

1981

Grain legume agronomy programme

G Walton

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Recommended Citation

Walton, G. (1981), *Grain legume agronomy programme*. Department of Agriculture and Food, Western Australia, Perth. Article.

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EXPERIMENTAL SUMMARY 1981

GRAIN LEGUME AGRONOMY PROGRAMME

G. Walton

Plant Research Division

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1. LUPIN AGRONOMY, SERIES 1 - GROWTH FACTOR INTERACTIONS

Objective

To evaluate the relative influence that various growth factors exert on crop yield.

Background

The rise in interest of including a lupin crop in wheatbelt rotations, where the growth environment is sub-optimal, prompted a re-appraisal of the relative importance of the agronomic recommendations.

The series consisted of two experiments in a wheatbelt sandplain environment compared with two in optimal environment.

Experiment 81GE3 - A. and B. Leishman, Allanooka

Yellow sandplain; basal fertiliser of 155 kg/ha super TE No. 1 + MnSO₄ mixture. Rainfall May to October = 409 mm. Sown early - before the break, without cultivation. Sown May 29, one week after rain. Simazine treatment: One and one-half L/ha applied before seeding. Heavy ryegrass emergence over the site, entire site sprayed with Hoegrass on July 2. Experimental design - Split-plot with time of planting as main plots. Replications = three. Harvested grain yield (kg/ha)*

Cultivar	Seed rate	Dry sown (May 1)			Sown May 29		
		52	104	152	52	104	152
Illyarrie		707 (20)	1100 (40)	1209 (58)	1567 (21)	1769 (41)	2031 (62)
Marri		643 (25)	795 (47)	909 (66)	874 (30)	1033 (46)	986 (73)

(Seedling density, plants/m²)

* The +/- Simazine treatments had no influence and results have been averaged.

Experiment 81ME2 - A.W. and B. Ivey, Bodallin South

Yellow (wodgil) sandplain. May to October rainfall = 256 mm, only 45 mm fell in September/October. Basal fertiliser = 153 kg plain super/ha. Sown dry (May 20), two days before opening rains. Sown June 15. Simazine treatment (2 L/ha) applied to the first sown plots on May 25 and just before seeding for the last sown plots. The reduced branching (determinate) selection P23240 was compared with the normal branched (indeterminate) Yandee. All lupin seed was inoculated.

Harvested grain yield (kg/ha)

Cultivar	Seed Rate:	Sown (May 1)			Sown June 15		
		46	85	110	46	85	110
Yandee	Simazine -	(NS)	902	824	477	773	819
	+		1000 (30)	870 (38)	606 (14)	629 (25)	870 (28)
P23240	-	(NS)	833	768	310	486	347
	+		458 (36)	565 (43)	222 (20)	366 (36)	366 (44)

(Seedling density, plants/m²)
(NS) = Not sown

- N.B. 1. Poor seedling establishment, especially the Yandee (sown deep and sand blast).
2. Soil type variation across replicates, from sand to increased loaminess which showed better seedling establishment and higher brome grass component (Simazine treatment effect).
3. Heavy pod loss at front of harvester. From quadrat samples after harvest, an additional 408 kg/ha and 655 kg/ha can be added to the harvest yields of Yandee and P23240 sown at 80 kg/ha.

Experiment 81N08 - J.D. and T.J. Bateman and Son, Gwambygine

York Gum, jam sandy loam. May to October rainfall = 337 mm, only 30 mm of which fell during September/October. Basal fertiliser of 150 kg super TE No. 1 + Cobalt mixture/ha. Sown June 2 and June 16. At each sowing, Treflan at 1.5 L/ha applied and incorporated, Simazine and Pespruf 25 applied at 1.5 L/ha. Hoegrass applied in July. All lupin seed inoculated. Seed rates used 45 kg and 80 kg/ha (= low), 85 and 150 (= recommended), 120 and 220 (= high) for Yandee and Ultra.

Harvested grain yields (kg/ha)

Cultivar	Seed	Sown May 8	June 2	June 16	(Seedling) Density/m ²
Yandee	Low	905	1136	930	23
	Recom.	1124	1205	1136	38
	High	1074	1361	1167	51
Ultra	Low	662	743	224	16
	Recom.	929	1074	268	28
	High	1299	1198	493	43

N.B. The time of planting treatments differed in level of weed population. The May 8 sowing had Capeweed and Doublegee at about 330 plants/m², June 2 had Doublegee at 36 plants/m² and June 16 had Bromegrass and Capeweed at 10 plants/m².

Experiment 81BR1 - I. Marshall, Boyup Brook North

Shallow gravelly loam soil, marri vegetation, new land cleared 1980. Rainfall May to October = 516 mm. Basal fertiliser: plain super broadcast at 400 kg/ha, super TE No. 1 + Cobalt mixture at 160 kg/ha at seeding. Sown May 13 (12 days before the break), June 17 and July. Patchy seedling establishment and during the growing season the ultra variety developed paleness of the older foliage and stunted growth. Comparative plant analysis suggested P deficiency in the ultra, with associated high levels of Mn accumulated.

Harvested grain yields (kg/ha)

Cultivar	Seed	Sown May 13	June 17	July	(Seedling) Density (plants,m ²)
Yandee	Low	1003	343	63	17
	Recom.	1003	629	222	28
	High	1384	1207	349	49
Ultra	Low	274	32	19	15
	Recom.	318	203	44	30
	high	756	152	51	39

Seed Rates: Low = 40 and 80 kg/ha for Yandee and Ultra
 Recommended = 80 and 150 for Yandee and Ultra
 High = 120 and 220 for Yandee and Ultra

Summary of growth factor interactions

Factor	Location								
	81GE3		81ME2		81NO8		81BR1		
	Yield	% of good yield	Yield	% of good yield	Yield	% of good yield	Yield	% of good yield	
Seeding Date	May 29	1376			June 2	119			
	May 1	894	65	May	899		May	790	
				June	696	77	May 8	998	89
Cultivar	Illy.	1396		Yandee		Yandee	1115		
	Marri	874	63			Ultra	765	69	
Density	65:	1283		33:	846	47:	1099		
	44:	1174	92	27:	826	97	33:	956	87
	24:	948	74	14:	541	64	20:	766	69
Simazine				+	795				
				-	759	95			

The correct time of planting is vital, as is the most appropriate lupin cultivar. The seed rate and establishment technique needs to provide a seedling density close to 40 plants/m². These agronomic "facts" do not appear to differ for the growth of lupins in the wheatbelt environment.

2. LUPIN AGRONOMY, SERIES 2 - HARVEST INDEX RESPONSE TO DENSITY

Objective

To establish whether the harvest index of the plants at maximum crop yield density remains constant over a range of environmental conditions and whether differences exist between cultivars.

Background

The effect of environmental stress on vegetative growth (biological yield) influences reproductive potential (grain yield) of the plant. Provided the stress is not of a "drought" situation, the change in reproductive potential should be proportional to that of the biological yield, that is the harvest index remains constant over environments. The grain yield is a function of biological yield and harvest index; if HI is constant over environments, it should be easier to extrapolate potential grain yield for any environment knowing the potential biological yield and the HI of any cultivar. This could be applied to the development of reduced branching (greater HI) lupin cultivars.

Experiment 81BA5, Paddock 1A, Badgingarra Research Station

Grey sand over gravel. May to October rainfall = 566 mm. Basal fertiliser 195 kg super-Manganese/ha. A tank mix of Treflan and Simazine, both at 1.5 L/ha sprayed and incorporated May 26. The trial sown on the same day. The biomass sampled from 20 plants/plot on November 17. The grain yield harvested on November 19.

Seed rate (kg/ha)	Illyarrie				P23240 (reduced branching)			
	Seedling establ. (pl/m ²)	Biomass (kg/ha)	Grain yield (kg/ha)	HI	Seedling establ.	Biomass	Grain yield	HI
50	25	7959	1376	0.290	25	4838	1011	0.367
70/84*	40	9012	1601	0.306	52	10890	1194	0.302
108/114	60	10403	1615	0.270	62	10424	1369	0.275
145/137	88.5	15523	1510	0.268	87	11903	1306	0.310
180/158	92.5	14597	1418	0.301	91.5	11677	1236	0.275
215/208	102	12513	1292	0.240	105.5	14391	857	0.279

(* Illy/P23240)

Experiment 81GE17 - J. Diepeveen, East Binu

Yellow sandplain soil with Callitris verrucosa vegetation. May to October rainfall = 280 mm (only 8 mm in September/October). Sown dry on May 19 with Simazine at 1.5 L/ha. Basal fertiliser of 200 kg super-manganese/ha. Biomass sampled from 20 plants/plot on grain yields harvested October 29. P22612 flowered one week before Illyarrie (i.e. August 7)

Seed rate (kg/ha)	Seedling establ. (pl/m ²)	Illyarrie			HI	P22612 (early flowering)			
		Biomass (kg/ha)	Grain yield (kg/ha)			Seedling establ.	Biomass (kg/ha)	Grain yield (kg/ha)	HI
35	16	7651	1495	0.281	11	6987	1003	0.290	
50	24	8322	1676	0.276	21	10762	1376	0.288	
65	35	10909	1862	0.283	24	11970	1486	0.293	
80	42	13699	2057	0.282	32	10625	1533	0.293	
120	46	14004	1890	0.280	36	10861	1619	0.271	

Experiment 81GE18 - A. and B. Leishman, Allanooka

White sand over gravel at 50 cm. May to October rainfall = 409 mm. Basal fertiliser = 200 kg super-manganese/ha. Sown July 10, with Simazine and Sprayseed tank mix. P22612 flowered September 15. Grain yields harvested on November 20.

Cultivar		Seed rate (kg/ha)				
		36	56	80	96	124
Illyarrie	Seedling establ.	8	19	24	29	38
	Grain yield	357	529	586	714	742
P22612	Seedling establ.	10.5	21	27	35	45
	Grain yield	214	329	414	443	514

Experiment 81TS24 - T. Reading, Three Springs

Red loamy sand. May to October rainfall = 275 mm (only 29 mm in September and October). Basal fertiliser 195 kg super-manganese/ha. Trial sown May 1 (three weeks before the break) with Simazine at 2 L/ha. One-half of plot lengths only sampled and harvested because of severe rabbit damage. Heavy Doublegee infestation. Biomass sampled from 10 plants/plot. Grain yield harvested on November 5.

Seed rate (kg/ha)	Seedling establ. (pl/m ²)	Illyarrie			HI	P22612			
		Biomass (kg/ha)	Grain yield (kg/ha)			Seedling establ.	Biomass (kg/ha)	Grain yield (kg/ha)	HI
42	19	6379	1027	0.305	24	6597	944	0.299	
49	20	5612	1139	0.307	24	6278	1120	0.294	
63	28	7050	1255	0.304	30	7240	1204	0.277	
84	32	6680	1259	0.291	42	7367	1111	0.287	
123	44	7695	1319	0.282	48.5	7143	1204	0.258	

Experiment 81WH18 - Paddock 1H, Wongan Hills Research Station

Elphin loamy sand. May to October rainfall = 287 mm (38 mm only in September/October). Basal fertilizer of 100 kg super/ha. Sown May 27. Simazine at 2 L/ha applied the next day. Biomass sampled from 20 plants/plot. Grain yield harvested on November 20.

Seed rate (kg/ha)	Illyarrie				P23240			
	Seedling establ. (pl/m ²)	Biomass (kg/ha)	Grain yield (kg/ha)	HI	Seedling establ.	Biomass	Grain yield	HI
55.5	14	8809	1190	0.308	23.6	7042 ^x	929	0.301 ^x
72	28	11205	1488	0.235	32	7353	1238	0.330
110	38	12008	1671	0.311	37.5	6844	1303	0.360
143.5	41	7662	1684	0.315 ^x	50	8797	1447	0.292
173	50	10241	1821	0.316	72	10752	1625	0.296
212	60	12269	1827	0.294	73	11100	1452	0.316

(^x = one replicate only)

Experiment 81MN6 - Manjimup Vegetable Research Station

Karri, red loam. April to October rainfall = 1025 mm. Basal fertiliser, 200 kg super trace element No. 1 mix/ha. Site sprayed with Diuron at 2 L/ha before seeding. Sown early (April 30) before the break. Sown June 15. Biomass on Yandee and P23240 (reduced branching lupin) from 20 plants/plot. Grain yield harvested on January 15.

Date	Seed rates (kg/ha)	65	80	115	135	165	205	220	260
April Yandee	Seedling establ. (pl/m ²)	19.6	38	51	58			80	1
	Biomass (kg/ha)	10845	18233	14417	14595			18514	189
	Grain yield (kg/ha)	1525	1895	1390	1895			2025	13
P23240	Seedling establ.	24	39	63.5	64.5	84.5	130		
	Biomass	5178	5581	7499	6979	8954	11787		
	Grain yield	365	740	915	1175	1350	1245		
June Yandee	Seedling establ.	19	33.5	57.5	54.5	71	105.5		
	Grain yield	1650	1965	1920	1670	1880	2095		
P23240	Seedling establ.	19	22 ^x	-	59.5	81.5	91		
	Grain yield	455	49 ^x	-	980	130	1180		

(^x one replicate only)

Date	Seed rates (kg/ha)	50	80	115	140	170	230	Unknown	
April 30	Hamburg Seedling establ.	9.5	18	23	28	46	54		
	Grain yield	2275	2650	2825	2900	2895	2675		
	Kiev Seedling establ.	14	21	31	53			18	23
	Mutant Grain yield	1855	1930	2535	2420			2135	2195

(* one replicate only)

Summary of yield and harvest index responses to crop density

A quadratic regression was fitted to the grain yield as a percentage of maximum yield response to crop density.

$$\% \text{ max. yield (Y)} = A + B.X + C.X^2 \quad (X = \text{density})$$

The constant "B" represents the slope of the regression

Cultivar	Experimental data	Equation	Density at Y max.	R ²
Illyarrie	BA5, GE17, TS24, WH18	$Y = 50.1 + 1.659x - 0.013 x^2$	50	0.838
Yandee	MN6	$Y = 55.7 + 1.084x - 0.008 x^2$	50	0.40
P22612	GE17, TS24	$Y = 29.8 + 3.487x - 0.044 x^2$	40	0.815
P23240	BA5, WH18	$Y = 14.3 + 2.467x - 0.018 x^2$	60	0.842
P23240	MN6	$Y = -26.2 + 2.40x - 0.011 x^2$	90	0.90

There is a negative relationship between crop density at maximum yield and the degree of apical branching; the cultivars in relative decreasing level of branching are P22612, Illyarrie and Yandee and P23240.

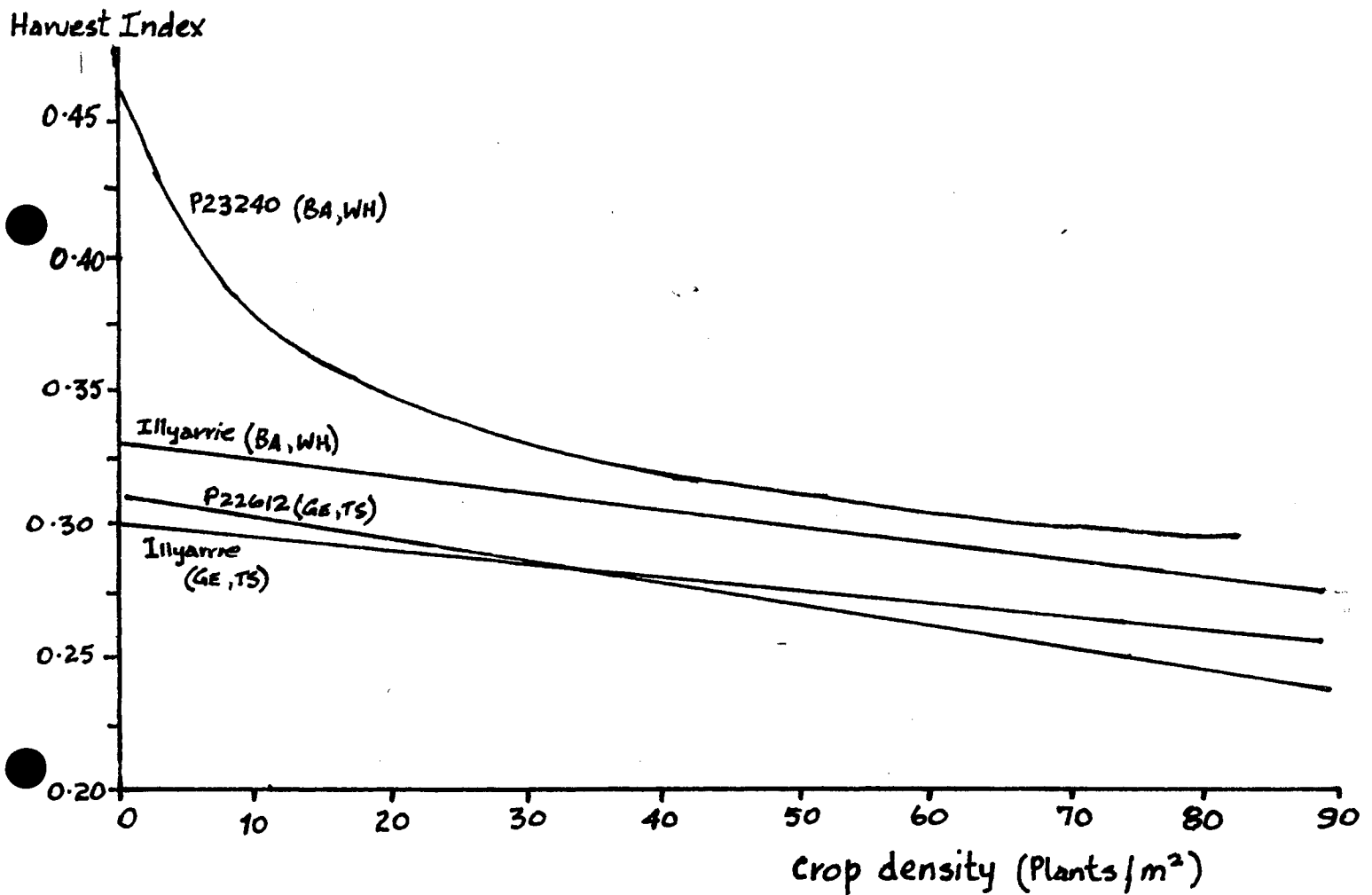


FIGURE : Cultivar response of Harvest Index to crop density

Cultivar	Experimental location	Harvest index at max. yield
Illyarrie	GE17, TS24	0.275
Illyarrie	BA5, WH18	0.300
P22612	GE17, TS24	0.277
P23240	BA5, WH18	0.302

It seems that environmental conditions produce significant differences in the harvest index of lupin plants, whereas there is very little difference in lupin cultivars at maximum yield. However, the cultivars differ in response of harvest index to crop density (Figure).

3. LUPIN AGRONOMY - NUTRITION

Objective

To compare the grain yield response to potash rates

Experiment 81MA1 - A. Ettridge, Bokerup

Gravelly sandy loam; red gum vegetation. Basal fertiliser 200 kg/ha, super No. 1 and Cobalt mix. Sown May 26. Yandee at 80 kg/ha and Ultra at 150 kg/ha. Trial plots were devastated by Rhizoctonia and Fusarium spp. root rots. Not harvested.

Experiment 81MA2 - Johnston, Bokerup

Gravelly sand - inadequate K site. Treatments the same as for 81MA1. Plots sown June 19. The trial devastated by rabbit damage and root rots. Not harvested.

Objective

A preliminary evaluation of L. albus nutrition on Lancelin sand

Experiment 81MO6 - G. Meadows, Lancelin

Siliceous sand over limestone (Uc 1). Banksia, blackboy vegetation.

Soil analysis: 4 ppm P
 43 ppm K
 1.5 ppm Mn

Basal fertiliser 300 kg/ha super topdressed before seeding, 200 kg Super TE No. 1 mix with seed. Trial seeded May 7 (dry) with Treflan at 1.5 L/ha incorporated before sowing. Ultra and Kiev mutant lupins sown at 150 kg/ha. Trace element treatments: MnSO₄ at 30 kg/ha mixed with the super No. 1 mix and sown with the seed. KCl broadcast by hand at 100 kg/ha, six weeks after seeding. CoSO₄ at 580 g/ha mixed with the super-Mn mix and sown with seed. Thick Bromegrass germination during winter. "Kerb" applied at 1.25 kg/ha on June 25 with no apparent effect on the grass.

Plots harvested on November 30

TE treatments			Ultra	Kiev mutant	cv. mean
Mn	K	Co			
0	0	0	849	972	910
+	0	0	936	949	942
0	+	0	982	1074	1028
+	+	0	1018	1149	1083
+	0	+	861	956	909

Potash appears to be the major limiting treatment.

Experiment 81M07 - G. Meadows, Lancelin

Soil type, basal fertiliser and seeding the same as 81M06. No potash basal applied, but Cu, Zn and Mo trace elements applied with the super treatments of 100, 198 and 365 kg/ha. Ultra and Illyarrie lupins sown dry and too deep which affected seedling establishment.

Cultivar	Seed rate (kg/ha)	Super rate (kg/ha)		
		100	198	365
Ultra	87.5	397	732	752
	150	578	1008	1118
	220	701	1073	1190
Illyarrie	45	639	814	1080
	80	790	1138	1432
	110	944	1381	1648

Summary

Good yield 1648 kg/ha = 100 per cent
Wrong cultivar 1190 kg/ha = 72 per cent
Wrong super rate 944 kg/ha = 57 per cent
Wrong seed rate 1080 kg/ha = 65 per cent

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4.1 GRAIN LEGUMES FOR WHEATBELT ROTATIONS

Objective

To compare the soil fertility after one year growth of different legume species.

Background

Evidence for the value of a lupin crop in cereal rotation in terms of soil -C and -N and cereal crop yields, has been found. We wish to examine other potential legume crops for comparative evidence.

Experiment 81GE6 - Fabling, Canna

Yellow sandplain, slightly acid pH reaction.

Initial soil analysis: 0.49 per cent organic carbon
0.031 per cent total nitrogen 0.10 cm

Basal fertiliser left to the district office to ensure adequate nutrition except no nitrogen fertiliser on the cereal. All legume seed inoculated. May to October rainfall = 343 mm. Trial sown June 15 after germinating rains. Nungarin clover sown at 50 kg/ha. Illyarrie lupin sown at 80 kg/ha. Derrimut pea sown at 120 kg/ha. Lanquedoc vetch sown at 30 kg/ha. Miling wheat sown at 50 kg/ha. Sprayseed applied before sowing. The lupin plots had Simazine at seeding, the sub. clover, pea and vetch plots had Tribunil post-emergence. The plots became infested with wild radish. A pig invaded the plots and devastated the grain yields so machine harvesting was not possible. The plots were quadrat sampled on October 22 for biomass and seed yields.

Quadrat yields

Cultivar	Total biomass (kg/ha)	Seed yield (kg/ha)
Nungarin clover	677	85
Illyarrie lupin	2148	488
Derrimut pea	1201	727
Lanquedoc vetch	604	214
Miling wheat	585	325

Experiment 81TS3 - W. Stoke, West Arrino

Grey sand over gravel. Blackboy and Banksia vegetation. May to October rainfall = 524 mm.

Soil analysis: 0.25 per cent organic carbon
0.019 per cent of total nitrogen

Basal fertiliser left to discretion of district office to ensure adequate nutrition, but no nitrogen applied to the wheat. All legumes inoculated. Trial sown May 28 after Sprayseed applied. The lupin sown at 80 kg/ha with

Simazine. The sub. clover, pea and vetch plots had Tribunil post-emergence. The sub. clover sown at 50 kg/ha, the Derrimut pea at 120 kg/ha and vetch at 30 kg/ha. Miling wheat sown at 50 kg/ha. The Arrowsmith River was supposed to keep sheep in the paddock off the trial, however the trial was grazed twice during the year. The plots were quadrat sampled on October 23. Lupin was the only treatment machine harvested.

Cultivar	Biomass yield (kg/ha)	Quadrat seed yield (kg/ha)	Harvested seed yield
Nungarin sub. clover	960	172	
Illyarrie lupin	2962	995	287
Derrimut pea	1636	797	
Lanquedoc vetch	1224	517	
Miling wheat	749	111	

Experiment 81ME3 - A.W. and B. Ivey, South Bodallin

Yellow sandplain, wodgil (Acacia) vegetation.

Soil analysis: 0.47 per cent organic carbon
0.028 per cent total nitrogen (0 to 10 cm)

May to October rainfall = 256 mm. Basal fertiliser 153 kg superphosphate/ha; the wheat received 133 kg/ha of Agras No. 1. The trial was sown May 20, two days before the opening rains. New land site, weeds not a problem. Nungarin clover sown at 50 kg/ha, Illyarrie lupin at 85, Derrimut pea at 119, Lanquedoc vetch at 30 and Halberd wheat at 45 kg/ha. The trial suffered poor growth from inadequate P and N deficiency in the wheat. The plots were quadrat sampled on October 28 and harvested November 27. Heavy pod drop with the lupins at the front of the machine and pod shattering with the peas.

Cultivar	Biomass yield (kg/ha)	Quadrat seed yield (kg/ha)	Harvested seed yield (kg/ha)
Nungarin sub. clover	635	74	
Illyarrie lupin	2128	532	243
Derrimut pea	3739	1918	463
Lanquedoc vetch	1047	481	-
Halberd wheat	1564	388	551

Experiment 81MO5 - J. Woods, "Karakin", Lancelin

Yellow, siliceous sand over limestone.

Soil analysis: 0.96 per cent organic carbon
0.042 per cent total nitrogen (0 to 10 cm)
(land cleared and cropped 1980)

May to October rainfall = 613 mm. Basal fertiliser of super Cu, Zn, Mo No. 1 at 395 kg/ha drilled, no N fertiliser for the wheat. Treflan sprayed and incorporated April 24. Trial sown May 5 (dry). Lupin plots had Simazine applied just before seeding. Seaton Park sub. clover sown at 50 kg/ha, Yandee and P23240 lupins at 80, chickpea 53007 at 145 kg/ha, Adeza 64, vetch at 40, Fababean 100074 at 255 and Miling wheat at 45 kg/ha. $MnSO_4$ at 60 kg/ha topdressed on lupin plots June 17. The Adeza 64 vetch had no effective nodulation and failed to grow vigorously. The fababean plants had about 50 per cent effective nodulation. Considerable Serradella plants throughout the site. Wild radish developed throughout the site. Plots quadrat sampled on November 12 and grain harvested November 27. Severe budworm damage to faba and chickpea pods.

Cultivar	Biomass yield (kg/ha)	Quadrat seed yield (kg/ha)	Harvested seed yield (kg/ha)
Seaton Park sub. clover	5076	355	
Yandee lupin	3486	1246	1042
P23240 lupin	3823	1239	942
Chickpea	1427	427	345
Fababean	874	153	0
Vetch	441	10	0
Miling wheat	858	446	455

Experiment 81M014 - Millsteed and Sons, Watheroo

Yellow sandplain, Tammar vegetation.

Soil analysis: 0.49 per cent organic carbon
0.042 per cent total nitrogen (0 to 10 cm)

May to October rainfall = 291 mm. Basal fertiliser 152 kg/ha super No. 1 mixture, no nitrogen applied to the wheat. Site had Sprayseed applied at 2 L/ha at seeding on May 29. The lupin plots had Simazine at 1.5 L/ha on the same day. The sub clover, vetch and pea plots had Tribunil applied at 850 g/ha on July 2.

The Northam sub. clover sown at 54 kg/ha, Illyarrie lupin at 82, Derrimut pea at 131, Lanquedoc vetch at 35 and Miling wheat at 50 kg/ha. A base level of sub. clover was found throughout the site, at a pasture density equivalent to 6 kg seed/ha. The plots quadrat sampled on October 23 and harvested on November 9.

Cultivar	Biomass yield (kg/ha)	Quadrat seed yield (kg/ha)	Harvested seed yield (kg/ha)
Seaton Park clover	2018	121	
Illyarrie lupin	5070	1715	1227
Derrimut pea	2265	863	444
Lanquedoc vetch	1200	480	0
Miling wheat	1114	342	222
Paddock (base) sub. clover	717	43	

4.2 GRAIN LEGUME SPECIES TRIALS

Experiment 81E30 - Paddock E 3B, Esperance Downs Research Station

Caitup sand over gravel at 15 cm depth. May to October rainfall = 308 mm. Basal fertiliser 200 kg/ha manganese super. Treflan at 1 L/ha applied one day before seeding on June 18. All legumes inoculated and lime pelleted. Wind damage lowered seedling establishment. Trial harvested December 2, many of the crops starting to shatter and not all seed recovered.

Cultivar	Seed rate (kg/ha)	Seedling establishment (pl/m ²)	Grain yield (kg/ha)
Egret wheat	55		2063
Illyarrie lupin	80	25	1280
72A15.2 lupin	80	32	1066
Dundale pea	125	29	1229
Dun pea	120	44	1152
Derrimut pea	90	37	1444
WP7 lupin	100	27	816
Langedoc vetch	30	29	1188
Popany vetch	30	31	1034
Adeza 46 vetch	45	25	305
Adeza 64 vetch	45	35	574
Lathyrus sativa (310028)	60	22	273
Lathyrus cicera (300010)	40	18.5	615
Lathyrus ochrus (320004)	60	23	355
Vicia faba 383A	250	10	337
Vicia faba 100020	250	17	346

Experiment 81MA3 - A. Ettridge, Bokerup

Gravelly sandy loam, redgum forest. Third year in crop after clearing. The lupin cultivars Ultra, Hamburg, Kiev mutant, Kiev skorospely, Yandee and Unicrop were sown May 27 and June. The trial was devastated by Rhizoctonia and Fusarium spp. root rots and was not harvested.

Experiment 80NO3 - J.D. and T.J. Bateman, Gwambygine

Red sandy loam with buckshot gravel. Basal fertiliser 200 kg/ha superphosphate. All previous year's plots sown to Miling wheat at 45 kg/ha on June 2. Plots soil sampled at the start of the season for organic carbon and total nitrogen (2 mm fraction). Selected treatments quadrat sampled for biomass and eventual nitrogen uptake calculation.

Plots harvested December 17

1980 crop	1980 grain yield (kg/ha)	1981 wheat biomass (kg/ha)	1981 wheat yield (kg/ha)	Yield as a % 1980 wheat treatment
Gamenya	1589	4634	1514	100
Illyarrie lupin	432		2200	145
Chittick lupin	200	6347	2013	133
Derrimut pea	636	9005	2278	150
Dundale	472		2169	143
Early Dun	407		2130	141
Pennant pea	(a)		1997	132
Lathyrus cicera	NH	5801	1966	130
Lanquedoc vetch	NH	5491	1904	126
Adeza 64 vetch	NH		2075	137
Popany vetch	130		1919	127
Vicia faba 100039	NH	6173	1763	116
Vicia faba 100090	NH	5379	1576	104

(a) = crows devastated pea yields

NH = not harvested because of poor growth or low habit

Experiment 80BR6 - C. Barron, Boyup Brook

Gravelly redgum loam. Basal fertiliser 180 kg/ha superphosphate. Plots soil sampled at start of season for soil C and soil N. All plots sown to West oats at 45 kg/ha. Trial harvested February 3.

1980 crop	1980 N available* (kg/ha)	1981 grain yield (kg/ha)	Yield as % cereal treatment
Clipper barley	44	2678	100
Ultra lupin	94	2889	108
Illyarrie lupin	100	3315	124
Dun pea	97	2863	107
Derrimut pea	124	2622	98
Dundale pea	102	2393	89
White Brunswick	164	2792	104
Lathyrus sativa	108	2633	98
Lathyrus cicera	113	2618	98
Lathyrus ochrus	81	2660	99
Lanquedoc vetch	117	2478	92
Adeza 46 vetch	143	2707	101
Adeza 64 vetch	116	2674	100
Popany	87	2822	105
namoi vetch	117	2415	90
Vicia faba	163	2548	95

* N available (kg/ha) = Total N uptake - N removed as seed
No account taken of N removed during grazing of stubble

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Summary of grain legumes for wheatbelt rotations

In the 1981 experiments, Derrimut field pea yielded well, outyielding the lupin treatment in the drier wheatbelt sites.

In the cereal year following the legume crops, all legumes gave large yield response relative to the cereal in 80N03, while at Boyup Brook, in spite of large calculated available N only the Illyarrie lupin treatment produced a large yield response.

5. ERREGULLA LUPIN ROTATION PLOTS

Objective

To gather information on the ability of the hardseeded Erragulla lupin to regenerate as a grain crop as well as improve cereal crop yields in a lupin-wheat rotation. Four identical experiments were set up in the Moora district; consisting of five lupin plots and five plots left to natural pasture. All plots will be cropped to cereal in 1982, left to regenerate in 1983 and recropped to cereal in 1984.

Experiment no.	Location	Soil type	Erragulla seed rate	Fertiliser	Natural pasture	Seed date
81MO27	R. Wilson "Fini", Lancelin	Yellow sand, some limestone	146	160 super 62 KCl 20 MnSO ₄	Some Brome, sparse sub. clover and serradella	May 1
81MO28	P. Shields "Menardie" Dandaragan	Red ironstone	165	195 super	Clover/ Capeweed with turnip and radish	May 14
81MO29	Waddell and Sons, Moora	Yellow sand	290	100 super	Sub. clover, Capeweed and Bromegrass	May 29
81MO30	R. Spencer, Watheroo	Yellow sandy loam	200	192 super	Sparse weed and sub. clover	May 15

All sites except 81MO29, the lupins sown with Simazine at 1.5 L/ha, the exception had Sprayseed at 1.5 L/ha across entire site. The fertiliser was applied across the entire site.

Erragulla seed germination (laboratory test) was 22 per cent. The lupin plots were not harvested in 1981 but the plants knocked down prior to grazing over summer.

Quadrat sampled grain yields (kg/ha)

Site	Erragulla	Estimated seed no./m ²	Clover seed
81MO27	1400	627	
81MO28	1250	560	
81MO29	1200	537	
81MO30	1256	562.6	105

6. LUPIN/OAT MIXTURES

Objectives

To examine the relative growth and yield of lupin and oat components in various mixtures for grain yield and protein.

Experiment 81AL87 - N. Shearer, Green Range

Grey sand over gravel. The Moore oat and Yandee lupin components sown separately into each plot on June 3. The seedling establishment was sampled, however Hoegrass was mistakenly applied over the trial late July which affected the oat component. Trial discarded.

Experiment 81BU10 - J. Allen, Jindong

Brown sandy loam. Basal fertiliser 192 kg super drilled and 90 kg/ha broadcast.

Site Sprayseeded at 2.5 L/ha two days before sowing on June 17. The Moore oat and Yandee lupins sown separately. The crop growth was quadrat sampled on November 18 and yields harvested in January. The oat component had considerable rust infection.

Seed rate (oat:lupin)	Plant density ratio (oat:lupin)	Oat biomass (kg/ha)	LO	Lupin biomass (kg/ha)	LL	Mixture biomass (kg/ha)	LER
50:0	100:0	5963	1.000				1.000
47.5:14	94:6	5407	0.867	2694	0.282	8101	1.149
45:30	82:18	5134	0.823	3391	0.365	8525	1.188
42.5:45	81:19	4914	0.792	4412	0.477	9326	1.269
39:57.5	73:27	4599	0.740	4986	0.551	9585	1.291
33:90	62:38	3782	0.611	4639	0.495	8421	1.106
29:120	51:49	3340	0.530	6217	0.675	9557	1.205
0:100	0:100			9386	1.000		1.000

The total crop density averaged at 100 per cent oat: 133 plants/m²
 mixtures: 120 plants/m²
 100 per cent lupin: 65 plants/m²

Grain yields

Plant density ratio (oat:lupin)	Oat		Lupin		Mixture	
	kg/ha	LO	kg/ha	LL	kg/ha	LER
100:0	2593	1.000				1.000
94:6	2786	1.081	501	0.182	3287	1.263
82:18	2419	0.946	1192	0.433	3611	1.379
81:19	2292	0.879	1096	0.402	3389	1.281
73:27	2394	0.916	1236	0.459	3630	1.375
62:38	1863	0.717	1332	0.480	3195	1.197
51:49	2093	0.806	1749	0.539	3842	1.345
0:100			2731	1.000		1.000

The land equivalent ratio (LER) indicate that the 81:19 and 73:27 mixtures would outyield a combined pure crops treatment by 27 to 29 per cent in dry matter production and 28 to 37.5 per cent in grain yield. This overyielding is a consequence of stimulated growth of the lupin component in dry matter and in both lupin and oat for grain yield. The highest yielding mixture is 33 per cent higher than the highest yielding mono-crop.

7. OAT/PEA HAY MIXTURES

Objective

To determine the best mixture of oat and pea for hay yield, protein and digestibility.

Experiment 81MP1 - J. McLoughlin, Bullsbrook

Redgum loam. Basal fertiliser 200 kg/ha superphosphate. The site had Sprayseed at 2 L/ha and Dicamba at 1 L/ha applied on June 12. The plots sown on June 18. The Dicamba had considerable phytotoxic effect on the pea seedlings.

The West oat, Dun pea and Popany vetch components were separately sown into plots. The plots were 4.2 m wide to allow use of mower, hay rake and baler equipment. The hay crop was mown on October 27, raked and baled on October 30.

Growth on several of the plots was severely reduced by waterlogging and dock infestation. These were not harvested.

Dry matter yield (kg/ha)

Seed rate Oat:pea	Density ratio Oat:pea	Yield	Yield (% oat)
80:0	100:0	4409	100
70:65	89:11	4934	112
60:110	74:26	5424	123
45:160	58:42	5510	125
0:250	0:100	4799	109
Oat:vetch			
65:20	93:7	5511	125
0:80	0:100	3648	83

8. LEGUME SPECIES GROWTH STUDY - SOUTH PERTH

Objective

To compare the plant growth rates of grain legume species during the winter growing season.

Small plots of each species were sown at South Perth plots on June 1. Five plants per plot were harvested at fortnightly intervals and the vegetative and reproductive components measured. The chickpea and Trigonella had poor nodulation and received nitrogen fertiliser broadcast on August 14 and 21.

Linear regression of the natural logarithm of biological yield per plant (Y) on days after sowing (X), indicate the relative growth rate. The point at which the plant dry weight diverges from the linear equation reflects the specie's maturity.

Growth rate grouping	Legume species	Maturity (days from sowing)
1. $Y = a + 0.7 x$	Conventional field pea	112
	Filby leafless pea	84
	Lathyrus cicera	140
2. $Y = a + 0.06 x$	Lathyrus sativa	140
	Lanquedoc vetch	112
	Vicia ervillia	126
	Lens culinaris	112
3. $Y = a + 0.05 x$	Lathyrus ochrus	126
4. $Y = a + 0.04 x$	Vicia faba	112
	Vicia narbonnensis	112
	Chickpea	140
	Trigonella	154