

Faba Beans

B1 Variety (Drought Tolerant) x Sowing Rate, LRZ Central Mallee (Ouyen), Victoria

B2 Variety (Drought Tolerant) x Sowing Rate, LRZ Southern Mallee (Curyo), Victoria

B3 Variety (HRZ adapted) x Sowing Rate, HRZ South West (Rokewood), Victoria

Aim

To evaluate the performance of 1. a range of faba bean varieties and breeding lines with traits for adaptation to high or low rainfall zones, and 2. investigate the optimum plant density for selected varieties and breeding lines.

Treatments

Varieties:

See Tables 1 and 2 below.

Plant densities:

See Table below. Only two selected varieties, PBA Samira and AF12025 at Curyo and Ouyen and PBA Zahra and Nura at Rokewood. All other varieties were sown at 20 plants/m².

Seed Weight and estimated Sowing Rate (kg/ha) to achieve targeted plant densities of each of the varieties sown in plant density trials at Rupanyup, Curyo and Ouyen, Victoria in 2016.

Variety	Seed Weight (g/100 seed)	Plant Density (pl/m ²)				
		5	10	15	20	30
PBA Rana	80	40	80	120	160	240
PBA Samira	65	33	65	98	130	195
PBA Zahra	60	30	60	90	120	180
AF12025	57	29	57	86	114	171

Other Site Details

	Trial Site		
	Ouyen	Curyo	Rokewood
Sowing Date	6 May	4 May	26 April
Stubble (height cm)	Standing (10)	Standing (15)	Standing (20)
Row Spacing (cm)	36	36	36
Fertiliser (kg/ha)¹	60	60	100

2. MAP (9.2, 20.2, 0, 2.7) + Zn (2.5)

Results and Interpretation

- Key Messages: New faba bean lines will offer opportunities for growers in the Mallee with profitable yields (>140% of PBA Samira) produced in both dry (2015) and wet (2016) seasons. Similarly, in the high rainfall zone, a new breeding line AF11212, appears to be significantly higher yielding most other varieties.

In the high rainfall season a sowing rate targeting 20 pl/m² at Curyo and 30 pl/m² at Rokewood was optimum for faba bean profitability.

1. Variety/Breeding Line low or high rainfall zone adaptation

- Establishment, vigour and plant growth and height: Across all sites establishment was consistent, ranging from 16 to 24 pl/m² (Table 1 and 2). Unfortunately due to issues with equipment resulting in variable establishment and missing rows, the trials at Ouyen could not be analysed.

Growth throughout the season was excellent at all sites, due to good opening rains, particularly at Curyo and Rokewood, and warm conditions following sowing. This vigorous early and rapid canopy development lead to conditions conducive for disease when combined with the high rainfall experienced from July onwards. Disease was adequately managed in the trials with an intensive regular fungicide program. Early vigour was assessed at Rokewood (Table 2) and showed significant differences between varieties. The broad beans, PBA Kareema and Aquadulce tended to have higher vigour along

with PBA Rana, AF12025 and AF13250, while PBA Samira, Nura, PBA Zahra and Fiesta showed lower vigour. Among the commercial varieties, differences were probably due to the larger seed size.

Flowering (at Curyo) again demonstrated the significantly earlier flowering of the new drought tolerant lines, which were up to 18 days earlier flowering than PBA Samira.

Continued rainfall, in the absence of major frost and heat events resulted in very high biomass production and grain yield. At Curyo, waterlogging was present in about 25% of the trial, but appeared to have no impact on grain yields.

- Biomass at maturity, Grain Yield and Harvest Index: Biomass ranged between 12 and 18.7 t/ha at Curyo (Table 1). There was no statistically significant difference between varieties. Based on these biomass levels, at least 200 – 300 kg/ha of nitrogen could have been contributed to the system.

Grain yields ranged between 3.88 and 5.75 t/ha at Curyo, and 3.46 and 6.65 t/ha at Rokewood (Table 1 and 2). It was estimated that the yields at Ouyen ranged between 2-3 t/ha. At Curyo all of the 'AF12-' series lines (with improved drought tolerance had higher grain yields than PBA Samira (4.12 t/ha), except AF12038, with AF12025 (5.75 t/ha) achieving 140 per cent of PBA Samira. This compares favourably with the results in the dry conditions of 2015, where AF12025 was also highest yielding, achieving 158% of PBA Samira. At Rokewood (focussing on HRZ adapted lines), AF11212 out yielded all other varieties and new lines except PBA Rana, Nura and AF09169, and yields 126% of PBA Samira (Table 2). The broad bean varieties, PBA Kareema and Aquadulce, were significantly lower yielding than all over varieties (Table 2). Interestingly the dry area adapted breeding line 'AF12025', had yields equivalent PBA Samira, despite the extremely wet season. A new 'determinant' type of bean 'AF13250' also produced yields similar to PBA Samira, and warrants further investigation as biomass is potentially significantly less than traditional varieties and may offer opportunities in environments where excessive biomass can make faba beans difficult to manage.

Harvest indices recorded at Curyo ranged between 0.27 and 0.39, with no significant difference between varieties.

An estimate of net return ranged from \$1079 in AF12025 to \$631 in AF12038 at Curyo (Table 1). The high yielding new breeding lines had up to 57% higher net return than PBA Samira. Similarly, the faba bean varieties and breeding lines had an estimated net income ranging from \$530 to \$1296 at Rokewood (Table 2).

New faba bean lines will offer opportunities for growers in the Mallee and south west, with profitable yields, significantly higher than commercial varieties, produced in both dry (2015) and wet (2016) seasons. Marketing of grain is likely to be the biggest issue in expanding production as currently there are limited international markets and over production results in low grain prices (eg \$230/t this year compared with >\$450/t in 2015). As one of the best nitrogen fixing pulse crops, beans could also provide opportunities as a brown manure crop, particularly when sown early

- Grain Weight: A significant variation in grain weight was observed among the varieties and breeding lines at Rokewood. The large seeded varieties, PBA Kareema and Aquadulce, had about 35 to 75% higher grain weight than all other varieties and breeding lines followed by PBA Rana which had 11, 15 and 24% higher grain weight than PBA Samira, Zahra, and both Nura and Farah, respectively (Table 2). Similarly, Nura and Farah had smaller grain weight than PBA Zahra and Samira (Table 3). The grain weight of one of the highest yielding lines (AF12025) at Curyo was significantly lower than all other varieties except Fiesta (Table 2).

Table 1. Establishment, flowering date, plant height at flowering, biomass at maturity, grain yield, harvest index and estimated net return of faba beans sown at Curyo in a trial focusing on lines with improved drought resistance in 2016. *Net return based on production costs of \$300/ha and returns on grain of \$240/t.*

Variety	Establishment (plants/m ²)	Flowering Date	Plant Height (cm)	Maturity Biomass (t/ha)	Grain Yield (t/ha)	%Samira	Harvest Index	Net Return (\$/ha)
AF12025	16	Jul 29	59	15.26	5.75	140	0.39	1079
AF10089	23	Aug 10	58	18.68	5.56	135	0.30	1033
AF09169	22	Aug 5	59	15.50	5.49	133	0.36	1019
AF12045	24	Jul 30	59	16.65	5.19	126	0.31	945
AF12028	22	Jul 30	59	15.20	4.70	114	0.31	829
AF09167	19	Aug 14	55	16.55	4.68	114	0.29	822
Farah	22	Aug 15	52	12.08	4.54	110	0.38	790
AF07125	19	Aug 14	54	15.06	4.52	110	0.31	785
PBA Zahra	19	Aug 16	54	16.12	4.42	107	0.27	762
Nura	18	Aug 14	55	13.29	4.42	107	0.34	761
PBA Samira	20	Aug 16	60	15.02	4.12	100	0.29	688
AF12038	24	Aug 1	53	12.03	3.88	94	0.33	631
LSD (<i>P</i> <0.05)	5		ns	ns	0.97		ns	232
CV%	13.5		7.5	17	12		20.6	16.2

Table 2. Establishment, early vigour (1=poor; 9=excellent; July 15), grain weight, grain yield and estimated net return of faba bean varieties and breeding lines at Rokewood in 2016. *Net return based on production costs of \$300/ha and returns on grain of \$240/t.*

Variety	Establishment (plants/m ²)	Vigour (1-9)	Grain Yield (t/ha)	%Samira	Grain weight (g/100 seed)	Net Return (\$/ha)
AF11212	18	5.7	6.65	126	70	1296
PBA Rana	19	7.0	5.85	111	84	1104
AF09169	20	5.0	5.81	110	75	1094
Nura	18	4.7	5.71	108	68	1070
AF12025	22	6.0	5.51	104	64	1022
Farah	22	4.7	5.45	103	68	1008
PBA Zahra	21	5.0	5.43	103	76	1003
PBA Samira	20	4.3	5.28	100	73	967
Fiesta	18	4.3	5.25	99	66	960
AF13250	20	6.7	5.21	99	75	950
PBA Kareema	16	6.0	4.06	77	114	674
Aquadulce	18	7.0	3.46	66	113	530
LSD (<i>P</i> <0.05)	ns	1.1	1.00	240		
CV%	14.9	12.1	11.1	300	2.3	

2. Planting Density x Variety

- Establishment, height and biomass: At Curyo, actual establishment was relatively close to the targeted sowing rate (Table 3). The main point worth noting was that at a sowing rate of 15 pl/m² the actual plant density was 18 pl/m² which was the same as observed at the 20 pl/m² sowing rate (Table 4). At Rokewood, the target plant population was achieved for all the sowing rates except for 30 pl/m², which was slightly less at 26 pl/m² (Table 4).

The height of faba beans at a flowering at Curyo was significantly impacted by sowing rate (there was no differences between varieties. There was an increase in height with each increase in plant density up to 20 pl/m² (Table 4). There was no difference between 20 and 30 pl/m². Despite significant differences in height at flowering, there were no differences in biomass at maturity, indicating that beans are able to compensate for lower densities, particularly in wet and longer cropping seasons.

- Grain Yield and profitability: At both Curyo and Rokewood, grain yield was significantly influenced by plant density, but there was no significant interaction between variety and sowing rate. At both sites, grain yield generally increased as planting density increased up to 20 pl/m² (Table 3 and 4) At Curyo there was a decrease in yield at 30 pl/m², compared Rokewood, where there was a continued slight

increase in yields. Continued increases in yield at higher plant densities tend to be reflective of high rainfall environments and seasons. Previous work has indicated that 15-20 pl/m² tends to be the lowest risk option for maintaining yield, while minimizing cost associated with sowing.

Net returns generally show a similar trend to grain yield, but obviously show a slightly lower relative increase as the sowing rate increases and a Curyo, shows a proportionally larger decrease than seen with grain yield due to the increase seeding costs. In the high rainfall season a sowing rate targeting 20 pl/m² at Curyo and 30 pl/m² at Rokewood was optimum for faba bean profitability.

- Grain Weight: Plant density and variety significantly affected grain weight but the effect of their interaction was insignificant at Rokewood. The 30 and 5 plants/m² densities gave the highest and lowest grain weight, respectively (Table 4). PBA Zahra had a higher highest grain weight (76.9 g) than Nura (69.1 g; Table 4).

Table 3. Establishment, plant height, biomass at maturity, grain yield, harvest index and net return of AF12025 and PBA Samira faba beans sown at 5 seeding rates at Curyo in 2016. Net return based on production costs of \$250/ha + \$0.50/kg of seed sown and returns on grain of \$240/t.

Sowing Rate (pl/m ²)	Establishment (pl/m ²)			Plant Height @ flowering (cm)			Biomass @ maturity (t/ha)		
	AF12025	PBA Samira	Average	AF12025	PBA Samira	Average	AF12025	PBA Samira	Average
5	6	7	7	43	41	42	13.86	12.61	13.24
10	11	10	11	51	49	50	16.93	10.16	13.55
15	17	18	18	57	53	55	12.53	10.66	11.60
20	16	20	18	59	60	59	15.26	15.02	15.14
30	27	30	29	59	59	59	14.42	14.32	14.37
Ave	15	17	16	54	52	53	14.60	12.55	13.58
LSD ($P<0.05$) _{Var}		ns			ns			ns	
LSD ($P<0.05$) _{SR}		4			5			ns	
LSD ($P<0.05$) _{VarxSR}		ns			ns			ns	
CV%		17.9			7.9			29.7	

Sowing Rate (pl/m ²)	Grain Yield (t/ha)			Harvest Index			Net Return (\$/ha)		
	AF12025	PBA Samira	Average	AF12025	PBA Samira	Average	AF12025	PBA Samira	Average
5	3.59	2.69	3.14	0.29	0.25	0.27	592	376	484
10	5.08	3.62	4.35	0.31	0.36	0.34	934	583	759
15	4.89	4.18	4.54	0.40	0.40	0.40	872	701	787
20	5.81	4.12	4.97	0.41	0.29	0.35	1076	671	874
30	4.74	3.46	4.10	0.33	0.25	0.29	787	480	634
Ave	4.82	3.61	4.22	0.35	0.31	0.33	852	562	707
LSD ($P<0.05$) _{Var}		0.42			ns			ns	
LSD ($P<0.05$) _{SR}		0.66			ns			ns	
LSD ($P<0.05$) _{VarxSR}		ns			ns			ns	
CV%		12.8			25.4			29.7	

Table 4. Establishment, grain yield, grain weight and net return of Nura and PBA Zahra faba beans sown at 5 seeding rates at Rokewood in 2016. Net return based on production costs of \$250/ha + \$0.50/kg of seed sown and returns on grain of \$240/t.

Sowing Rate (pl/m ²)	Establishment (pl/m ²)				Grain Yield (t/ha)		
	Nura	PBA Zahra	Ave		Nura	PBA Zahra	Ave
5	4	4	4		3.22	3.51	3.37
10	9	9	9		4.90	4.79	4.85
15	14	16	15		5.30	5.23	5.27
20	18	21	20		5.71	5.43	5.57
30	24	27	26		5.50	6.12	5.81
<i>Ave</i>	14	15	15		4.93	5.02	4.97
LSD ($P<0.05$) _{Var}		1				ns	
LSD ($P<0.05$) _{SR}		2				0.60	
LSD ($P<0.05$) _{VarxSR}		ns				ns	
CV%		10.7				10.6	

Sowing Rate (pl/m ²)	Grain weight (g/100seed)				Net Return (\$/ha)		
	Nura	PBA Zahra	Ave		Nura	PBA Zahra	Ave
5	68.7	72.8	70.8		504	573	538
10	69.1	77.9	73.5		891	864	877
15	68.9	76.4	72.7		970	953	962
20	67.9	76.1	72.0		1052	985	1019
30	70.9	81.1	76.0		970	1118	1044
<i>Ave</i>	69.1	76.9	73.0		877	899	899
LSD ($P<0.05$) _{Var}		2					
LSD ($P<0.05$) _{SR}		3					
LSD ($P<0.05$) _{VarxSR}		ns					
CV%		2.9					