Weed control in sweet lupins

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Replacement of about 100 000 ha of winter crops in South Africa, with sweet white lupin would restore the economic balance and would lead to a sustainable agricultural production system. However, a need exists for herbicides to control weeds, especially broad leave weeds, in lupins. Without effective registered herbicides on lupins, it will be impossible to cultivate lupins economically, especially in rotation systems with wheat or maize. A most important factor to take into account, however, is that the herbicides must be effective in controlling weeds, but not be phytotoxic to lupins.

In South Africa only a few active ingredients of herbicides are registered on lupins namely propaquizafop (aryloxyphenoxypropionate), diflufenican(nicotinanilide), quizalofop-p-ethyl(phenoxy-phenoxy coumpound), cycloxydim(cyclohexenone compound), haloxyfop-r-methyl ester(pyridinyl-oxyphenoxy compound) and alachlor (chloracetanilide).

The aim of this study was to identify herbicides, which would be commercially acceptable for weed control in lupins. On recommendation from the Protein Research Trust (PRT) and chemical companies demonstration trials were planted in which several herbicides, some of which are already registered in other countries, were tested against a repetitive standard, alachlor. The choice of herbicides used in this study was based on the expertise of the PRT. Where unregistered herbicides were used, chemical companies were involved in herbicide dosage determinations. Where efficacy and phytotoxicity results on unregistered herbicides were commercially acceptable, companies will be requested to consider registration.

Demonstrative field trials were conducted in which ten treatments (Table 1) were evaluated. Four field trials were conducted, three during the winter of 2001 and another trial during the spring 2001. Lupin seeds were planted on 15 May 2001 (winter-trial at the ARC experimental farm at Potchefstroom), 12 June 2001 (winter-trial), 8 November 2001 (spring-trial at Bethlehem) and 29 May 2001 (at Brits). Cultivar Hantie was planted at Brits and Potchefstroom, while cultivar Esta was planted at Bethlehem. In all trials, eight rows of 10m each were respectively planted with a Bramley planter. Inter row spacing was 0.45m. Size of each treatment-plot was 3.6m x 10m, thus $36m^2$. To evaluate herbicide efficacy, every treatment plot was compared to an adjacent untreated control strip of 1.5m. Control strips were not hand or chemical weeded. Four alachlor applications (which were used as repetitive standards), s-metolachlor, simazine, terbuthylazine, a combination of simazine+terbuthylazine, a split application of simazine (a full dosage of simazine at planting followed by a half dosage of simazine when the weeds are in the four to six leave stage), a substituted urea, a substituted urea+simazine combination , an imazamox and a metosulam treatment were applied at dosages mentioned in Table 1. Treatments with alachlor, s-metolachlor, simazine, terbuthylazine and substituted urea were applied pre-emergence, while the half dosage of simazine, the imazamox and metosulam treatments were applied when the weeds

were in the four to six leave stages. Treatments were applied according to the clay percentage at each locality. Clay percentages were 33% at Potchefstroom, 42.6% at Brits and 16.2% at Bethlehem.

Throughout the different observation periods, visual symptoms of phytotoxicity and herbicide efficacy were recorded weekly up to 70 days after the application of the pre-emergence herbicide (DAA). Before trial termination, the lupin seed production at each trial was determined. Phytotoxicity and seed production were expressed as percentages of the repetitive standards. Efficacy was expressed as percentages of the control strips.

Efficacy and seed production data are summarized in Table 2.

With regard to herbicide efficacy, the following standards were used: Control between 90 and 100% was approved as "acceptable, sufficient or effective" weed control. Weed control less than 90%, namely between 50 and 89% was a reflection on "reduced or suppressed" weed control. Less than 50% weed control was deemed commercially unacceptable.

The following weeds infested each locality:

Weeds	Brits (winter)	Bethlehem (winter)	Bethlehem (spring)	Potchefstroom (winter)
african goosegrass (jongosgras)		X	X	
Bladdar weed (terblansbossie)		X		
bristly oxtongue (ostong)				X
cape wild mustard (strandwildemosterd)	X			
Common pigweed (misbredie)	X	X	X	X
Canada thistle (skotse dissel)	X			
devil's thorn (dubbeltjie)	X			
dwarf marigold (kleinkakiebos)		X	X	X
Gallant soldier (knopkruid)		X		
garden urochloa (beesgras)		X	X	X
Horseweed (kleinskraalhans)	X			
jersey cudweed (roerkruid)	X			
Khaki weed (kakiebos)			X	
Wandering jew (wandelende jood)	X			
white and green goosefoot (wit- en groenhondebossie)	X	X	X	X
pepperweed (peperbossie)	X			X
pigweed (porslein)	X	X		
ribwort (smalblaar piantago)				X
Sowthistle (sydissel)	X			X
Spiny emex (kaapse dubbeltjie)				X
Starvation senecio (radiatorbossie)				X
Thornapple (stinkblaar)	X	X		
sticky goosebery (klewerige appelliefie)	X			
wild tettuce (wildeslaai)	X			
yellow sweet clover (eenjarige geelstinkklawer)	X			

With regard to the herbicide efficacy the following was recorded:

* In the Brits-winter, Bethlehem-winter and spring trials, alachlor, s-metolachlor, simazine, terbuthylazine, simazine + terbuthylazine, a split application of simazine, substituted urea, substituted urea + simazine, imazamox and metosulam caused commercially effective control of the weeds present in each plot.
* At the Potchefstroom-winter trial alachlor, s-metolachlor, simazine, terbuthylazine, simazine + terbuthylazine, a split application of simazine, substituted urea and substituted urea + simazine caused commercially effective control of the weeds present in each of these plots. In the Potchefstroom-winter trial imazamox and metosulam did not control any of the weeds present in these plots.

It appears that all the tested herbicides can be used effectively for the control of certain weeds at Brits (winter) and Bethlehem (winter and spring). Herbicides such as alachlor, s-metolachlor, simazine, terbuthylazine, simazine + terbuthylazine, a split application of simazine, substituted urea, substituted urea + simazine may be effective for the control of certain weeds at Potchefstroom (winter). Imazamox and metosulam are not commercially recommended for weed control in the Potchefstroom area.

Throughout the observation period, no visual symptoms of phytotoxicity in the sense of chlorosis, necrosis, stunting, scorched leaves, malformation of plant parts and / or whiplashing (twisted whorls) of the growth points occurred with s-metolachlor, simazine, terbuthylazine, simazine+terbuthylazine, a split application of simazine, the substituted urea, substituted urea+simazine and the metosulam treatments. In all trials post emergence application of imazamox caused 80% stunting of lupins.

Seed production was expressed as percentages of the repetitive standards. Yield loss of more than 20% is considered as commercially unacceptable. Production data is summarized in Table 2. With regard to seed production, it seemed that herbicides such as s-metolachlor, simazine, simazine-split application, substituted urea, substituted urea + simazine and alachlor may be recommended for possible registration or use in lupins. After the application of herbicides such as terbuthylazine, simazine + terbuthylazine and metosulam, production varied between commercially unacceptable and commercially acceptable - thus a variable production. The latter herbicides may possible be considered for the possible use in lupins in certain areas. As imazamox caused stunting and commercially unacceptable seed production in all trials, this herbicide is not recommended for use in lupins.

Conclusion: If seed production and efficacy is taken into account it seemed that with the exception of terbuthylazine, simazine+terbuthylazine, imazamox and metosulam, all the other herbicides may be considered for use in lupins. As s-metolachlor and alachlor are already registered on lupins, it is recommended that registration trials may in future be considered on simazine, substituted urea and simazine+substituted urea. Terbuthylazine, imazamox and metosulam are not recommended for registration in lupins.

Table 1: Herbicide treatments for demonstration trials on lupins

	Herbicidesl (R/NR op lupins)		Time of application	Dosage (l/ha) applied at Bethlehem	Dosage (l/ha) applied at Brits	Dosage (l/ha) applied at Potchefstroom
Treatment	Trade name	Active ingredient				
1	Lasso MT	Alachlor (R)	Pre-em	3.4 l/ha	4.0 l/ha	4.0 l/ha
2	Metagan Gold 960 EC	s-metolachlor (R)	Pre-em	0.7l/ha	1.2 l/ha	1.2 l/ha
3	Simazol SC	Simazine (NR)	Pre-em	0.6l/ha	1.0l/ha	1.0l/ha
1	Lasso MT	Alachlor (R)	Pre-em	3.4 l/ha	4.0 l/ha	4.0 l/ha
4	Terbusip SC	Terbuthylazine (NR)	Pre-em	0.6 l/ha	1 l/ha	1 l/ha
5	Simazol/Terbusip	Simazine/Terbuthylazine 0.5; 0.5 (NR)	Pre-em	0.3l/ha +0.3lha	0.5l/ha +0.5lha	0.5l/ha +0.5lha
6	Simazol (1.0 + 0.5)	Simazine (NR)	Pre-em + Post-em	0.6l/ha+ 0.3l/ha	1l/ha+ 0.5l/ha	1l/ha+ 0.5l/ha
1	Lasso MT	Alachlor (R)	Pre-em	3.4 l/ha	4.0 l/ha	4.0 l/ha
7	Diuron 800	Diuron (NR)	Pre-em	0.6l/ha	1l/ha	1l/ha
8	Diuron / Simazine	Diuron / Simazine 0.50; 0.50 (NR)	Pre-em	0.3l/ha + 0.3 l/ha	0.5l/ha + 0.5 l/ha	0.5l/ha + 0.5 l/ha
9	Successor	Imazamox (NR)	Post-em	0.3l/ha	0.3l/ha	0.3l/ha
10	Sinal 10SC	Metosulam (R on certain Lupin cultivars)	Post-em	0.075l/ha	0.075l/ha	0.075l/ha
1	Lasso MT	Alachlor (R)	Pre-em	3.4 l/ha	4.0 l/ha	4.0 l/ha

R = Registerd on Lupins; NR = Not registered on Lupins ; Pre-em = Pre emergence herbicide; Post - em = post emergence herbicide

Table 2: Summary of lupin yields after the application of ten herbicide-treatments in demonstration trials

Locality		S-metolachlor	Simazine	Terbuthylazine	Simazine	Simazine 1 x +	Substituted	Substituted	Imazamox	Metosulam	Alachlor
					Terbuthylazine	Simzine 1/2 x	Urea	Urea +			Average of
								Simazine			4 Replicates
		Metagan	Simazol	Terbusip	Simazol +	Simazol +	Diuron	Diuron 800	Successor	Sinal	LassoMT
		Gold	SC	SC	Terbusip	Simazol	800	Simazol		10SC	
		Production as percentage of repetitive standard									
Brits	winter	91	96	60	70	80	109	112	44	96	100
Bethlehem	winter	82	102	84	81	80	153	82	50	77	100
Bethlehem	spring	hail damage	hail damage	hail damage	hail damage	hail damage	hail damage	hail damage	hail damage	hail damage	hail damage
Potchefstroom	winter	103	90	95	81	92	85	85	51	113	100
	Production	Good	Good	?	?	Good	Good	Good	x	?	Good
		Weed control									
Brits	winter	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Bethlehem	winter	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Bethlehem	spring	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Potchefstroom	winter	yes	yes	yes	yes	yes	yes	yes	no	no	yes
General conclusion	efficacy/production	Good	Good	?	?	Good	Good	Good	x	x	Good

yes	all weeds present in plots were controlled effectively
no	none of the weeds present in the plots were controlled
Good	recommended for possible use in lupines
x	not recommended for possible use in lupines
?	variable - but could be considered for possible use in lupins