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## Grain legume adaptation to soil type

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DEPARTMENT OF AGRICULTURE

WESTERN AUSTRALIA

SUMMARY OF 1989 EXPERIMENTAL RESULTS

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DRYLAND RESEARCH INSTITUTE  
MERREDIN

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1) Grain legume adaptation to soil type

Trials: 89ME95, 96 and 97.

Location: Welbungin.

Soil types: 89ME95 : Sand to at least 70 cm.  
pH (CaCl<sub>2</sub>) = 4.66 at the surface and 4.4 at 50 cm.

89ME96 : Sand over clay at 40 cm.  
pH (CaCl<sub>2</sub>) = 4.54 at the surface and 5.03 at 50 cm.

89ME97 : Sandy loam over clay at 20 cm.  
pH (CaCl<sub>2</sub>) = 4.63 at the surface and 7.85 at 50 cm.

Sowing details: Direct drilled into moist soil on 4/5/89 with 106 kg/ha plain superphosphate. 2 L/ha Bladex applied immediately prior to sowing and sowing rate adjusted to achieve 45 plants/m<sup>2</sup>.

Results:

Machine harvest yields (t/ha)

	89ME95	89ME96	89ME97
Danja lupins	1.32	1.30	1.00
Yorrel lupins	1.39	1.29	0.89
Dundale peas	0.82	1.60	1.21
Wirrega peas	1.24	1.72	1.47
LSD (P=0.05)	0.20	0.26	0.35

Dry matter production and harvest index

	89ME95			89ME96			89ME97		
	Mature D.M. (g/m <sup>2</sup> )	Quadrat grain (g/m <sup>2</sup> )	HI	Mature D.M. (g/m <sup>2</sup> )	Quadrat grain (g/m <sup>2</sup> )	HI	Mature D.M. (g/m <sup>2</sup> )	Quadrat grain (g/m <sup>2</sup> )	HI
Danja lupins	431	136	0.313	372	117	0.311	213.0	86.6	0.419
Yorrel lupins	359	115	0.319	360	108	0.304	217.4	78.4	0.365
Dundale peas	284	127	0.442	538	257	0.480	273.3	127.7	0.478
Wirrega peas	393	186	0.485	578	221	0.399	343.0	113.7	0.357
LSD (P=0.05)	72.7	65.3	0.192	149	64.7	0.179	76.0	60.7	0.251

Trials: 89ME98 and 99.

Location: Totadgin.

Soil types: 89ME98 : Loamy sand to at least 70 cm.  
pH (CaCl<sub>2</sub>) = 4.44 at the surface and 5.08 at 50 cm.

89ME99 : Loamy sand becoming heavier with depth. Gravelly sandy clay at 30 cm.  
pH (CaCl<sub>2</sub>) = 4.56 at the surface and 5.10 at 50 cm.

Sowing details: Sown into moist soil on 11/5/89 with 100 kg/ha plain superphosphate. 2 L/ha Bladex applied before sowing and sowing rates adjusted to give 45 plants/m<sup>2</sup>. Misted with 100 ml/ha Rogor on 9/6/89.

Results:

Machine harvest yields (t/ha)

	89ME98	89ME99
Danja lupins	0.58	0.84
Yorrel lupins	0.51	0.68
Dundale peas	0.92	1.09
Wirrega peas	0.91	0.81
LSD (P=0.05)	0.137	0.181

Dry matter production and harvest index

	89ME98			89ME99		
	Mature D.M. (g/m <sup>2</sup> )	Quadrat grain (g/m <sup>2</sup> )	HI	Mature D.M. (g/m <sup>2</sup> )	Quadrat grain (g/m <sup>2</sup> )	HI
Danja lupins	169.8	52.8	0.307	258.6	82.8	0.319
Yorrel lupins	152.7	52.9	0.345	184.9	54.6	0.296
Dundale peas	199.9	108.7	0.544	265.7	100.4	0.399
Wirrega peas	184.4	103.1	0.559	237.7	106.7	0.467
LSD (P=0.05)	52.8	27.5	0.084	62.6	42.9	0.213

Trials: 89N36 and 37.

Soil types: 89N36 : Loamy sand over clay at 40 cm.  
pH (CaCl<sub>2</sub>) = 4.73 at the surface and 5.68 at 50 cm.

89N37 : Loamy sand over clay at 30 cm.  
pH (CaCl<sub>2</sub>) = 5.06 at the surface and 6.44 at 50 cm.

Sowing details: Sown into moist soil of 25/5/89 with 145 kg/ha of plain superphosphate. 2 L/ha Bladex applied immediately prior to sowing. Sowing rate adjusted to achieve 45 plants/m<sup>2</sup>. 80 ml/ha perfekthion applied for RLEM on 19/6/89 and 1.0 L/ha Hoegrass on 5/7/89.

Results:

Machine harvest yields (t/ha)

	89N36	89N37
Danja lupins	1.61	0.81
Gungurru lupins	1.38	0.71
Dundale peas	1.27	0.35
Wirrega peas	1.27	0.42
LSD (P=0.05)	0.148	0.196

Dry matter production and harvest index

	89ME36			89ME37		
	Mature D.M. (g/m <sup>2</sup> )	Quadrat grain (g/m <sup>2</sup> )	HI	Mature D.M. (g/m <sup>2</sup> )	Quadrat grain (g/m <sup>2</sup> )	HI
Danja lupins	574	156	0.270	434	113.7	0.262
Gungurru lupins	587	132	0.226	416	97.4	0.238
Dundale peas	403	190	0.473	154	39.8	0.276
Wirrega peas	359	156	0.439	178	55.2	0.305
LSD (P=0.05)	62.1	63.4	0.138	71.9	46.6	0.109

Note: 89N37 was very weedy despite the application of hoegrass on 5/7/89.

Trials: 89EB28, 29, 30.

Location: East Beverley Research Annexe.

Soil types: 89EB28 : Sand over clay at 40 cm.  
pH (CaCl<sub>2</sub>) = 4.73 at the surface and 5.5 at 50 cm.

89EB29 : Sand over clay at 10 cm.  
pH (CaCl<sub>2</sub>) = 4.93 at the surface and 6.0 at 50 cm.

89EB30 : Gravelly sand over gravelly clay at 30 cm.  
pH (CaCl<sub>2</sub>) = 5.28 at the surface and 5.96 at 50 cm.

Sowing details: 89EB28 and 89EB30 : Sown into moist soil with 100 kg/ha plain superphosphate on 31/5/89. Sowing rate adjusted to achieve 45 plants/m<sup>2</sup>. 65 ml/ha Rogor on 12/6/89 and 400 ml Fusilade on 29/6/89.

89EB29 : Sown into moist soil with 100 kg/ha plain superphosphate on 1/6/89. Sowing rate adjusted to achieve 45 plants/m<sup>2</sup>. Lupins sprayed with 150 ml/ha Brodal and peas with 1 L/ha Bladex on 21/6/89.

Results:

Machine harvest yields (t/ha)

	89EB28	89EB29	89EB30
Danja lupins	0.80	1.23	0.38
Yorrel lupins	0.64	0.84	0.49
Dundale peas	0.27	0.35	0.68
Wirrega peas	0.42	0.73	1.24
LSD (P=0.05)	0.209	0.124	0.152

Trial: 89ME65

Location: Merredin.

Soil types: 89ME65a : Sand over clay at 50 cm.  
pH (CaCl<sub>2</sub>) = 4.89 at the surface and 6.92 at 50 cm.

89ME65b : Sand over clay at 40 cm.  
pH (CaCl<sub>2</sub>) = 4.81 at the surface and 6.74 at 50 cm.

89ME65c : Sandy over clay at 10-20 cm.  
pH (CaCl<sub>2</sub>) = 4.88 at the surface and 8.34 at 50 cm.

Sowing details: Sown into moist soil with 96 kg/ha plain superphosphate on 15/5/89. 2 L/ha Bladex applied prior to sowing.

Results:

Machine harvest yields (t/ha)

	89ME65a	89ME65b	89ME65c
Danja lupins	1.48	0.98	0.59
Yorrel lupins	1.41	0.94	0.66
Dundale peas	1.07	1.35	1.37
Wirrega peas	1.25	1.61	1.35
LSD (P=0.05)	0.128	0.292	0.098

Dry matter production and harvest index

	89ME65a		89ME65b		89ME65c	
	Quadrat grain (g/m <sup>2</sup> )	HI	Quadrat grain (g/m <sup>2</sup> )	HI	Quadrat grain (g/m <sup>2</sup> )	HI
Danja lupins	117.8	0.248	97.2	0.259	51.4	0.218
Yorrel lupins	123.2	0.275	94.6	0.265	70.6	0.223
Dundale peas	138.1	0.429	111.3	0.400	119.7	0.438
Wirrega peas	117.6	0.367	101.9	0.342	105.3	0.386
LSD (P=0.05)	34.3	0.066	30.6	0.106	31.5	0.120



Total water use (19/6-7/11 for lupins and 19/6-10/10 for peas) and water use efficiency for grain production

	89ME65a		89ME65b		89ME65c	
	Water Use (mm)	WUE (kg/ha/mm)	Water Use (mm)	WUE (kg/ha/mm)	Water Use (mm)	WUE (kg/ha/mm)
Danja lupins	161.4	9.02	142.2	6.93	135.3	4.36
Yorrel lupins	168.5	8.64	149.7	6.34	151.6	4.39
Dundale peas	130.2	8.29	127.2	10.36	125.5	11.06
Wirrega peas	120.0	10.61	134.4	12.16	122.3	11.32
LSD (P=0.05)	30.3	1.81	19.7	2.54	14.6	1.48

D.M. growth throughout season ( $\text{g m}^{-2}$ )

Date	89ME65a				89ME65b				89ME65c			
	Lupins		Peas		Lupins		Peas		Lupins		Peas	
	Log DM	DM	Log DM	DM	Log DM	DM	Log DM	DM	Log DM	DM	Log DM	DM
3/7	1.933	6.91	2.170	8.76	2.048	7.76	2.396	11.0	2.402	11.0	2.392	10.9
24/7	3.094	22.1	3.624	37.5	2.967	19.4	3.902	49.5	3.201	24.5	3.794	44.4
14/8	4.060	58.0	4.950	141.2	4.170	64.7	5.173	176.5	4.316	74.9	5.151	172.7
11/9	5.840	343.6	5.794	328.2	5.584	266.2	5.927	375.0	5.301	220.6	5.931	376.6
26/9	6.096	444.0	6.110	450.2	5.943	381.0	6.156	471.8	5.430	228.2	6.069	432.1
10/10	6.147	467.2	-	-	5.935	377.9	-	-	5.610	273.2	-	-
20/10	-	-	6.051	424.5	-	-	5.949	383.4	-	-	5.894	362.9
LSD (P=0.05)	0.224	-	0.224	-	0.175	-	0.175	-	0.185	-	0.185	-

Water use (mm) and water use efficiency ( $\text{g m}^{-2} \text{mm}^{-1}$ ) for dry matter production during season

Time period	89ME65a		89ME65b		89ME65c		LSD (P=0.05)
	Lupins	Peas	Lupins	Peas	Lupins	Peas	
3/7 - 24/7							
Water Use	24.4	26.6	24.4	25.0	23.6	27.6	5.74
WUE	0.65	1.14	0.53	1.69	0.70	1.44	0.519
24/7 - 14/8							
Water use	23.9	24.7	33.2	33.3	33.4	30.8	6.84
WUE	1.54	4.85	1.38	4.38	1.56	4.60	1.671
14/8 - 11/9							
Water Use	55.7	42.1	38.8	36.6	36.6	34.8	17.4
WUE	5.42	4.59	5.96	9.23	3.98	6.46	4.64
11/9 - 26/9							
Water Use	27.0	12.6	19.0	15.4	16.9	14.5	8.48
WUE	5.55	8.66	6.20	7.60	2.20	3.15	6.27
14/8 - 26/9							
Water Use	82.8	54.7	57.8	52.0	53.6	49.3	22.5
WUE	5.19	5.29	5.95	7.02	3.11	5.65	2.26

**Conclusions:** As in 1988, the yield of peas relative to that of lupins was higher on shallow soils than on deep ones. This was not entirely due to shallow soils restricting lupin water use since there were large differences between soils in lupin water use efficiency. The differences in water use efficiency between peas and lupins appear to be due to differences in early growth since later in the season when a reasonable amount of canopy area cover exists there was no difference between the two species in water use efficiency for dry matter production.

2) Lupin yield response to seed size and plant density.

Seed details for these trials.

Trials 89LG37, 89WH60, 89ME63

Seed	Seed Size (mg)	Germination Percentage
Danja small	126.1	92
Danja large	166.5	80
Danja bulk	132.7	87
Yorrel small	135.5	92
Yorrel large	172.4	87
Yorrel bulk	157.0	94
Gungurru small	122.9	88
Gungurru large	153.8	86
Gungurru bulk	141.6	89

Trial 89M32

Seed	Seed Size (mg)	Germination Percentage
Danja	146.4	92

Trial : 89LG37.

Location: Lake Grace.

Soil type: Deep yellow sand.

Sowing details: Sown into moist soil on 24/5/89 with 150 kg/ha plain superphosphate. 750 ml/ha Simazine applied prior to sowing.

Results:

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Treatment	Plant Density ( $m^{-2}$ ) 30/6/89	Grain Yield (t/ha)
Small Danja 30 kg/ha	18.4	1.36
" " 50	37.5	1.44
" " 70	46.0	1.44
" " 100	73.4	1.46
" " 200	139.3	1.26
Large Danja 30 kg/ha	16.9	1.26
" " 50	24.3	1.52
" " 70	36.2	1.60
" " 100	45.7	1.47
" " 200	93.2	1.29
Bulk Danja 30 kg/ha	18.3	1.21
" " 50	31.8	1.45
" " 70	42.0	1.41
" " 100	59.1	1.39
" " 200	111.0	1.25
Small Gungurru 30 kg/ha	25.5	1.12
" " 50	37.3	1.25
" " 70	53.2	1.26
" " 100	73.5	1.30
" " 200	144.1	1.09
Large Gungurru 30 kg/ha	24.0	1.15
" " 50	30.9	1.27
" " 70	43.7	1.18
" " 100	58.2	1.25
" " 200	106.5	1.06
Bulk Gungurru 30 kg/ha	17.2	1.09
" " 50	30.4	1.19
" " 70	42.4	1.23
" " 100	68.2	1.31
" " 200	123.5	1.13
LSD (P=0.05)	10.3	0.172

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Trial: 89WH60.

Location: Wongan Hills Research Station.

Sowing details: Sown into moist soil 20/5/89.

Results:

Treatment	Plant Density (m <sup>-2</sup> ) 28/6/89	Grain Yield (t/ha)
Small Danja 30 kg/ha	22.3	1.25
" " 50	35.1	1.36
" " 70	40.9	1.39
" " 100	58.9	1.64
" " 200	124.1	1.70
Large Danja 30 kg/ha	17.2	1.32
" " 50	24.5	1.44
" " 70	37.9	1.69
" " 100	49.1	1.82
" " 200	89.3	1.92
Bulk Danja 30 kg/ha	18.6	1.12
" " 50	28.8	1.32
" " 70	39.1	1.55
" " 100	56.5	1.59
" " 200	100.1	1.91
Small Gungurru 30 kg/ha	25.2	1.20
" " 50	37.6	1.61
" " 70	47.9	1.78
" " 100	67.6	1.88
" " 200	128.0	1.99
Large Gungurru 30 kg/ha	19.9	1.31
" " 50	34.9	1.45
" " 70	41.9	1.63
" " 100	57.7	1.73
" " 200	110.5	2.04
Bulk Gungurru 30 kg/ha	19.9	1.17
" " 50	28.6	1.56
" " 70	45.8	1.68
" " 100	68.9	1.63
" " 200	122.9	2.34
LSD (P=0.05)	8.20	0.31

Trial: 89ME63.

Location: Yelbeni.

Soil: Good sandplain.

Sowing details: Sown into moist soil with 120 kg/ha plain superphosphate.  
1.5 L/ha simazine applied prior to sowing.

Results:

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Treatment	Plant Density (m <sup>-2</sup> ) 21/6/89	Grain Yield (t/ha)
Small Danja 30 kg/ha	14.8	0.44
" " 50	27.1	0.80
" " 70	34.8	0.75
" " 100	47.8	0.78
" " 200	98.6	0.86
Large Danja 30 kg/ha	10.2	0.55
" " 50	21.2	0.81
" " 70	24.4	0.91
" " 100	39.4	0.97
" " 200	66.5	1.07
Bulk Danja 30 kg/ha	13.9	0.58
" " 50	21.6	0.72
" " 70	29.6	0.87
" " 100	41.6	0.85
" " 200	94.0	0.91
Small Yorrel 30 kg/ha	16.4	0.62
" " 50	31.5	0.78
" " 70	38.0	0.95
" " 100	51.9	1.04
" " 200	100.0	0.98
Large Yorrel 30 kg/ha	14.2	0.75
" " 50	20.9	0.72
" " 70	27.3	0.95
" " 100	38.2	1.02
" " 200	89.3	1.10
Bulk Yorrel 30 kg/ha	15.9	0.66
" " 50	24.6	0.77
" " 70	32.5	0.92
" " 100	43.0	1.06
" " 200	84.4	1.08
LSD (P=0.05)	10.5	0.14

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Trial: 89M32.  
Location: Merredin, CSIRO lease block.  
Soil: Shallow sand over clay.  
Sowing details: 1.5 L/ha simazine applied on 9/5/89, sown on 10/5/89 with 100 kg/ha plain superphosphate into moist soil.

Results:

Treatment	Plant Density (m <sup>-2</sup> ) 7/6/89	Grain Yield (t/ha)
Danja 30 kg/ha	15.6	0.70
" 50	24.9	0.95
" 70	31.2	0.88
" 100	38.5	0.88
" 150	60.2	0.82
" 200	73.6	0.77
Yandee 100 kg/ha	28.0	0.87
LSD (P=0.05)	4.47	0.138

Water use and water use efficiency

Treatment	Water Use (12/6-12/11) (mm)	Water Use Efficiency For Seed Production (kg/ha/mm)
Bare	122.2	-
Danja 30 kg/ha	152.1	4.99
" 50	157.1	6.20
" 70	149.4	6.12
" 100	153.2	5.84
" 150	161.7	4.96
" 200	165.5	4.67
Yandee 100 kg/ha	152.1	5.70
LSD (P=0.05)	21.2	1.28

Early water use and D.M. production

Treatment	Water Use (12/6-31/8) (mm)	D.M. Increment (12/6-31/8) (g/m <sup>2</sup> )	Water Use Efficiency for D.M. Production (kg/ha/mm)
Bare	77.4	-	-
Danja 30 kg/ha	95.0	126.1	13.8
" 50	98.5	186.5	19.0
" 70	96.5	211.4	21.9
" 100	98.5	247.3	25.1
" 150	111.6	251.4	22.5
" 200	112.8	285.7	25.6
Yandee 100 kg/ha	96.5	191.1	19.1
LSD (P=0.05)	11.2	52.8	5.84

Leaf water potentials (-MPa)

	1/9/89	14/9/89	28/9/89	19/10/89*
Danja 30 kg/ha	1.01	1.33	1.73	1.45
" 50	1.14	1.39	1.76	1.43
" 70	1.13	1.39	1.61	1.32
" 100	1.31	1.37	1.87	1.23
" 150	1.22	1.29	1.80	1.25
" 200	1.37	1.30	1.70	1.18
Yandee 100 kg/ha	1.06	1.50	1.70	1.44
LSD (P=0.05)	0.11	0.16	0.27	0.27

\* 3.4 mm rain was received on 18/10/89.

**Conclusions:** Seed size had a much smaller effect on final seed yield than it has in previous years. In fact it only had an effect in Danja lupins, but not in Gungurru or Yorrel. The dry finish to the 1989 season resulted in some trials showing a parabolic yield response to density: 89LG37 and 89M32. In 89M32 this seemed to be associated with too rapid early growth and water use in dense treatments. Thus, the 200 kg/ha treatment used 68% of its total seasonal water use by early flowering when it was under significantly greater stress than the 50 kg/ha treatment which had only used 62% of its total seasonal water use.



3) Doublegee control in field peas with Bladex/MCPA (MCPA-amine 50%)

Trial: 89M31.  
Location: Merredin Research Station.  
Soil: Brown sandy loam.  
Sowing details: Derrimut peas sown into moist soil at 120 kg/ha with 105 kg/ha plain superphosphate on 30/5/89.  
Spraying details: 2 L/ha sprayseed on 19/5/89. Treatments sprayed 24/7/89.  
Results:

Treatment	*Weed Control Ratings 9/8/88	Doublegees/m <sup>2</sup> 17/8/89	Grain Yield (t/ha)	Doublegee +contamination(L <sup>-1</sup> ) square-root back-transformed transformation
Control	0	13.0	1.51	15.2
Bladex 500 ml/ha	1.75	7.5	1.40	24.2
" 700 "	1.25	4.6	1.55	26.0
" 1000 "	3.50	3.3	1.55	3.4
MCPA 200 ml/ha	0	10.4	1.50	32.9
Bladex 500 + MCPA 200	2.50	5.3	1.63	5.7
" 700 + " "	2.50	4.9	1.53	10.6
" 1000 + " "	3.25	3.3	1.56	3.8
MCPA 400 ml/ha	0	10.4	1.51	42.3
Bladex 500 + MCPA 400	3.75	2.6	1.44	2.4
" 700 + " "	4.50	3.6	1.48	2.2
" 1000 + " "	4.75	1.7	1.53	0.8
Brodal 50 ml/ha	0.25	12.2	1.59	20.0
Bladex 500 + Brodal 50	1.50	10.9	1.48	8.6
" 700 + " "	2.00	5.2	1.54	4.6
" 1000 + " "	2.75	5.2	1.61	4.7
LSD (P=0.05)	1.25	4.24	n.s.	-

\* Weed control ratings are on a scale from 0 (no damage to weeds) to 5 (complete control).

+ Doublegee contamination of harvested seed. Data transformed to  $\sqrt{x+1}$  for analysis of variance, back-transformed data are derived from means produced by this analysis.

Conclusions: Inclusion of 400 ml/ha of MCPA significantly improved the activity of 500 and 700 ml/ha Bladex against doublegees, however there was no effect on seed yield. There was a significant reduction in the doublegee contamination in harvested grain. Inclusion of 50 ml/ha Brodal with these rates of Bladex did not have the same effect. 1,000 ml/ha Bladex on its own was significantly better than 500 or 700 ml/ha Bladex on their own.