Effect of Lime and Herbicide on the Control of Wild Radish in a Wheat-Wheat-Lupin-Barley Rotation

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Key Messages

- Three years after application of lime, soil pH increased by about 1 unit at the top soil and 0.08 - 0.26 units at the sub-soil layers.
- The effect of liming improved crop vigour in 2013 by up to 16% and this effect reduced wild radish density by 50%. This reduction was however not significant, most likely due to low radish densities and a high level of variability.
- Velocity® together with simazine in previous seasons reduced wild radish density by 98% in 2013 season and improved crop vigour by up to 16%.
- Lime increased barley grain yield by up to 6% and Velocity® by up to 8%.
- Lime effect on herbicide efficacy to control radish in barley crop was not evident.

Aim

A four-year study has investigated if lime applied in a low pH soil could enhance the efficacy of herbicides on wild radish and improve crop performance in a wheat-wheat-lupin-barley rotation at the Wongan Hills Research Station, Western Australia (WA).

Background

The presence of 10 - 75 plants/m^2 of wild radish could reduce wheat grain yield by 7 - 56% and even more in lupins. The competitive ability of crops may be improved through application of lime. Altered soil pH and improved competitive ability of crops resulting from the application of lime may subsequently influence the performance of herbicides.

Lime application is expected to raise soil pH resulting in better crop growth and suppression of wild radish. Wild radish showed signs of becoming less competitive with wheat at higher soil pH, resulting in reduced wild radish growth (Wills 2006). With barley crop being more sensitive to soil acidity, applications of lime should result in better barley crop growth and improved weed control.

Prior studies have indicated that application of lime leads to increased yield of barley and reduction in annual ryegrass biomass (Gazey and Andrew 2010). However, data on the effect of lime on wild radish in wheat or barley crop are not yet available from designed field studies. It is therefore important to examine if lime can suppress weeds and improve the efficacy of herbicides on wild radish.

Trial Details

Property	Wongan Hills Research Station
Plot size & replication	20m x 2m x 4 replications
Soil type	Deep sand
Soil pH ($CaCl_2$)	See Table 1
Paddock rotation	2009: pasture, 2010: wheat, 2011: wheat, 2012: lupin
Seeding date	14/05/13
Seeding rate	90 kg/ha Hindmarsh barley
Fertiliser	14/5/13: 80 kg/ha MacroPro Plus
Herbicides	Summer weed control: 1.5 L/ha Roundup, 600 mL/ha 2,4-D Ester 14/05/13: 2 L/ha Spray.Seed, 2 L/ha Trifluralin

	17/06/13: Velocity at different rates (as per treatments)
Harvest	04/12/13
Growing Season Rainfall	256mm

A four-year study investigated if lime applied in low pH soils could influence the efficacy of herbicides on wild radish at the Wongan Hills Research Station, WA. The crop rotation was wheat-wheat-lupin-barley, grown from 2010 to 2013. The trial was set up in a split plot design, with four rates of limesand (0, 1.25, 2.5 and 5 t/ha) in the main plots (applied in 2010 prior to sowing the wheat crop) and five rates of herbicide in the sub-plots.

2010 Wheat: Velocity was applied at 0, 250, 350, 500 and 670L/ha in the sub-plots at the 3-leaf stage of wild radish.

2011 Wheat: Velocity was applied at 0, 250, 350, 500 and 670L/ha in the sub-plots at the 3-leaf stage of wild radish.

2012 Lupin: Lupin crop was grown with simazine applied at 0 or 2 L/ha and incorporated by seeding (IBS). Brodal 100 mL/ha + metribuzin 150 g/ha was applied at 4-5-leaf stage of lupins on all the plots except the untreated (no herbicide) control.

2013 Barley: Velocity was applied at 0, 250, 350, 500 and 670L/ha in the sub-plots.

In the 2013, the Velocity application was applied when the barley crop was at Z13-Z14 stage. In cereal crops, trifluralin was applied as IBS to control grass weeds. No post-emergent broadleaf weed herbicide was sprayed in any cereal crop.

Key Results

- Three years after application of lime, soil pH increased by about 1 unit at the top soil, and 0.08 - 0.26 units at the sub-soil layers compared to the no lime treatment. Soil pH increased progressively with the increases in lime rate from 0 to 5 t/ha (Table 1).
- Wild radish density was reduced by 50% in limed plots but the reduction was not significant probably due to very low radish density (2 plants/m^2 in the no lime plots) and high variability in radish distribution at this site. However, visual assessment at the heading stage of crop showed a 12 - 16% improvement in barley crop vigour in lime treatments compared to no lime plots (Table 2).
- Velocity together with simazine in previous seasons reduced wild radish by 98% in 2013 season and improved crop vigour by 13-16% (Table 2).

Table 1: Effect of different rates of lime applied in 2010 season before sowing crop on the soil pH at different depths measured before sowing crop at Wongan Hills in 2013 season.

Lime rate (t/ha)	Soil Depth		
	0-10 cm	10-20 cm	20-30 cm
0	5.3	4.3	4.2
1.25	5.9	4.4	4.3
2.5	6.0	4.5	4.3
5	6.3	4.5	4.5
L.S.D. (p=0.05)	0.31		

Table 2: Effect of lime (applied in 2010) and Velocity on the density of wild radish, barley crop vigour and barley grain yield in 2013 season at Wongan Hills Research Station.

	Rate	Wild radish (plants/m^2)	Barley crop vigour (%)	Barley grain yield (t/ha)
Lime (t/ha)	0	2.0	100	3.96
	1.25	2.0	112	4.09
	2.5	1.0	112	4.18
	5	1.0	116	4.21
L.S.D. (0.05)		NS[1]	3.01	0.123
Velocity (mL/ha)	0	5.1	100	3.84
	250	1.4	113	4.09
	350	0.5	115	4.18
	500	0.5	115	4.15
	670	0.1	116	4.14
L.S.D. (0.05)		1.27	3.36	0.138

- Despite low density of wild radish at this site, lime increased barley grain yield by up to 6% and Velocity by up to 8% (Table 2).
- Like in previous cropping seasons, lime effect on herbicide efficacy to control wild radish in barley crop was not evident in 2013 season either.

Comments

Three years after application of lime, soil pH ($CaCl_2$) increased by about 1 unit at the top soil and 0.08- 0.26 units at the sub-soil layers compared to the no lime treatment. Soil pH increased progressively with the increases in lime rate from 0 to 5 t/ha. This increase in soil pH resulted in a 50% reduction of wild radish density even though this reduction was not significant, probably due to very low density (2 plants/m^2 in the no lime plots) and high variability in the distribution pattern of wild radish. Such reduction in wild radish density due to lime was not found in previous seasons.

Velocity herbicide was always effective in controlling wild radish regardless of lime rates.
Despite low density of wild radish at this site, lime increased barley grain yield by up to 6% and Velocity increased barley grain yield by up to 8%.

The effects of lime in the reduction of wild radish density or improvement in crop vigour and grain yield of crop due to lime were not observed in the previous seasons in this study since the application of lime.
An interaction effect of lime and herbicide on barley crop and wild radish was not evident, and while lime could improve crop growth, it may have no effect on the efficiency of herbicides or it may take longer period of time to get such an effect.

Since an interaction effect was not yet evident, it may be worthwhile to continue this trial in case a clear effect of lime on herbicide efficacy becomes evident.

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