufenican applied pre-emergent is taken up, translocated and metabolised (5 metabolites have been detected in addition to the parent compound, but estimated levels remain well below diflufenican itself). In crops, diflufenican is rapidly metabolised via the nicotinamide and nicotinic acid to carbon dioxide.

Bromoxynil: Bromoxynil is not readily translocated throughout the plant once it has been absorbed. Studies have shown that there are no detectable residues in cereals at harvest time.

In water and light

Diflufenican: Diflufenican was shown to be highly stable in abiotic conditions, i.e. hydrolysis and photolysis (half-life of about 100 days). Under laboratory conditions, diflufenican was shown to be slowly degraded in anaerobic aquatic systems (half-life of about 1 year).

Bromoxynil: Solubility in water of both bromoxynil octanoate and phenol are very low (sub ppm). Bromoxynil octanoate is rapidly hydrolysed in water to form bromoxynil (phenol). Degradation at pH 7 and 9 and in natural (non-sterile) water is more rapid than in pH 5 and under sterile conditions. Bromoxynil phenol itself is stable to hydrolysis under sterile conditions. Bromoxynil photolyses in water solutions to two main photo-degradation products. Half-life of bromoxynil octanoate is about 18 hours. The photo decomposition of bromoxynil octanoate involves debromination, cleavage of the ester carbon oxygen bond to give phenols and ring hydroxylation.

In soil

Diflufenican: Diflufenican is strongly adsorbed onto soil particles and no mobility has been detected on soil columns in the laboratory. Under field conditions, both lysimeter and field studies have shown that leaching of diflufenican and its metabolites does not occur to any significant extent.

This was confirmed by field studies conducted in the UK and Belgium where, after 5 years of cultivation, any remaining diflufenican was present in the 0–10 cm layer (without ploughing) or spread fairly evenly in the 25–30 cm layer (with ploughing).

In aerobic conditions, diflufenican was tested for its degradation under both laboratory and field situations. The degradation proceeds via the metabolites 2-(3-trifluoromethylphenoxy) nicotinamide and 2-(3-trifluoromethylphenoxy) nicotinic acid to bound residues and carbon dioxide. The obtained values of half-lives varied from 9 weeks up to 50 weeks, with typical values of 200 days for soil dissipation conducted in-field.

The biological persistence is dependent on the bioavailability of the residue, corresponding to the herbicide concentration in the soil solution. Diflufenican is typically a product of which the bioavailability for plants is low, whatever the dose rate. It is around 2–3% of the residual amount determined by chemical analysis.

In conclusion, the degradation and mobility studies under both field and laboratory conditions show that the rate-limiting step in the degradation of diflufenican is the first step and there is, therefore, no significant build-up of metabolites. Thus, under normal use conditions, neither diflufenican nor its metabolites would be expected to pose a threat to groundwater.

Bromoxynil: The half-life for radio-labelled bromoxynil octanoate, incubated aerobically in a sandy loam soil was calculated to be 2 days. Principal degradation products were bromoxynil (phenol) and three other degradation products which were also detected with further degradation with increased incubation time to $^{14}CO_2$.

Bromoxynil demonstrated low to medium mobility when freshly applied to clay-loam, loamy-sand, loam and sandy-loam soils.

When freshly-applied and previously-aged bromoxynil (phenol) was used in clay-loam, loamy-sand, loam and sandy-loam soils, only small amounts of bromoxynil and bromoxynil-related material appeared in the leachate. Bromoxynil octanoate showed limited degradation and a low to medium mobility for freshly-applied and previously-aged pesticide in sand, loam and two sandy-loam soils.

Conclusion: It can be concluded from these results that bromoxynil octanoate, due to its quick degradation into bromoxynil, does not pose a problem for accumulation in the soil, nor for leaching into the ground to reach the groundwater level.

EFFECTS ON FLORA AND FAUNA

Extensive testing of diflufenican and bromoxynil has been undertaken with a number of different animal species, using various routes of administration.

Acute toxicity

Species	Tests	Results
Diflufenican		
Rat	Oral LD_{50}	>2000 mg/kg
Rabbit	Oral LD_{50}	>5000 mg/kg
Mice	Oral LD_{50}	>1000 mg/kg
Rat	Dermal LD_{50}	>2000 mg/kg
Rat	Inhalation LC_{50} (4 hrs)	>2.34 mg/L
Rat	Intraperitoneal LD_{50}	>2000 mg/kg
Rabbit	Dermal irritation	Negative
Rabbit	Ocular irritation	Negative
Guinea pig	Dermal sensitisation	Negative
Mutagenicity		Negative
Teratogenicity		Negative
Reproductive performance		Negative
Bromoxynil		
Rat	Oral LD_{50}	365 mg/kg
Mice	Oral LD_{50}	306 mg/kg
Rat	Dermal LD_{50}	>2000 mg/kg
Rabbit	Ocular irritation	Mild irritant
Teratogenicity		Negative

Environmental impact

Species	Tests	Results
Diflufenican		
Mallard duck	Acute oral LD_{50}	>4000 mg/kg
Bobwhite quail	Acute oral LD_{50}	>2125 mg/kg
Rainbow trout	LC_{50} 96-hour	56–100 mg/kg
Carp	LC_{50} 96-hour	105 mg/L
Daphnia	LC_{50} 48-hour	No effect at 10 mg/L
Algae	Growth inhibition 96-hour	No effect at 10 mg/L
Honey bee	Contact/ingestion toxicity	Non-toxic
Earthworm	Acute toxicity	Non-toxic
Soil microbial processes	Incorporation into soil	Negligible effect at 10 ppm
Bromoxynil		
Mallard duck	Acute oral LD_{50}	>200 mg/kg
Bobwhite quail	Acute oral LD_{50}	>175 mg/kg
Rainbow trout	LC_{50} 96-hour	0.15 mg/kg
Honey bee	Contact/ingestion toxicity	Non-toxic

Soil residual effects to flora and fauna are negligible and the chemical is effectively broken down by soil micro-organisms and hydrolysis. Available information indicates that Jaguar is of low toxicity to animals, birds, fish, honey bees, earthworms, soil and aquatic organisms. When used as directed the product presents very little danger to the operator or the environment.

JAGUAR WEED POSITIONING CHART

These rate recommendations are based on extensive trial work. Always refer to the product label for further details and critical comments.

Broadleaf weed	Weed size			
	2-leaf [1]	4-leaf [1]	6-leaf [1]	8-leaf [1]
Amsinckia	750 mL/ha	750 mL/ha		
Bedstraw	1.0 L/ha	1.0 L/ha		
Capeweed	500 mL/ha	500 mL/ha	750 mL/ha	1.0 L/ha
Charlock	500 mL/ha	750 mL/ha		
Climbing buckwheat	500 mL/ha	750 mL/ha	1.0 L/ha	
Corn gromwell	500 mL/ha	500 mL/ha	750 mL/ha	
Deadnettle	500 mL/ha	750 mL/ha		
Doublegee	500 mL/ha	750 mL/ha		
Wild mustard	500 mL/ha	500 mL/ha	750 mL/ha	1.0 L/ha
Paterson's curse	500 mL/ha	750 mL/ha		
Prickly lettuce	1.0 L/ha*	1.0 L/ha*		
Wild radish	350 mL/ha#	500 mL/ha	750 mL/ha	1.0 L/ha
Wild turnip	500 mL/ha	750 mL/ha		
Wireweed	1.0 L/ha			

Always refer to the label for the appropriate product use rates. 1. Refer to label for further weed size details.
* Suppression only # WA only (no more than 60 mm in diameter and less than 50 plants per metre square)

Key selling points

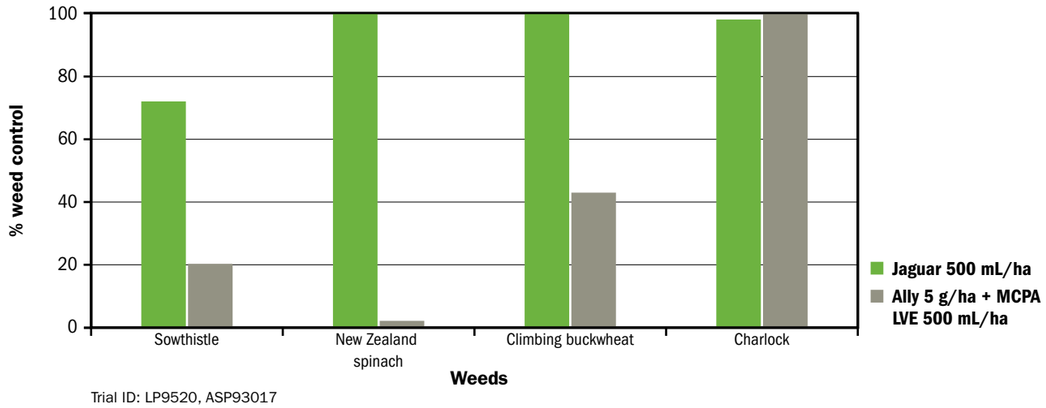
- Outstanding activity against wild radish
- Up to 4 weeks residual activity against wild radish
- Safe to undersown clover
- Control or suppression of a wide range of hard-to-kill weeds
- Compatibility with a wide range of grass and broadleaf weed herbicides
- Registrations for use in wheat, barley, triticale, cereal rye and clover pastures in all States
- Fast knockdown

EFFICACY

Weed control in cereal crops

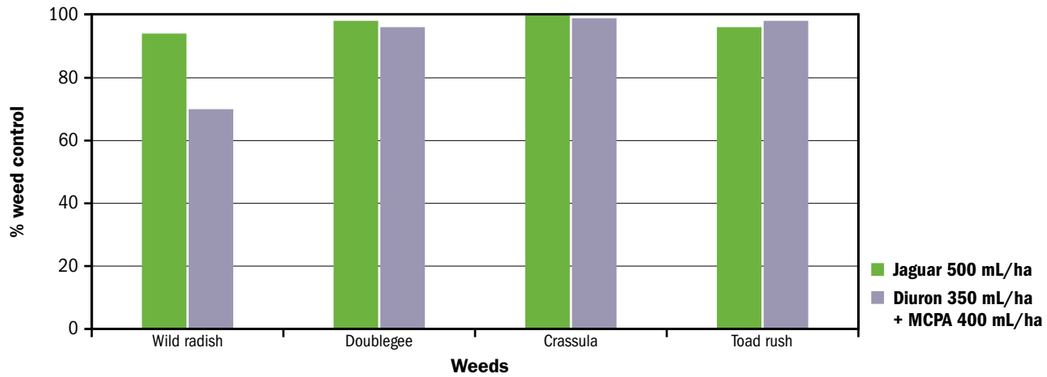
Jaguar is very effective at controlling a wide range of broadleaf weeds that cause significant yield loss in wheat and barley crops. The graphs below demonstrate the effectiveness of Jaguar when compared to some of the more traditional weed control products.

GRAPH 1: Jaguar efficacy versus Ally® + MCPA LVE



Trial ID: LP9520, ASP93017

GRAPH 2: Jaguar efficacy versus Diuron + MCPA

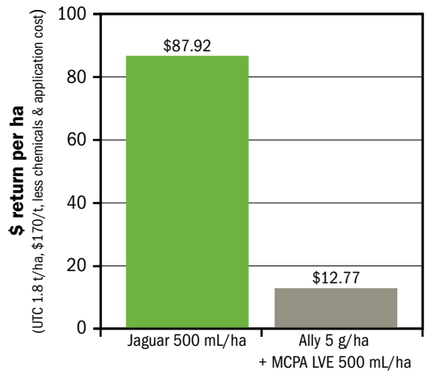


Trial ID: WJFH9723, WJFH9830Y, WJFH9830M, WJFH9624, WJFH9620, WJFH9608, 97IAWAM, 99IAWAY, 99IAWATS

Maximising yield

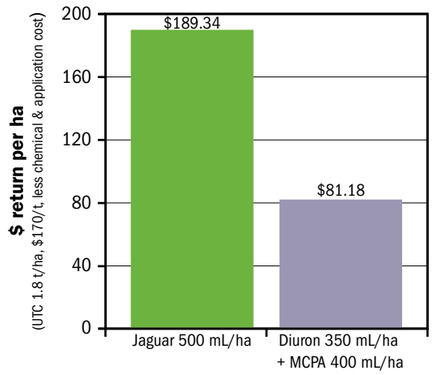
The benefit of Jaguar's robust weed control is reflected in increased yield and return on investment, as these graphs demonstrate.

GRAPH 3: ROI – Jaguar vs Ally/MCPA LVE



Trial ID: LP9520

GRAPH 4: ROI – Jaguar vs Diuron/MCPA

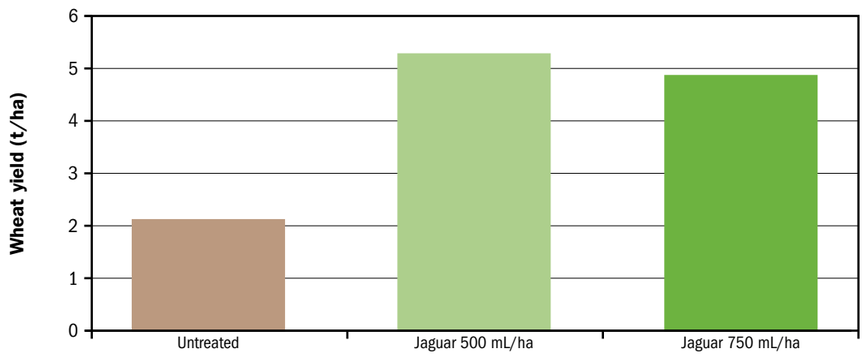


Trial ID: WJFH9620, WJFH9608, WJFH9624, WJFH9830Y, WJFH9830M, 2000/147Y, 2000/147TS, KAF93017, 94AASB, 94AAM, 94AAN, 97IAWAM

Extensive trial work conducted across Australia by researchers in Departments of Agriculture (Code & Reeves 1981, Rutherglen, Vic; Moore 1979, W Aust) and private consultants (Lamond & Burgess 1997) have demonstrated the yield increases that can be achieved by early control (before the 3-leaf crop stage) of weeds such as wild radish that have germinated with or soon after the crop.

The graph below summarises a trial conducted in 1997 that quantified the yield benefit of an early Jaguar application compared to traditional application timings.

GRAPH 5: Superior return on investment of early Jaguar application (Wombat NSW)



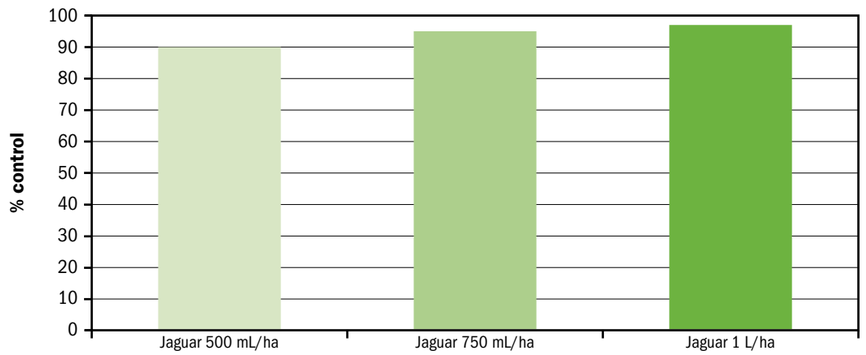
Trial ID: RJG97013

Early application	Late application
43 days after sowing	74 days after sowing

Weed control in lucerne

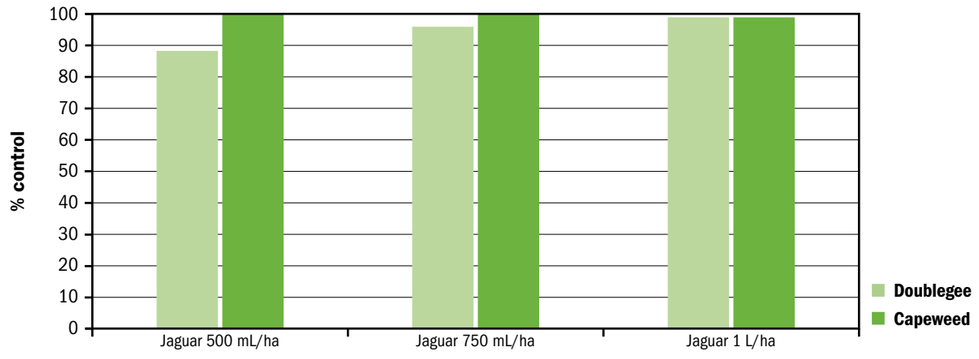
Jaguar offers excellent reliable broadleaf weed control in lucerne. While capably controlling the brassica weeds, Jaguar will also control the harder-to-kill weeds such as amsinckia (yellow burr weed), Paterson's curse, doublegee, fireweed and ox-tongue.

GRAPH 6: Paterson's curse control 47 DAT



Trial ID: 92/015 – NSW

GRAPH 7: Doublegee & capeweed control in lucerne



(Source: Bayer CropScience demo trial 93 – SA)

DIRECTIONS FOR USE

Crop	Weeds controlled	Weed stage	Rate (ha)	State	Critical comments
Wheat, barley, triticale, cereal rye (including undersown with clover and/or lucerne), and these cover crops in vineyards **Pasture** Clover and/or lucerne-based pasture (newly sown or established) including **cover crops in vineyards**	Wild radish	Up to 2-leaf stage and not more than 60 mm in diameter and where weed density is less than 50 plants/m^2	350 mL	WA only	**CROP STAGE:** ***Cereals*** 2-leaf to fully tillered (Zadoks Z12–29) Optimum results are achieved when sprayed at 4–8 weeks post-sowing. **Warning:** Jaguar may cause transient crop yellowing of cereals. (Refer to **Crop Tolerance** section of **General Instructions**.) ***Clover and lucerne*** Application is recommended prior to the 8th trifoliate-leaf stage. Application can be made from the 1st-trifoliate leaf stage in Qld, NSW, ACT and Vic only. In other states, applications prior to the 3-leaf stage may result in crop damage if seedlings are under stress and in sandy soils. DO NOT apply to annual medics. **Warning:** Jaguar may affect growth and seed-set of some varieties of clover and lucerne. (Refer to **Crop Tolerance** section of **General Instructions**.) **COVER CROPS IN VINEYARDS:** **When using in vineyard situations, apply during vine dormancy only. Contact with vines must be avoided. Particular care should be taken if applied in late autumn or early spring, when vines may not be fully dormant.** **WEED STAGE:** Apply from early post-emergence. **APPLICATION:** Apply when weeds are actively growing. Ensure thorough coverage of weeds. Where crop or weed density is high, increase water volume. **CONTINUED ON NEXT PAGE**
	Wild mustard Wild radish	Up to 4-leaf stage and not more than 120 mm in diameter	500 mL	All States	
		Up to 6-leaf stage and not more than 150 mm in diameter	750 mL		
		Up to 8-leaf stage and not more than 180 mm in diameter	1.0 L		
	Canola (rapeseed) Charlock Turnip weed Wild turnip	Up to 2-leaf stage and not more than 60 mm in diameter	500 mL		
		Up to 4-leaf stage and not more than 120 mm in diameter	750 mL		
	Shepherd's purse		1.0 L		
	Capeweed	Up to 4-leaf stage and not more than 120 mm in diameter	500 mL		
		Up to 6-leaf stage and not more than 150 mm in diameter	750 mL		
		Up to 8-leaf stage and not more than 180 mm in diameter	1.0 L		
	Corn gromwell	Up to 4-leaf stage	500 mL		
		Up to 6-leaf stage	750 mL		
	Climbing buckwheat	Up to 2-leaf stage	500 mL		
		Up to 4-leaf stage	750 mL		
		Up to 6-leaf stage	1.0 L		
	Deadnettle Paterson's curse (Salvation Jane) Rough poppy	Up to 2-leaf stage	500 mL		
		Up to 4-leaf stage	750 mL		
	Amsinckia				
	Doublegee (spiny emex)	Up to 2–leaf stage	500 mL	Qld, NSW, ACT, Vic, Tas, WA only	
		Up to 4–leaf stage	750 mL	All States	

Directions for use continued

Crop	Weeds controlled	Weed stage	Rate (ha)	State	Critical comments
Wheat, barley, triticale, cereal rye (including undersown with clover and/or lucerne), and these cover crops in vineyards **Pasture** Clover and/or lucerne-based pasture (newly sown or established) including **cover crops in vineyards**	Chamomile Common peppercress Lesser swinecress Purple calandrinia (mountain sorrel) Tree hogweed	Up to 4-leaf stage.	1.1 L	All States	**CONTINUED FROM PREVIOUS PAGE** In most situations, the rate specified for each weed size will give satisfactory control. However, under certain conditions such as: • high crop and weed density, • late-season germinations, • abnormal weed growth (including early flowering); higher rates of product (up to the maximum rate of application specified for that weed) may be required. Jaguar will not effectively control: • regrowth of suppressed weeds, • transplanted weeds, • regrowth from rhizomes or roots, • weeds growing under stress from previous herbicide applications. • radish plants beyond rosette stage **WILD RADISH:** Effective residual activity of this product may be reduced where: • rates lower than 1.0 L/ha are used; • dry conditions prevail; • poor coverage of the soil surface is achieved; • crop is grown in non-wetting sand; • soils have a high content of clay or organic matter. **VOLUNTEER LUPINS:** In some situations, the higher rate of 1.0 L/ha may be required to effectively suppress volunteer lupins at the 4-leaf stage. # Jaguar will suppress seedling dock but will not suppress regrowth from transplanted roots.
	Fat hen Field madder Saffron thistle Variegated thistle		1.0 L		
	Ox-tongue Wireweed	Up to 2-leaf stage			
	Fireweed	Up to 4-leaf stage	500 mL	Qld, NSW, ACT, Vic, SA, WA, NT only	
	Common cotula (bird's eye) Pheasants eye (adonis)	Up to 4-leaf stage	560 mL	SA only	
		Greater than 4-leaf stage	1.1 L		
Wheat, barley, triticale, cereal rye	Fumitory	2–6 leaf stage	350 mL + 200 mL/ha terbutryn (500 g/L)	WA only	
Wheat, barley, triticale, cereal rye (including undersown with clover and/or lucerne), and these cover crops in vineyards **Pasture** Clover and/or lucerne-based pasture (newly sown or established) including **cover crops in vineyards**	**Suppression of the following weeds**				
	Dense-flower fumitory	Up to 2-leaf stage	750 mL	All States	
		Up to 4-leaf stage	1.0 L		
	Chickweed Common sowthistle (milk thistle) Dock# Hexham scent (King Island melilot) Prickly lettuce Scarlet pimpernel Skeleton weed Sorrel Speedwell Three-horned bedstraw Toad rush				
	Volunteer lupins		500 mL–1.0 L		
	Crassula (stonecrop)	Up to 5-leaf stage	500 mL		
	Long storksbill	Up to 4-leaf stage			
	Volunteer field peas	Up to 5-node stage	750 mL		
	Ward's weed	Up to 5-leaf stage	1.0 L		
	Vetch	Up to 2-leaf stage			
	Mouse-eared chickweed			NSW & ACT only	
	Mexican poppy			Qld only	
	Mintweed Spoon cudweed	Up to 4-leaf stage		NSW & ACT only	
	New Zealand spinach	Up to 2-leaf stage	750 mL	Qld only	
	Cleavers	Up to 1-whorl stage	1.0 L	SA only	
	Ball mustard	Up to 4-leaf stage			
	Horehound	Pre-emergence			
	Marshmallow	Up to 2-leaf stage			

Directions for use continued

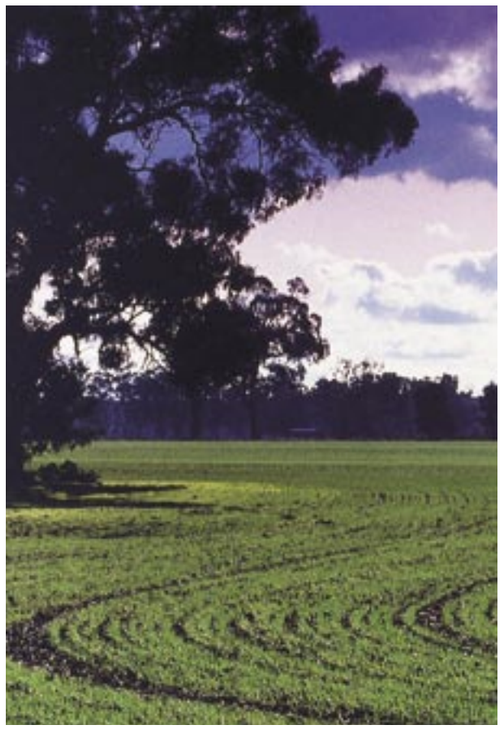
Crop	Weed controlled	Weed stage	Rate (ha)	State	Critical comments
Wheat, barley, triticale, cereal rye	Wild radish	Up to the 4-leaf stage and not more than 120 mm in diameter	350 mL plus 200 mL MCPA LVE (500 g/L)	WA only	Refer also to all **Critical comments** for cereals above. DO NOT use this tank-mix if cereals are undersown with lucerne or annual medics. DO NOT use this tank-mix in vineyards. Crop stage Jaguar 350 mL + MCPA LVE 200 mL: apply from 3-leaf to fully tillered (Zadoks Z13 to Z30). Jaguar 500 mL + MCPA LVE 200 mL: apply from 3-leaf to fully tillered (Zadoks Z13 to Z30). Jaguar 500 mL + MCPA LVE 400 mL: apply from 5-leaf stage to fully tillered (Zadoks Z15 to Z30). Optimum results are achieved when sprayed at 4–8 weeks post-sowing. Warning: Jaguar may cause transient crop yellowing of cereals. (Refer to **Crop Tolerance** section of **General Instructions**.) Observe instructions also on MCPA LVE product label.
		Up to the 6-leaf stage and not more than 150 mm in diameter	500 mL plus 200 mL MCPA LVE (500 g/L)	All States	
		Up to the 8-leaf stage and not more than 180 mm in diameter.	500 mL plus 400 mL MCPA LVE (500 g/L)		

Restraints

DO NOT apply if crop or weeds are stressed due to dry or excessively moist conditions.
DO NOT apply to crops under stress due to disease or insect damage.
DO NOT apply to frost-affected crops or if frosts are imminent.
DO NOT apply if heavy rain is expected within 4 hours.
DO NOT apply with crop oils (cereals only).

Withholding period

Grazing: Pasture, cereals: DO NOT GRAZE OR CUT FOR STOCK FOOD WITHIN 14 DAYS AFTER APPLICATION.
Harvest: Cereals, grapes: NOT REQUIRED WHEN USED AS DIRECTED.

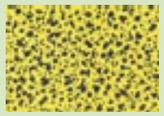


APPLICATION

Jaguar should be applied by correctly calibrated ground-boom spray equipment. Achieving even and thorough coverage of the target weeds (leaf area and growing point) and soil surface is essential to optimise knockdown and residual control of wild radish with Jaguar. With contact herbicides like Jaguar it is accepted that an even droplet density of 40–60 droplets per sq. cm is the MINIMUM required for adequate coverage.

Examples of spray coverage

Excellent coverage
Hardi No. 10 nozzles
Pressure 2.0 bar Speed 9 km/h
Water volume 50 L/ha
258 droplets/cm^2



Adequate coverage
Hardi No. 12 nozzles
Pressure 2.2 bar Speed 15 km/h
Water volume 50 L/ha
129 droplets/cm^2

Fair coverage
Hardi No. 12 nozzles
Pressure 1.5 bar Speed 20 km/h
Water volume 30 L/ha
45 droplets/cm^2

Poor coverage
Hardi No. 16 nozzles
Pressure 1.0 bar Speed 25 km/h
Water volume 30 L/ha
16 droplets/cm^2

Given the variety of spraying equipment and practices used by growers across Australia, it is not practical to specify any single boom-spray configuration for applying Jaguar. Rather, there are a range of principles that need to be considered in establishing the best set-up for spray equipment.

Nozzles

Correct nozzle selection is essential to achieve the desired droplet density and range of droplet sizes. Tests carried out by the Charles Sturt University in Wagga Wagga demonstrate that wide-angle nozzles such as 110° flat-fan jets generate a more consistent spray pattern than 80° jets. Most post-emergent herbicides require droplets ranging from 150–400 microns in size, with most droplets sized between 200 and 300 microns.

Choose a nozzle that produces this droplet spectrum at your chosen water volume and pressure settings.

Consult with your boom-spray equipment supplier about the correct nozzle for your equipment.

Water volume

Higher water volumes have been found to contribute significantly to Jaguar's performance. This is especially the case where conditions are marginal.

- A minimum water volume of 50 L/ha should be used, but for optimum results water volumes of 70–100 L/ha are recommended.
- Higher water volumes (up to 100 L/ha) will ensure faster knockdown activity of Jaguar on weeds, but may increase the transient crop effect.
- Water volume should be raised where weed infestation is heavy or the crop canopy is dense.

Nozzle pressure

Altering the nozzle pressure affects both the flow rate from the nozzle and the range of droplet sizes. At very low pressures (e.g. <100 kPa), nozzles usually fail to atomise droplets properly, producing fewer and larger droplets. The fan angle can also close, resulting in stripping where the spray from each nozzle does not overlap. If the pressure is raised too high, a larger proportion of small droplets is formed and the risk of spray drift increases.

Travel speed

The desire to cover more ground in less time has seen the increased use of four-wheel-drive vehicles instead of tractors to tow boom sprays in recent years.

One of the main risks of spraying at higher speeds (>20 km/h) is boom instability. Boom instability can lead to increased spray-drift, and stripping where the spray pattern does not overlap.

Ground application summary

- Ensure a minimum droplet density of 40–60 droplets per sq. cm.
- Use 110° flat-fan jets to optimise spray distribution.
- Use a minimum water volume of 50 L/ha.
- Use higher water volumes (70–100 L/ha) when the weed infestation or crop density is high.
- Set pressure within the 210–350 kPa range.
- Do not compromise boom stability by travelling at excessive ground speeds.
- Consult with your boom-spray manufacturer for recommended ground speed range.

Aerial application

Trials conducted to evaluate aerial application of Jaguar produced highly variable levels of weed control. Therefore, Jaguar is not recommended for application by air.

Mixing

To ensure even mixing, half-fill the spray tank with clean water and add the required amount of product. Agitate thoroughly, then add the remainder of the water. Agitate again before spraying commences. Jaguar should be applied immediately after mixing and not left to stand in the spray tank. Reseal part-used containers immediately after use.

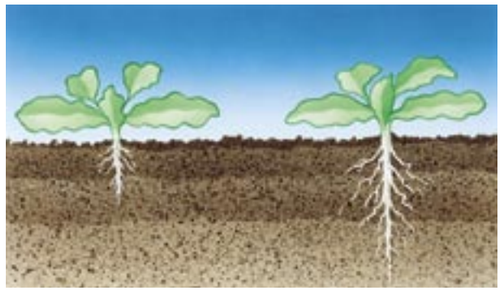
Application timing

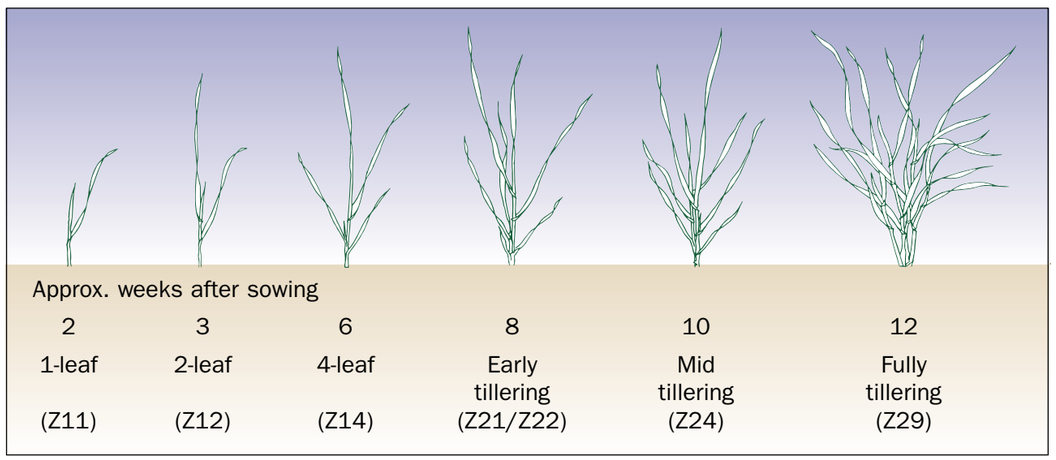
For optimum weed control, Jaguar should be applied to seedling weeds. With Jaguar there is no need to wait for the crop to reach an advanced growth stage before controlling weeds. The key to success with Jaguar is to apply it as early as possible (from the 2–3 leaf stage of the crop). Where a range of rates is given on the label, use the higher rates as weed size and/or density increases.

Cereals: Note: the minimum registered rate is 350 mL/ha (WA) & 500 mL/ha (NSW, Vic, SA, Tas).

Pastures: In clover and lucerne pastures, the optimum application timing is the third trifoliate-leaf stage. Application can be from the first trifoliate-leaf stage in Qld, NSW, ACT and Vic only. In other States, applications prior to the third-leaf stage may result in crop damage, especially under stressed conditions and in sandy soils. **DO NOT** apply to annual medics.

Weed age: Weed age and weed size normally go hand-in-hand. Small weeds, however, are not always young weeds. To arrive at a sound spraying decision, check the above-ground parts of the plant for size, but also the tap roots for the age of the weed. If the tap root is longer than would normally be expected at the specific growth stage of the weed, consult your agronomist or Bayer CropScience Area Manager.





Residual control

Jaguar will provide up to 4 weeks of residual control of wild radish seedlings that germinate after application. This is a unique property of Jaguar that allows cereal farmers to achieve unprecedented control of this key problem weed. The residual barrier formed by Jaguar on the soil surface can be immediately broken down by cultivation and therefore poses no risk to following cereals, legumes, canola or pastures.

The residual activity of Jaguar is best under good soil moisture conditions. It may be reduced where:

- rates lower than 1.0 L/ha are used,
- dry conditions prevail,
- poor coverage of the soil surface is achieved,
- the crop is in non-wetting sand,
- soils have a high content of clay or organic matter.

If weed density is high, it is important to spray early in order to avoid shading of the soil surface by weeds present at the time of spraying.

Climatic effects

Jaguar works best on crops and weeds actively growing in warm, moist growing conditions. Speed of activity will be greatest in warm, humid conditions where weed death can occur within a few days. Under cold, dry conditions, complete weed death may take up to two or three weeks, however competition with the crop will cease soon after treatment.

Surfactant

DO NOT add oil or surfactant.

It is recommended that no surfactant should be added to Jaguar when used alone. However, when Jaguar is used in tank-mixtures with other grass herbicides, the surfactant addition recommendations of the grass herbicide should be followed. Do not apply Jaguar with oil in any situation.

Stress

If a weed is under stress, it may not be able to absorb the herbicide as well as it would under normal growing conditions. Crops under stress may also be damaged because they cannot metabolise the herbicide as quickly as normal.

Critical points

Jaguar should NOT be applied under any of the following conditions:

- If the crops or weeds are stressed by dry or excessively moist conditions.
- If the crop is under stress from insect or disease damage.
- If the crop is affected by frost or if frosts are imminent.
- If rain is expected within 4 hours of application.

Jaguar should not be applied when temperatures exceed 20˚C.

The mode of action of Jaguar is such that stressed weeds are not controlled well. Frosts and cold conditions can have disastrous effects on results. As a rule, the following guide can be used to ensure that cold conditions are avoided when spraying Jaguar.

If the minimum air temperature is less than 4°C, or the maximum air temperature is less than 10°C, delay spraying for 48 hours in order to allow weeds to recover. If the cold conditions are prolonged, longer delays to spraying may be necessary.

Rate selection

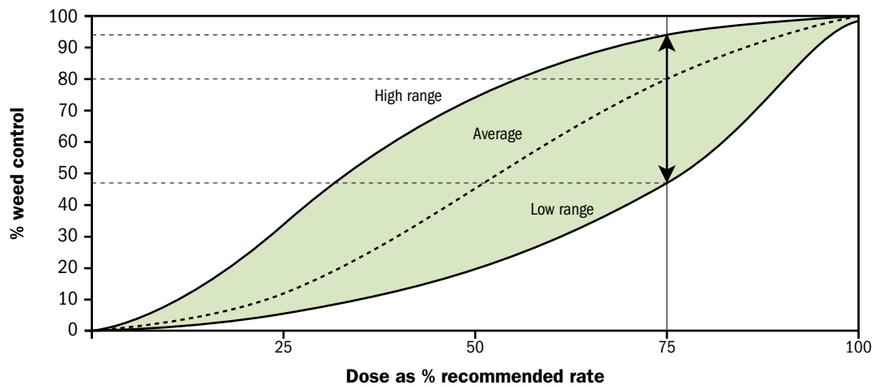
The recommended label rates for Jaguar were established following an extensive field trial program. These rates will ensure a consistently high level of weed control is achieved across a range of climatic and environmental conditions. The danger of using lower than label rates is that, unless spraying conditions are ideal, you run a high risk of getting poor weed control and a slow speed of kill.

Contact herbicides allow minimal rate variance, particularly when climatic conditions are marginal.

The diagram below depicts a typical herbicide dose-response curve that is generated using the results from development trials. The graph shows the efficacy range (% weed control) of a herbicide as the rate is varied for a particular size weed. The registered rate is represented by the 100% mark. Using the model response curve, at the recommended label rate (100%) for this sized weed the variance in efficacy is minimal and the average result across a range of climatic and environmental conditions is consistently high.

As the herbicide rate is reduced, there is greater variation in the level of weed control achieved. If the rate used was 75% of the recommended rate, the level of weed control could range from as high as 95% (under ideal conditions) to as low as 45% (under marginal spraying conditions). The average level of weed control would be around 80%.

WEED CONTROL vs DOSE AS % OF RECOMMENDED RATE



In a situation where a grower is spraying problem weeds like wild radish or prickly lettuce, and the weed infestation is heavy, this level of control would be inadequate and require salvage spraying to stop seed-set. The cost of the additional herbicide application, plus the potential yield loss due to competition from the surviving weeds, would offset any initial saving from cutting the rate of the first herbicide application.

Summary

When selecting the rate of Jaguar for a particular situation, it is important that all impacting factors are considered. Weeds may be stressed from previous herbicide applications, the weather may be unfavourable, or the paddock may be excessively dry or wet. Special attention should be given to the leaf stage and root development of the weeds (i.e. small plants may have a large root system, indicating that they are older than they appear to be). The rate that worked last year may not necessarily be the most appropriate this season.

- Always read the label before choosing your application rate.

COMPATIBILITY

Grass herbicides

An important feature of Jaguar is its compatibility with most of the grass herbicides registered for use in cereals. Jaguar can be applied in tank-mixes with these products in order to minimise application costs and maximise yield benefits.

The compatibility of any given grass herbicide with Jaguar is determined by a number of factors. These include the product in question, the rates used and the target weed. A large number of trials have been conducted, testing the compatibility of Jaguar, Wildcat,® Tristar® Advance and Hoegrass.®

The conclusion from these trials is that the addition of a grass herbicide to Jaguar does not impact upon broadleaf weed control. However, some variations in grassweed control may be encountered – as the table shows.

Which grass herbicide, which weed?

Product	Weed	Jaguar up to 0.75 L/ha
Wildcat 110EC at 300 mL/ha	Wild oats	1
	Annual phalaris	
Tristar Advance at 1.5 L/ha	Wild oats	
	Ryegrass	
Hoegrass 500 at 750 mL/ha	Ryegrass	
	Wild oats	

Source: Bayer CropScience

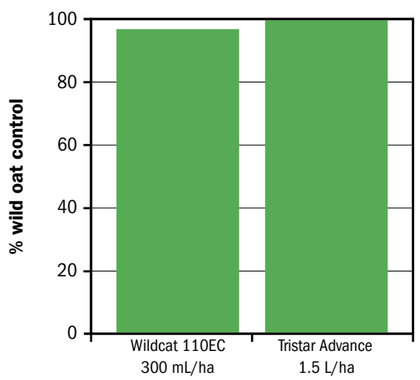
Trials indicate no reduction in grassweed control when used as recommended. Results at below recommended rates may indicate some reduction in some cases. Mixtures may be used with minimal loss of activity under good growing conditions, with all label recommendations followed.

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.

Trials at recommended rates indicate severe reduction in grassweed control and/or significant crop injury. Mixture is not recommended.

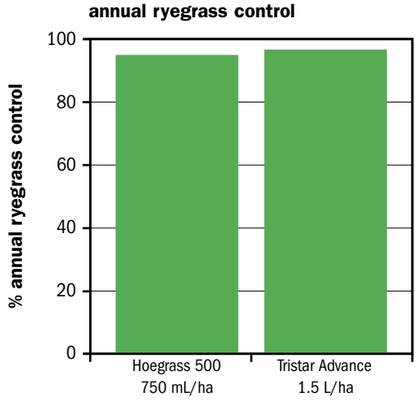
1 Whilst no/or some reduction in grassweed control is anticipated, slight transient crop discolouration may be evident.

GRAPH 8: Compatibility of Jaguar (750 mL/ha) with Wildcat 110EC and Tristar Advance for wild oat control



Trial ID: S17-91, NW9-96, QD5-96, QD7-97, QD10-97, NN3-97, ND7-96, WA26-96, NN8-96

GRAPH 9: Compatibility of Jaguar (750 mL/ha) with Hoegrass and Tristar Advance for annual ryegrass control



Trial ID: ND6-91, S17-91

It is recommended that no surfactant should be added to Jaguar when used alone. However, when Jaguar is used in tank-mixtures with grass herbicides, the surfactant addition recommendations for the grass herbicide should be followed. **DO NOT** apply Jaguar with oil in any situation.

Broadleaf herbicides

Jaguar is compatible with a range of other broadleaf herbicides. This flexibility to tank-mix allows farmers to adapt their treatment for each individual paddock's weed spectrum.

Ally® Jaguar is compatible with Ally in situations where volunteer legumes are present. The addition of Ally to Jaguar will improve activity against weeds such as volunteer lupins and volunteer field peas, as well as weeds such as doublegee and wireweed. A maximum rate of 500 mL/ha of Jaguar should be used.

Glean® Glean is another alternative that can be added to Jaguar for improved activity against volunteer legumes. Glean also has activity against other broadleaf weeds not controlled by Jaguar. Consult the Glean label for details. A maximum rate of 500 mL/ha of Jaguar should be used.

MCPA LVE Where growers are looking to boost the activity of Jaguar with a phenoxy product, MCPA LVE can also be added. This tank-mix will improve the activity of Jaguar against the harder-to-control weeds like thistles. A maximum rate of 500 mL/ha MCPA LVE should be used. Consult the label for details.

Lontrel® Where volunteer legumes are present, Lontrel can be added to Jaguar for improved activity. This tank-mix can also be very effective against thistles and harder-to-control weed species.

Cadence® (dicamba) Jaguar is compatible with Cadence where growers are looking to boost the activity of Jaguar on volunteer legumes and weeds such as doublegee, wireweed and sorrel. Cadence can be used as an alternative to the Group B herbicides metsulfuron and chlorsulfuron in a herbicide resistance management strategy.

Compatibility

The herbicides listed in the table below are physically compatible with Jaguar as two-way mixtures in the spray tank, but should only be used for the crops specified, and only when the crop is also specified on the label of the compatible product.

Crop	Jaguar	Compatible product
Wheat, triticale, cereal rye (including undersown)	Up to 750 mL/ha	Hoegrass (barley also), Tristar Advance (barley also), Wildcat® 110 EC (wild oats only, high rate)
Wheat, barley, triticale, cereal rye (including undersown)	All rates	Broadstrike®
Wheat, barley, triticale, cereal rye (not undersown)	Up to 500 mL/ha	Ally, Glean, MCPA LVE (500 g/L product) (up to 500 mL/ha only)
	All rates	2,4-D amine 500, Eclipse,® Cadence (up to 115 g/ha only), Lontrel
Wheat only (not undersown)		Topik®
Established lucerne only	Up to 750 mL/ha	Simazine (500 g/L product) (up to 1.25 L/ha only) and simazine (500 g/L)/paraquat (200 g/L) mixture
Newly sown and established lucerne and clover only	Up to 750 mL/ha	Targa,® Fusilade,® 2,4-DB amine (500 g/L)
	Up to 1.0 L/ha	Broadstrike

When mixing Jaguar with other herbicides, crop yellowing may be enhanced.
When mixing with Hoegrass, Wildcat 110 EC or Tristar Advance, some reduction in the efficacy and speed of action of these products may occur.
When mixing with Targa or Fusilade, some reduction in the efficacy and speed of action of these products and Jaguar may occur.
In tank-mixtures with Ally and Glean, rates of Jaguar higher than 500 mL/ha may cause significant crop damage.
If the crop is stressed, the application of the herbicide tank-mixtures may cause yield reduction.
When mixing with Cadence, a temporary wilting may be evident in some crops after application.
The mixture of Jaguar and simazine should be applied during winter to lucerne which is not actively growing. This mixture may result in an increased crop effect, but this can be reduced if the lucerne is grazed or cut before spraying.

DO NOT mix Jaguar with Verdict.®
Growers should seek advice before spraying recently released cereal varieties.
This product may be mixed in the spray tank with one of the following insecticides according to the directions for the insecticide product: Chlorpyrifos (500 g/L product), Decis® Options, dimethoate, Dominex® 100EC, Fastac® Duo, Le-mat® 290 SL and Talstar.®
Use the recommended rates for Jaguar and its tank-mix partner as well as the surfactant recommendation of the tank-mix partner. Read the label of the tank-mix partner before mixing and using the tank-mixture. If another herbicide is applied as a tank-mix, observe the plantback restrictions on that label.

Warning
DO NOT use crop oils with Jaguar or Jaguar tank-mixtures in cereals.

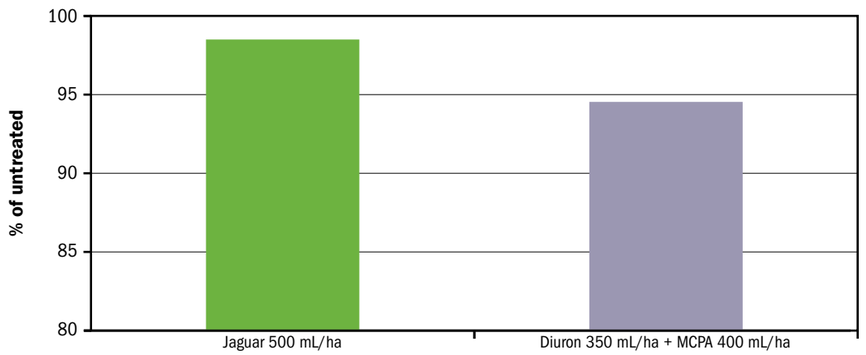
CROP SAFETY

Jaguar Selective Herbicide has a high degree of safety for cereals as well as clover and lucerne-based pastures.

Cereals

Following application of Jaguar, some transient crop discolouration may occur. This effect is caused by the diflufenican component of Jaguar. However, provided the crop is not under stress from pre-emergent herbicide, root disease, insect damage, frost, dry or excessively moist conditions, the development of the crop and subsequent growth will be unaffected.

GRAPH 10: Grain yield as a % of the weed-free control average of 6 varieties



Crop tolerance to post-emergent herbicides
(Source: Agriculture WA crop Variety Sowing Guide, 1993).

The benefits of the selectivity of Jaguar to young cereal crops should not be underestimated.

The tolerance of the crop to the herbicide and the application window must both be considered in herbicide selection. The key to using Jaguar is that it can be applied early. Jaguar can be applied from the two-leaf stage of the crop. With other herbicides, it may be necessary to delay application until the crop is more developed. The table below demonstrates the yield benefits that can be gained from the early control of broadleaf weeds such as wild radish.

Jaguar appplication timing

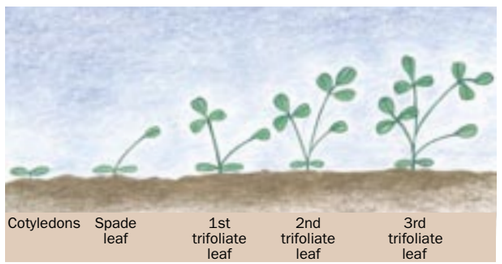
	% yield gain from weed control (plants/m²)*				
WILD RADISH	Plants/m²	50 p/m²	100 p/m²	200 p/m²	300 p/m²
	Pre-tiller	20.0%	29.5%	40.0%	45.0%
	Tillering	17.5%	26.0%	34.0%	39.0%
	Mid-tillering	13.0%	19.0%	24.0%	25.5%

* Note: All data on 2 t/ha yields. PISA weed decide calculator 1997

Pastures and undersown cereals

In pastures, Jaguar has also demonstrated a high degree of crop selectivity. A number of lucerne and clover varieties have been tested for tolerance to Jaguar.

Application is recommended prior to the 8th trifoliate-leaf stage of lucerne and clover. Application can be made from the 1st trifoliate-leaf stage in Qld, NSW, ACT and Vic only. In other States application prior to the three-leaf stage may result in crop damage if seedlings are under stress in sandy soils. **DO NOT** apply Jaguar to medics.



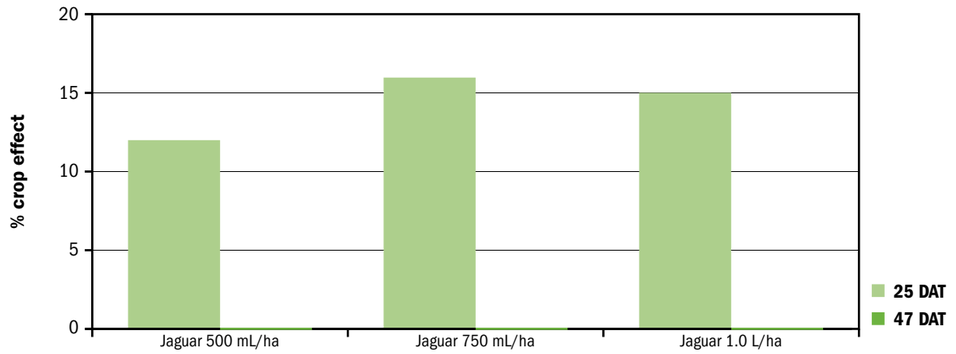
Seedling and established lucerne

Jaguar is safe for lucerne either sown alone or undersown in a cereal crop. Established lucerne is very tolerant to Jaguar, but diflufenican – one of the active ingredients in Jaguar – can cause a transient effect on lucerne. This is usually seen as a yellow or white discolouration on the youngest growth present at the time of spraying. However, trial results show no long-term effects on herbage production.

Jaguar should be applied to lucerne early, before it has too much foliage. This will reduce the leaf effect. As new growth is unaffected, the lucerne will recover rapidly. Early removal of weeds has the added advantages of lower weed control costs and an increase in winter and early spring herbage production. Winter weeds have a dramatic effect on the herbage production of both lucerne and clovers.

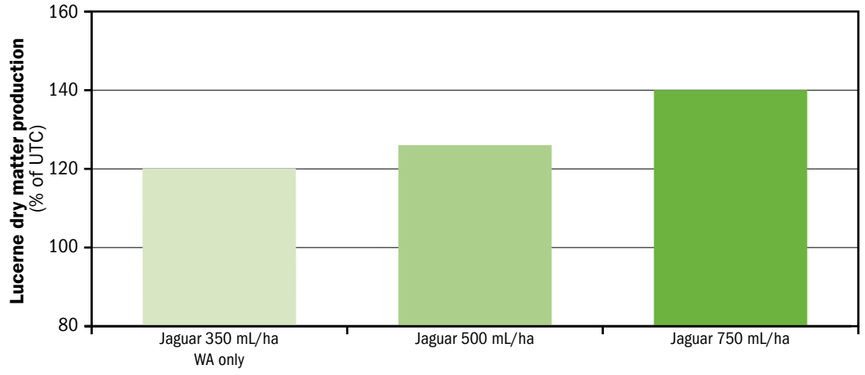
As Jaguar is selective to clovers, it can be used where both lucerne and clover co-exist in a mixed pasture sward.

GRAPH 11: Effects on undersown lucerne



Trial ID: 92/015 – NSW

GRAPH 12: Effects on undersown lucerne



Trial ID: AU93

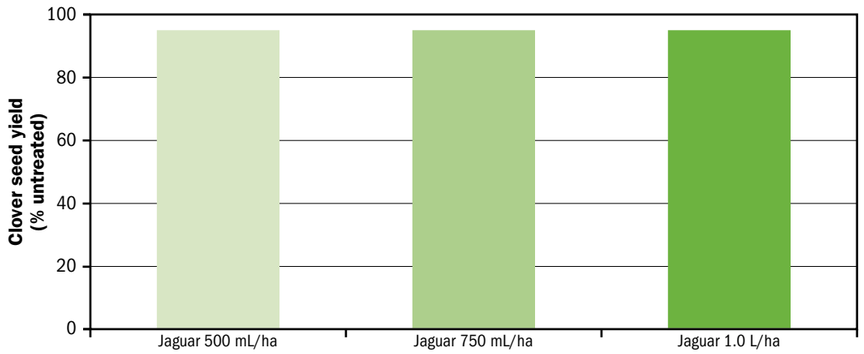
Clover

Many clover varieties are also tolerant to Jaguar, however transient crop effects may occur. As with lucerne, this is usually yellow or white discolouration on the youngest growth present at the time of spraying. However, trial results indicate that this effect will not reduce the seed-set of the undersown legumes.

The selectivity chart on the right can be used as a guide to determine the effects of these products on a particular pasture species or variety.

Further information is available from your Bayer CropScience Area Manager.

GRAPH 13: Effects on undersown clover



Jaguar – Selectivity to undersown clover
Trial ID: 92/146 – VIC

Species	Cultivar	Jaguar	Jaguar
		Foliage tolerance	Seed effect
Subterranean clover	Clare		
	Daliak		
	Dalkeith		
	Denmark		
	Esperance		
	Geraldton		
	Goss		
	Goulburn		
	Junee		
	Karridale		
	Larissa		
	Leura		
	Mt. Barker		
	Nungarin		
	Rosedale		
	Seaton Park		
	Trikkala		
	Woogenellup		
Berseem clover	Bigbee		
	Sacromonte		
White clover	Haifa		
Arrowleaf clover	Zulu		
Persian clover	Kyambro		
	Lupers		
	Maral		
Balansa clover	Paradana		
Rose clover	Hykon		
Strawberry clover	O'Connor		
	Palestine		
Lucerne	Dekalb 185		
	Hunter River		
	Nova		
	Aurora		
	Hunterfield		
	Quadrella		
	Sheffield		
	Si River		
	Southern Special		
	Springfield		
	Trifecta		
	Pioneer 5929		
	Cuf 101		

- Acceptable level of foliage tolerance at 750 mL/ha
- Increased sensitivity
- No information
- Limited trial data* indicates acceptable tolerance below 500 mL/ha
- Acceptable level of seed yield tolerance at 500 mL/ha
- May affect seed yield

* These varieties have been evaluated in limited field trials and, as such, the nominated tolerance level should be used as a guide only. The tolerance of clover varieties to Jaguar can vary with application, soil type, crop health, stage of growth and degree of moisture. Varieties not listed should be tested on a small area before large-scale treatment.

GENERAL INSTRUCTIONS

Protection of crops, native and other non-target plants:

DO NOT apply under weather conditions or from spraying equipment that may cause spray to drift onto nearby susceptible plants/crops, cropping lands or pastures. Wash sprayer thoroughly after use.

Protection of wildlife, fish, crustaceans and environment:

Dangerous to fish. **DO NOT** contaminate streams, rivers or waterways with the chemical or used containers.

Storage and disposal:

Store in the closed, original container in a dry, cool, well-ventilated area out of direct sunlight. Triple or (preferably) pressure rinse containers before disposal. Add rinsings to the spray tank.

Do not dispose of undiluted chemicals on-site.

Break, crush, or puncture and bury empty containers in a local authority landfill. If no landfill is available, bury the containers below 500 mm in a disposal pit specifically marked and set up for this purpose clear of waterways, desirable vegetation and tree roots.

Empty containers and product should not be burnt.

Pack size: 5 L, 20 L

SAFETY DIRECTIONS

Product is harmful if inhaled or swallowed. Will irritate eyes, nose, throat and skin. Avoid inhaling spray mist. When preparing spray wear elbow-length PVC gloves, and face-shield. If product in eyes, wash it out immediately with water. After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash gloves, face-shield and contaminated clothing.

First Aid: If poisoning occurs, contact a doctor or Poisons Information Centre (**ph 131 126**). If swallowed, **DO NOT** induce vomiting. Give glass of water. If in eyes, wash out immediately with water.

Material safety data sheet: Additional information is listed in the Material Safety Data Sheet available from Bayer CropScience or www.bayercropscience.com

JAGUAR®

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