Herbicide tolerance of pasture legumes and herbs.

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Abstract

This project evaluated the feasibility of using several pre-emergent, post-sowing pre-emergent, early post-emergent and late post-emergent herbicides on a range of pasture legume and herb species. TriflurX* and Stomp*, both incorporated by sowing, were found to cause minimal damage to most species. None of the post-sowing pre-emergent herbicides evaluated were found to be acceptable, except atrazine and simazine on woolly pod vetch. Species varied considerably in their tolerance to post emergent herbicides. The results indicate that it is very important to choose species with similar herbicide compatibility to maximise herbicide options when choosing species to include in a pasture mix.

Introduction

In recent years a wide variety of new legumes and herbs have become available for use in pastures. Many of these new species are capable of very high levels of production when sown as part of a pasture mix or as a forage legume. Generally two or three different species will be sown together to increase pasture or forage crop productivity. It is important when choosing which species to include in a pasture or forage crop mix they have similar compatibility to herbicides to be used to control broadleaf weeds in order to avoid causing significant damage. Relatively little information is available on herbicide tolerance of new legume and herb species. This paper discusses the results of a recent field research project which assessed the tolerance of a range of species to commonly used herbicides and herbicide mixtures.

Materials and Methods

A range of legumes and herbs were sown in long strips (four replicates) directly into a burnt oat stubble paddock at Wagga Wagga Agricultural Institute on 27 May 2004 (Table 1). The soil was a red-brown earth with pH_{CaCl2} of 4.5.

All species were sown with a cone seeder fitted with inverted "T" type narrow points with a 17.5 cm row spacing. Seed rows were firmed with a trailing press wheel. All species were sown at 12 kg/ha except vetch which was sown at 40 kg/ha. Fertiliser (13.5%P, 6.5%S) was applied at sowing at 135 kg/ha.

Herbicides were either incorporated by sowing (IBS), as a post-sowing pre-emergent (PSPE), as an early post-emergent (EPE) at the 3-4 leaf stage, or at full canopy cover (FC) (Table 2).

Herbicides were applied in strips 2 m wide perpendicular to the direction of sowing using a tractor mounted compressed air sprayer at 150 kPa

Table 1 Pasture species sown for evaluation of herbicide tolerance in 2004 and 2005

Classification	Common name	Botanical name	Cultivar sown
Annual legume	Arrowleaf clover	*Trifolium vesiculosum*	Cefalu
	Balansa clover	*Trifolium michelianum*	Frontier
	Berseem clover	*Trifolium alexandrinum*	Elite II
	Biserrula	*Biserrula pelecinus*	Casbah
	Woolly pod vetch	*Vicia villosa*	Capello
	Gland clover	*Trifolium glanduliferum*	Prima
	Persian clover	*Trifolium resupinatum var. majus*	Laser
	Purple vetch	*Vicia benghalensis*	Popany
	Rose clover	*Trifolium hirtum*	Hykon
	French serradella	*Ornithopus sativus*	Erica
	HDL mix*		
Biennial legume	Sulla	*Hedysarum coronarium*	Aokau
Perennial herb	Chicory	*Chicorium intybus*	Puna
	Plantain	*Plantago lanceolata*	Tonic

*High density legume mix of Persian/Arrowleaf/Berseem clovers.

Table 2 Herbicides used and rates of application on annual legumes, biennial legume and perennial herbs.

Method	Trade name	Active Ingredient	Application rate /ha	Adjuvant
Incorporated by sowing	TriflurX®	Trifluralin (480 g/L)	1.5 L	
	Stomp®	Pendimethalin (3 00g/L)	1.2 L	
Post sowing pre-emergent	Atrazine	Atrazine (500 g/L)	1.5 L	
	Simazine	Simazine (500g/L)	1.5 L	
	Spinnaker®	Imazethepyr (700g/kg)	100 g	
	Lexone® DF	Metribuzin (750 g/kg)	380 g	
	Atrazine + Simazine	Atrazine(500g/L)/Simazine (500 g/L)	750 mL/750 mL	
Early post emergent	Broadstrike®	Flumetsulam (800 g/L)	25 g	Uptake 0.5%
	Spinnaker®	Imazethepyr (700 g/kg)	200 g	Hasten 0.5%
	Sniper®#	Picolinafen (750 g/L)	50 g	
	Sniper®	Picolinafen (750 g/L)	45 g	
	Raptor® WG	Imazamox (700 g/L)	50 g	Hasten 0.5%
	2,4-DB	2,4-DB (500 g/L)	3 L	
	Jaguar®	Bromoxynil (250 g/L)/Diflufenican (25 g/L)	1 L	
	MCPA amine*	MCPA amine (500 g/L)	1.5 L	
	MCPA amine	MCPA amine (500 g/L)	750 mL	
	MCPA LVE®	MCPA (500 g/L)	750 mL	
	Brodal®	Diflufenican (500 g/L)	200 mL	
	Diuron + Broadstrike®	Diuron (500 g/L)/Flumetsulam (800 g/L)	100 mL/25 g	Uptake 0.5%
	Bromoxynil	Bromoxynil (200 g/L)	2 L	
	Dual Gold®	S-Metolachlor (960 g/L)	200 mL	
	Igran®	Terbutryn (500 g/L)	750 mL	
	Agtryne MA®	Terbutryn (275 g/L)/MCPA (160 g/L)	1 L	
	Tigrex®	MCPA (250 g/L)/Diflufenican (25 g/L)	1 L	
	Select®	Clethodim (240 g/L)	200 mL	Uptake 0.5%
	Verdict®	Haloxyfop-R (520 g/L)	100 mL	Uptake 0.5%
	Igran® + MCPA amine	Terbutryn (500 g/L)/MCPA amine (500 g/L)	500 mL/500 mL	
	Simazine + Jaguar®	Simazine(500 g/L)/Bromoxynil (250 g/L)/ Diflufenican (25 g/L)	500 mL/750 mL	
	Broadstrike®+Jaguar®	Flumetsulam(800 g/L)/Bromoxynil (250 g/L)/ Diflufenican (25 g/L)	25 g/750 mL	
	Broadstrike® + Igran®	Flumetsulam (800 g/L)/Terbutryn (500 g/L)	25 g/200 mL	
	Broadstrike® + MCPA amine	Flumetsulam(800 g/L)/MCPAamine (500 g/L)	25 g/500 mL	Uptake 0.5%
Full canopy	Gramoxone®	Paraquat (250 g/L)	2 L	
	Roundup CT®	Glyphosate (450 g/L)	1 L	
	Sprayseed®	Paraquat (135 g/L)/Diquat (115 g/L)	2 L	
	Simazine + Broadstrike®	Simazine (500 g/L)/Flumetsulam (800 g/L)	1.25 L/25 g	
	Simazine + Tigrex®	Simazine(500 g/L)/MCPA (250 g/L)/ Diflufenican (25 g/L)		

Sniper was applied at 50 g/ha in 2004 and at 45 g/ha in 2005
*MCPA amine applied at 1.5 L/ha in 2004 and at 750 mL/ha in 2005

through XR8002VS nozzles. Rate of water applied was 100 L/ha. Details of herbicide application rates can be found in Table 2.

Assessment of herbicide damage was made by harvesting an area of 1.5 m x 1.45 m using a sickle-bar mower on the 26 October 2004.

In 2005 the experiment was repeated with the annual legume mix replaced with narrow leaf Tonic plantain. The 2005 experiment was sown on 17 June due to the late seasonal break. Assessment of herbicide damage was made on the 2 November 2005.

Results and Discussion:

In reporting results a reduction in yield of 30% was considered an "acceptable level" of damage. While this reduction in yield is in all cases significant, it is considered appropriate if it can salvage the investment that has been made on seed, fertiliser and sowing costs and reduce weed problems in subsequent years.

Herbicides incorporated before sowing or as post sowing pre-emergent

TriflurX® and Stomp® caused minimal yield reduction when incorporated before sowing. Chicory was the most affected with yield reduced by 30% with use of TriflurX® and HDL mix reduced by 30% with the use of Stomp. TriflurX® applied at 1.0 L/ha maybe a safer option on these more sensitive species. Both atrazine and simazine applied as a post sowing pre-emergence (PSPE) caused significant damage to all species except woolly pod vetch.

Lexone®DF and Spinnaker® both caused unacceptable harvest loss in all species.

Strategic use of TriflurX® and Stomp® applied as pre-emergents appear acceptable for most species and could be used strategically to enhance establishment of legume pastures (Table 3).

Early post emergent herbicides

In some cases there was considerable variation between years with the herbicides used. For example, Igran® was the safest herbicide over all species in 2004 (Table 4), but caused unacceptable levels of damage on many species in 2005 (Table 5). Air temperature in the week following spraying in 2005 was greater than 18°C. The label specifies that greater damage can occur at temperatures above this and emphasises the importance of complying with these directions.

Broadstrike® was the only other EPE herbicide that was generally acceptable on most species. The exceptions to this were biserrula, woolly pod vetch and plantain where damage levels were high. Broadstrike®, either alone or in a mixture should not be applied to biserrula. The only herbicide found to cause acceptable levels of damage on biserrula was bromoxynil.

Raptor® in the one year that it was trialled appears an option with all species except biserrula, woolly pod vetch and plantain.

There were generally less herbicide options available to control weeds in chicory and plantain compared to most of the legume species. There appears to be little commonality in herbicides options available for chicory and plantain, with the exception perhaps of bromoxynil. Therefore, it would not be advisable to sow these two herbs together in a mix where broadleaf weed problems would be encountered. Additionally care should be taken in the selection of a companion legume for these species to ensure herbicide options are maximised.

The grass herbicides Select® and Verdict® were safe on all species.

Jaguar® caused harvest loss of between 25 and 70% to all crops in both years.

Herbicides applied at the full canopy stage

The only herbicide that may be able to be used successfully at the full canopy stage on most species was simazine+Broadstrike® (except on biserrula), all others evaluated caused high levels of damage.

Conclusions

Herbicides are a valuable tool that can be used to facilitate successful establishment of pasture and forage species. However, great care needs to be taken when choosing which species to include in a mix. Try to choose species which have similar herbicide compatibilities to ensure that there are sufficient options to control weeds which may occur. Herbicides should not be used as the only option to control weeds. Prior preparation of paddocks through use of cropping or pasture cleaning can greatly reduce weed burdens. Therefore an integrated approach to weed control will always be the most successful strategy.

Disclaimer

Some of the herbicides mentioned here are not registered for use on some species on which they were tested. Only herbicides registered for use on a particular species may be legally applied. Always check the label.

Table 3 The effect application of several herbicides either incorporated before sowing (IBS) of applied as a post-sowing pre-emergent (PSPE)on herbage yield (expressed as a percentage of the unsprayed control) of a range of pasture species in 2004. Shaded areas indicate severe yield depression of >30%.

	Unsprayed control yield (kgDM/ha)	TrifurX® IBS	Stomp® IBS	Atrazine+Simazine PSPE	Atrazine PSPE	Simazine PSPE	Spinnaker® PSPE	Lexone® DF PSPE
Arrowleaf	4454	87	101	2*	2*	0*	6*	36*
Balansa	4408	91	90	0*	0*	2*	19*	0*
Berseem	3026	87	106	0*	0*	9*	21*	2*
Biserrula	2977	78	97	0*	0*	0*	0*	0*
Woolly pod	5109	90	92	94	87	111	51*	67*
Chicory	2726	71*	90	0*	0*	1*	3*	9*
Gland	4619	98	89	10*	0*	19*	16*	8*
Persian	2990	85	84	0*	0*	0*	40*	0*
Purple vetch	5066	81*	88	32*	14	62*	59*	29*
Rose	5369	99	99	1*	2*	28*	23*	41*
French serradella	3538	93	80	0*	1*	18*	62*	1*
HDL mix	2239	72	60*	0*	0*	0*	0*	18*
Sulla	2642	98	95	85	2*	0*	11*	4*

* indicate statistically significant yield depression compared to unsprayed control.

Table 4 The effect of several herbicides applied as early post emergents (EPE) or at full canopy (FC) cover on yield (expressed as a percentage of the unsprayed control) for a range of pasture species in 2004. Shaded areas indicate severe yield depression of >30%.

	Yield unsprayed control (kgDM/ha)	Broadstrike®	Broadstrike® + MCPA amine	Sniper®	2,4-DB	Jaguar®	MCPA amine	Brodal®	Bromoxynil	Igran®	Igran® + MCPA amine	Agtryne MA®	Tigrex®	Simazine + Broadstrike®	Simazine + Tigrex®	Gramoxone®	Sprayseed®	Roundup CT®
		EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	FC	FC	FC	FC	FC
Arrowleaf	4454	95	94	79*	76*	50*	81*	67*	74*	117	84	67*	62*	77*	40*	27*	17*	25*
Balansa	4408	94	95	76*	93	52*	87	76*	76*	104	80*	75*	78*	72*	77*	28*	17*	29*
Berseem	3026	104	86	78	76*	48*	59*	78	73*	102	66*	68*	65*	74*	43*	51*	34*	34*
Biserrula	2977	1*	3*	63*	35*	55*	24*	65*	82	95	66*	40*	41*	38*	36*	0*	0*	2*
Woolly pod	5109	63*	62*	73*	85*	38*	22*	83*	58*	108	71*	49*	18*	85*	49*	46*	35*	67*
Chicory	2726	94	69*	52*	60*	10*	20*	27*	68*	85	69*	36*	19*	74*	60*	38*	24*	4*
Gland	4619	95	84*	65*	67*	35*	78*	44*	81*	48*	57*	53*	63*	91	35*	10*	26*	23*
Persian	2990	87	95	58*	90	43*	65*	55*	90	70*	69*	43*	40*	74*	61*	45*	16*	9*
Purple vetch	5066	88	62*	93	89	48*	22*	97	63*	93	81*	54*	9*	92	50*	45*	29*	73*
Rose	5369	104	95	77*	94	49*	90	88	61*	99	90	76*	89	71*	87	50*	21*	33*
French serradella	3538	99	95	66*	105	53*	75*	55*	97	61*	42*	70*	49*	74*	74*	51*	51*	0*
HDL mix	2239	74	58	39*	74	21*	33*	22*	53*	69	59*	31*	15*	71	30*	16*	14*	18*
Sulla	2642	90	86	81	61*	49*	57*	52*	57*	88	73*	54*	47*	78	51*	47*	24*	13*

* indicate statistically significant yield depression compared to unsprayed control.

Table 5 The effect of several herbicides applied as early post emergents (EPE) (3-4 leaf stage) on yield (expressed as a percentage of the unsprayed control) for a range of pasture species in 2005. Shaded areas indicate severe yield depression of >30%.

	Yield unsprayed control (kgDM/ha)	Broadstrike®	Broadstrike® +MCPA amine	Sniper®	2,4-DB	Jaguar®	MCPA amine	Brodal®	Bromoxynil	Igran®	Igran® + MCPA amine	Agtryne MA®	Tigrex®	Select®	Verdict®	Raptor® WG	Simazine + Jaguar®	Broadstrike® + Jaguar®	Broadstrike® + Igran®	MCPA LVE	Diuron +Broadstrike®
		EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE	EPE
Arrowleaf	8556	97	96	72*	86*	47*	86*	80*	68*	75*	61*	85*	77*	84*	103	88*	35*	58*	91	89*	86*
Balansa	6349	82*	67*	68*	99	62*	85*	72*	63*	44*	65*	62*	64*	94	121	94	16*	43*	46*	73*	59*
Berseem	4002	87	44*	94	70*	77*	82	83	80	83	65*	77*	59*	104	92	91	51*	55*	71*	65*	75*
Biserrula	6616	0*	0*	81*	31*	64*	69*	94	105	68*	18*	53*	56*	92	98	67*	56*	1*	2*	50*	1*
Woolly pod	6836	25*	13*	75*	79*	33*	17*	82*	35*	73*	5*	18*	10*	99	97	78*	33*	24*	23*	8*	29*
Chicory	4931	109	28*	46*	31*	17*	17*	63*	71*	52*	23*	58*	3*	96	101	104	13*	17*	75*	4*	74*
Gland	5878	92	70*	39*	56*	26*	99	49*	67*	28*	23*	40*	58*	87	112	96	9*	17*	43*	60*	68*
Persian	3357	84	99	79	87	69*	82	99	81	71*	74*	89	81	83	97	87	14*	41*	77	75*	76
Purple vetch	5486	100	43*	78*	51*	75*	41*	112	64*	74*	14*	32*	28*	110	91	97	57*	73*	78*	32*	80*
Rose	6254	85*	62*	73*	79*	45*	78*	73*	37*	37*	36*	48*	75*	100	130	89	14*	39*	35*	69*	43*
French serradella	4477	72*	61*	42*	83	31*	48*	2*	68*	0*	0*	8*	3*	81*	97	88	1*	17*	43*	43*	69*
Plantain	5487	61	31*	61*	0*	33*	26*	61*	73*	71*	47*	75*	14*	91	96	59*	1*	31*	59*	15*	57*

* indicate statistically significant yield depression compared to unsprayed control.