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Potassium nutrition of pastures on the sandplain soils of Western Australia.

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TITLE: Potassium Nutrition Of Pastures On The Sandplain Soils Of
Western Australia

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AIMS: Determine the factors affecting the fate of native and applied
potassium on sandplain soils.

Define current and residual response curve parameters for
potassium applications.

Develop recommendations for the economic management of soil
potassium levels.

Maintenance application rates of potassium on sandplain soils

88BA46/5818 EX

Location: Badgingarra Research Station, nutrition block

Soil type: Deep yellow sand (> 1 m)

Fertilizer: Pastures and L. cosentinii - 200 kg/ha Super topdressed, wheat - 100 kg/ha Super topdressed, 120 kg/ha Agras No 1 drilled, lupins - 240 kg/ha Super Mn drilled. Urea topdressed on wheat on 26 June, 100 kg/ha.

Seeding date: 24-25 May. The pastures germinated at the end of April.

Species: Dagger wheat - 60 kg/ha, Gungurru lupins - 100 kg/ha, Dalkeith subclover, Serena medic, Tauro and Eneabba serradella, L. cosentinii.

Treatments: K rates topdressed by hand. Treatments applied annually. Pastures treated 30 May, crops treated 8 June.

Vegetative
sampling

dates: L. cosentinii 6/9, wheat-11/9, white lupins-11/9, subclover 11/9, serradella+medic 11/10.

Results:

Table 1. Effect of K on vegetative growth and grain yield

Crop	Potassium rate (kg/ha)	Vegetative yield (t/ha)	Grain yield (t/ha)
Wheat after lupins	0	3.20	1.50
	10	3.56	1.71
	20	3.89	1.67
	40	3.76	1.80
	70	3.98	1.86
	150	4.15	1.82
	SED	0.33	LSD (5%) 0.19
Wheat after subclover	0	3.16	1.56
	10	3.57	1.62
	20	3.27	1.60
	40	3.40	1.59
	70	4.17	1.76
	150	4.08	1.80
	SED	0.34	SED 0.13
	0	1.85	1.29
	10	1.91	1.26
	20	2.07	1.30
	40	2.03	1.29
	70	1.90	1.32
	150	1.79	1.23
	SED	0.14	SED 0.08

Table 1 continued ...

Crop	Potassium rate (kg/ha)	Vegetative yield (t/ha)	Grain yield (t/ha)
	0	2.90	
	10	2.76	
	20	2.58	
	40	2.97	
	70	3.28	
	150	2.82	
		SED	0.42
Subclover after wheat	0	1.02	0.55*
	10	1.51	0.52
	20	2.18	0.82
	40	2.07	0.86
	70	2.55	0.92
	150	2.29	0.94
		LSD (5%)	0.98
			LSD (2%) 0.34
Serradella/medic	0	1.97	
	10	1.88	
	20	2.21	
	40	2.10	
	70	2.28	
	150	2.46	
		SED	0.23

* Subclover seed bank

Table 2. Effect of potassium fertilizer on the concentration of K (% db) in the whole tops, youngest leaves and grain

Crop	Potassium rate (kg/ha)	Whole tops	Youngest leaves	Grain
Wheat after lupins	0	0.88	1.45	0.39
	10	1.08	1.85	0.40
	20	1.20	2.00	0.39
	40	1.26	2.25	0.40
	70	1.47	2.32	0.40
	150	1.51	2.38	0.40
		LSD (0.1%) 0.197	LSD (0.1%) 0.45	SED 0.01
Wheat after subclover	0	0.78	1.24	0.40
	10	0.97	1.60	0.41
	20	1.21	1.96	0.41
	40	1.38	2.20	0.40
	70	1.49	2.23	0.39
	150	1.66	2.31	0.40
		LSD (0.1%) 0.33	LSD (0.1%) 0.40	SED 0.01

Table 2 continued ...

Crop	Potassium rate (kg/ha)	Whole tops	Youngest leaves	Grain
Lupins after wheat	0	0.92	0.65	
	10	1.04	0.62	
	20	1.14	0.65	
	40	1.51	0.66	
	70	1.64	0.67	
	150	1.98	0.66	
		LSD (0.1%) 0.28		SED 0.02
Subclover after wheat	0	0.74		
	10	1.00		
	20	1.24		
	40	1.64		
	70	2.07		
	150	2.38		
		LSD (0.1%) 0.56		
<u>L. cosentinii</u>	0	0.72	1.25	
	10	0.87	1.36	
	20	1.12	1.30	
	40	1.17	1.47	
	70	1.34	1.45	
	150	1.71	1.63	
		LSD (0.1%) 0.57		

Comments:

There was a grain response to K in wheat following lupins. Although wheat following subclover also showed an increasing trend with K applied, this was not significant. Both species of lupins were unresponsive to K. There was a vegetative response up to 20 kg/ha of K in the subclover in rotation with wheat (1:1), and a seed yield response up to 150 kg/ha of K. The serradella/medic plots are now dominated by serradella, and were unresponsive to K. The continuous subclover blocks were not assessed this season due to a large weed infestation caused by the large amount of summer rain.

Maintenance application rates of potassium on sandplain soils

88TS69/5818 EX

Location: R. Halbert, North Eneabba

Soil type: Deep grey sand (> 1 m)

Fertilizer: Pastures and L. cosentinii - 150 kg/ha Super topdressed, wheat - 65 kg/ha Super topdressed, 120 kg/ha Agras No 1 drilled, lupins - 165 kg/ha Super drilled. Urea topdressed on wheat on 5 July, 100 kg/ha

Seeding date: Lupins 22 May, wheat 29 May

Species: Reeves wheat - 75 kg/ha, Gungurru lupins - 100 kg/ha, Dalkeith/Nungarin subclover, L. cosentinii

Treatments: K rates topdressed by hand on 12 June. Treatments applied annually

Vegetative sampling dates: 13-14 August

Harvest: 21 November

Results:

Table 1. Effect of K on vegetative growth and grain yield

Crop	Potassium rate (kg/ha)	Vegetative yield (t/ha)	Grain yield (t/ha)
Wheat after lupins	0	1.13	0.51
	10	1.18	0.56
	20	1.56	0.64
	40	1.75	1.02
	70	1.72	1.01
	150	1.66	1.21
		LSD (5%) 0.39	LSD (10%) 0.44
Wheat after subclover	0	0.41	0.24
	10	0.97	0.43
	20	1.06	0.44
	40	0.94	0.44
	70	1.12	0.69
	150	1.10	0.52
		LSD (0.1%) 0.34	LSD (10%) 0.21
Lupins after wheat	0	1.53	1.68
	10	1.64	1.91
	20	1.75	2.01
	40	1.55	1.92
	70	1.58	2.00
	150	1.58	2.02
		SED 0.15	SED 0.14

Table 1 continued ...

Crop	Potassium rate (kg/ha)	Vegetative yield (t/ha)	Grain yield (t/ha)
<u>L. cosentinii</u>	0	1.99	
	10	2.07	
	20	2.12	
	40	1.95	
	70	2.13	
	150	1.63	
		SED 0.24	

Table 2. Effect of potassium fertilizer on the concentration of K (% db) in the whole tops, youngest leaves and grain

Crop	Potassium rate (kg/ha)	Whole tops	Youngest leaves	Grain
Wheat after lupins	0	0.78	0.73	0.38
	10	0.94	0.88	0.38
	20	1.18	0.95	0.38
	40	1.99	1.59	0.41
	70	2.24	1.96	0.37
	150	2.91	2.58	0.40
		LSD (0.1%) 0.72	LSD (0.1%) 0.44	SED 0.02
Wheat after subclover	0	0.63	0.51	0.39
	10	0.77	0.84	0.40
	20	0.96	1.03	0.40
	40	1.65	1.60	0.40
	70	1.98	1.99	0.40
	150	2.53	2.43	0.40
		LSD (0.1%) 0.29	LSD (0.1%) 0.40	SED 0.02
Lupins after wheat	0	0.84	1.74	0.74
	10	1.01	2.00	0.75
	20	1.10	2.00	0.78
	40	1.65	2.15	0.76
	70	1.92	2.20	0.81
	150	2.21	2.32	0.78
		LSD (0.1%) 0.65	LSD (0.1%) 0.27	SED 0.02
<u>L. cosentinii</u>	0	1.20	1.54	
	10	1.49	1.59	
	20	1.50	1.66	
	40	1.98	1.83	
	70	2.43	2.08	
	150	2.95	2.14	
		LSD (0.1%) 0.55		

Comments:

There was a severe brome grass infestation in both wheat blocks which affected yields. Grain lupins were unresponsive to K at this site also, despite the K% in the whole tops at first flowering being less than 1.5% (critical level) until 40 kg/ha of K was applied for the third year. L. cosentinii was not responsive to K. The serradella plots were cropped to wheat to reduce the amount of capeweed and the subclover grew very poorly, partly due to capeweed infestation, and set very little seed.

Maintenance application rates of potassium on sandplain soils

89K026/5818 EX

Location: Kojaneerup Research Block

Soil type: Deep grey sand over yellow sand (> 1 m)

Fertilizer: Pastures - 200 kg/ha Super topdressed, barley - 100 kg/ha Super topdressed, 120 kg/ha Agras No 1 drilled, lupins - 200 kg/ha Super Mn drilled

Seeding date: Lupins, barley 15/5. Barley was reseeded on 13/6 with 140 kg/ha Agras No. 1

Species: Barley - 70 kg/ha, Gungurru lupins - 100 kg/ha, Madeira serradella, Dalkeith subclover

Treatments: K rates topdressed by hand on 5/6 (except for barley which was treated 3 weeks after reseeding). Treatments applied annually.

Sampling date: 25/9

Results:

Table 1. Effect of K on vegetative growth and concentration of K in whole tops (K % db)

Crop	Potassium rate (kg/ha)	Vegetative yield (t/ha)	K %
Serradella	0	3.16	1.10
	10	3.23	1.31
	20	3.80	1.78
	30	4.10	1.76
	60	3.99	2.29
	120	4.55	2.66
	200	4.12	3.60
	LSD (1%)	0.77	LSD (0.1%) 1.16

Comments:

Weed levels at this site (brome grass in the barley and broad leaf weeds in the pastures) and severe damage by rabbits to the lupins have reduced the results obtained. The serradella/subclover rotation was dominated by serradella in 1990, with very little subclover seed set in 1989. The serradella was responsive up to 30 kg/ha of K applied for the second year. A visual response to K was observed in the subclover, with the nil plots lower than the treated plots.

Residual value of potassium on sandplain soils.

89BA24/5818 EX

Location: Badgingarra Research Station

Soil type: Deep yellow sand (> 1 m)

Fertilizer: Pastures - 200 kg/ha Super topdressed, lupins - 240 kg/ha Super Mn drilled

Seeding date: Lupins - 24 May, pastures germinated at the end of April

Crop: Gungurru lupins (inoculated, 100 kg/ha), Dalkeith subclover, Serena and Santiago medic, Madeira serradella

Treatments: K rates topdressed by hand on 31 May on pastures, lupins - 8 June. Fresh plots treated in 1990

Vegetative sampling dates: Pastures - calibrated rating 21/8, lupins - 5/9, flowers on primaries

Results:

Table 1. Effect of K on vegetative growth and grain yield

Crop	Potassium rate (kg/ha)	Vegetative yield (t/ha)		Grain yield (t/ha)	
		1989	1990	1989	1990
Lupins	0		2.76		
	25	2.75	2.67	2.26	1.97
	50	2.72	2.64	1.87	1.95
	75	2.87	2.94	2.15	2.19
	100	2.38	2.75	2.09	2.18
	150	2.54	2.50	2.01	2.18
	200	2.86	2.24	2.22	1.81
MEAN		2.69	2.62	2.10	2.05
Subclover	0		1.49		
	25	1.56	1.57		
	50	1.60	1.73		
	75	1.79	1.75		
	100	1.66	1.60		
	150	1.72	1.74		
	200	1.86	1.67		
MEAN		1.70	1.68		
Medic	0		2.56		
	25	2.49	2.76		
	50	2.52	2.80		
	75	2.46	2.74		
	100	2.60	2.32		
	150	2.55	2.48		
	200	2.62	2.46		

Table 1 continued ...

Crop Year K Applied	Potassium rate (kg/ha)	Vegetative yield (t/ha)		Grain yield (t/ha)	
		1989	1990	1989	1990
MEAN		2.54	2.59		
Serradella	0		3.10		
	25	3.34	3.62		
	50	3.62	3.27		
	75	3.40	3.62		
	100	3.26	3.76		
	150	3.94	3.87		
	200	3.49	4.09		
MEAN		3.51	3.70		

Table 2. Effect of potassium on pasture seed bank (t/ha)

Year K applied	Potassium Rate(kg/ha)	Subclover	Medic	Serradella
1989	0	0.66	0.97	0.93
	50	0.80	1.09	0.94
	200	1.05	1.12	0.93
1990	25	0.86	0.97	0.98
	50	0.83	0.97	0.94
	100	0.75	0.87	0.88
	200	0.83	0.87	0.99

Table 3. Effect of potassium fertilizer on the concentration of K (% db) in the whole tops, youngest leaves and grain

Crop	Potassium rate (kg/ha)	Whole Tops		Tips		Grain	
		1989	1990	1989	1990	1989	1990
Lupins	0	1.13		1.52		0.67	
	25	1.27	1.36	1.57	1.56	0.63	0.66
	50	1.31	1.58	1.57	1.65	0.69	0.65
	75	1.33	1.77	1.63	1.67	0.67	0.68
	100	1.43	1.86	1.58	1.72	0.68	0.71
	150	1.60	2.01	1.66	1.74	0.66	0.68
	200	1.71	1.99	1.73	1.74	0.66	0.67
MEAN		1.44	1.76	1.62	1.68		
Subclover	0	0.93					
	25	1.09	1.33				
	50	1.26	1.53				
	75	1.47	1.70				
	100	1.39	1.94				
	150	1.79	2.05				
	200	1.99	2.15				
MEAN		1.50	1.78				
Medic	0	1.15					
	25	1.28	1.68				
	50	1.54	1.86				
	75	1.66	2.15				
	100	2.03	2.23				
	150	2.17	2.54				
	200	2.32	2.63				
MEAN		1.83	2.18				
Serradella	0	1.19					
	25	1.47	1.60				
	50	1.44	1.94				
	75	1.84	2.10				
	100	1.94	2.26				
	150	1.95	2.46				
	200	2.41	2.77				
MEAN		1.84	2.19				

Comments:

K rates were applied in 1989 and to fresh plots (previously nil) in 1990 to assess the residual value of K fertilizer. Fresh plots will also be treated in 1991. There was no difference in growth of the pastures or lupins whether K was applied in 1989 or 1990. Grain and seed yields were also not affected by year of application. This may indicate that residual value of K is higher on sandplain soils than previously thought, although the K concentrations in whole tops were affected by the year of application for all species.

Potassium requirements of pastures on the sandplain soils of Western Australia.

90MO60/EX5818

Location: J. Felber, Bibby Springs

Soil type: Deep grey over pale yellow sand (> 1 m)

Fertilizer: 200 kg/ha Super Cu Zn Mo topdressed

Seeding date: 21 May

Management: Cultivated prior to sowing, Fusilade 31/7

Species: Dalkeith subclover 120 kg/ha, Paros serradella pod 150 kg/ha, topdressed and harrowed to cover

Treatments: K rates topdressed by hand 14/6

Vegetative sampling date: 18/9

Results:

Table 1. Effect of potassium on vegetative growth and seed yield of subclover and serradella

Species	Potassium rate (kg/ha)	Vegetative yield (kg/ha)	Seed yield (kg/ha)
Subclover	0	670	40
	25	910	480
	50	870	610
	75	970	650
	100	1080	560
	150	1250	660
	200	1100	570
		LSD (10%) 310	LSD (0.1%) 210
Serradella	0	250	40
	25	710	190
	50	980	230
	75	980	210
	100	960	220
	150	1,070	240
	200	1,100	230
		LSD (1%) 500	LSD (0.1%) 80

Table 2. Effect of K on potassium concentration (% K db) in the whole tops of subclover and serradella

Potassium Rate (kg/ha)	Subclover	Serradella
0	0.21	0.45
25	0.59	0.84
50	1.05	1.13
75	1.28	1.43
100	1.45	1.47
150	1.62	1.74
200	1.73	1.96
	LSD (0.1%) 0.37	LSD (0.1%) 0.26

Comments:

This site was a newly cleared deep grey sand. Both species showed large vegetative and seed yield responses to applied K. Seed yields were unresponsive to rates higher than 25 kg/ha of K.