

TRIAL SUMMARIES

Lentils

L1 Sowing Time x Plant Density, LRZ Southern Mallee (Curyo), Victoria

L2 Sowing Time x Plant Density, MRZ Wimmera (Rupanyup), Victoria

L3 Plant Density, LRZ Central Mallee (Ouyen), Victoria

Aim

To investigate the adaptability of a range of lentil varieties and breeding lines to sowing dates and varying plant densities.

Treatments

Varieties: See Figure 1 below.

Plant Densities: Only for four selected varieties (See Table 1).

Table 1. 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)				
		40	80	120	160	200
PBA Flash	3.8	15	30	46	61	76
PBA Ace	3.2	13	26	38	51	64
PBA Jumbo2	3.8	15	30	46	61	76
CIPAL1301	4.0	16	32	48	64	80

Table 2. Other Site Details

	Trial Site		
	Curyo	Rupanyup	Ouyen
Sowing Date	4 May, 2 June	13 May, 15 June	6 May
Stubble (height cm)	Standing (15)	Standing (30)	Standing (10)
Row Spacing (cm)	36	36	30
Fertiliser (kg/ha) ¹	60	80	60

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

Results and Interpretation

- Key Messages: Results have highlighted the yield stability of a number of lentils, but particularly PBA Jumbo2, which similar to previous seasons performed extremely well in 2016, highlighting its yield stability in both dry and wet conditions. It is a variety that reduces disease risks and benefits from sowing early to maximize yield potential. Potential net returns, based on yields in the Curyo trial in 2016 were around \$2500/ha. Other varieties, with lower disease resistance ratings may benefit from delayed sowing where fungicide management of disease can be difficult.
- Disease management is critical to maximize yield and quality, particularly varieties with resistance ratings less than 'R'. Applying the appropriate preventative fungicide early and just prior to canopy closure reduces disease pressure and losses. It is estimated that in the susceptible variety, BGM resulted in a yield loss of 1-1.5 t/ha (\$650 - \$975/ha).
- Similar to 2015, lowering the seeding rate of lentils from 120 pl/m² to 80 pl/m² is viable, particularly with early sowing and the use of varieties like PBA Jumbo2, but significant yield reductions have been observed in drier seasons below 80 pl/m² and with delayed sowing. It is important that lower seeding rates are only utilised in paddocks where minimal weed competition is expected.

A range of higher yielding lentil varieties have been released, with improvements in agronomic traits including biomass production, lodging resistance, disease resistance, herbicide tolerance, maturity and pod retention. In addition, growers are sowing crops earlier to maximise yield potential and reduce risks of heat

and terminal drought stress. Research in 2016, similar to 2015, focused on identifying potential advantages of lower seeding rates for these new varieties and its interaction with sowing date, without incurring yield penalties. Several new breeding lines were also compared at the traditional sowing rate of 120 plants/m².

The combination of high rainfall and large canopy development in lentils led to a moderate to severe outbreak of botrytis grey mould (BGM) at both the Curyo and Rupanyup trial sites. No fungicides were applied to these trials to ensure a clear understanding of the relative resistance of varieties and breeding lines under high disease pressure. No disease was observed at the Ouyen trial site.

Sowing Dates

- Establishment and Plant Growth: Across all sites and sowing dates establishment ranged from 91 to 131 pl/m² (Table 3). PBA Jumbo2 and PBA Ace tended to have slightly lower establishment (approximately 100 pl/m², while CIPAL1301 commonly achieved the target density of 120pl/m². At both Curyo and Rupanyup there appeared to be little overall difference between the sowing dates, although some varieties showed slight positive or negative responses.

Growth throughout the season was excellent at all sites, due to good opening rains, particularly at Curyo and Rupanyup, 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. Continued rainfall, in the absence of major frost and heat events resulted in very high biomass production and grain yield. At Curyo and Ouyen, waterlogging affected small patches in the trials.

At Rupanyup and Ouyen there was moderate and high damage from Brodal[®], with significant differences observed between varieties at Ouyen (Table 4). While the differences were not statistically significant, it was notable that PBA Jumbo, which has been observed in industry to potentially tolerate herbicides better, had lower scores than many other varieties, while PBA Ace was relatively high.

- Botrytis Grey Mould and Ascochyta blight: At Rupanyup and Curyo BGM disease scores were generally higher in the plots sown 'early' compared with those sown late (Table 4). PBA Jumbo2 showed no obvious symptoms of disease at any site or sowing date consistent with its resistance rating of 'R'. PBA Blitz, PBA Greenfield and the breeding line CIPAL1422 also showed little or no disease consistent with their 'MR' rating for BGM. The susceptible variety PBA Bolt (rated 'S' for BGM) and breeding line CIPAL1504 were generally worst affected by BGM.

Ascochyta blight was also noted early in the season (July) at Rupanyup, however due to conditions late in the season BGM became the predominant disease.

- Biomass at maturity, Grain Yield and Harvest Index: Biomass ranged between 8.12 and 12.89 t/ha at Curyo, 5.79 and 8.77 t/ha at Ouyen and 8.75 and 15.16 t/ha at Rupanyup (Table 5). Relative rankings of varieties varied between sites and sowing dates, however there were some notable trends. The varieties and breeding lines more susceptible to BGM generally showed a lower reduction in biomass (eg CIPAL1301 and CIPAL1504) from delayed sowing than the more resistant varieties and breeding lines (eg PBA Jumbo2, PBA Blitz and CIPAL1422).

Grain yields ranged between 1.75 and 4.04 t/ha at Curyo, 1.82 and 3.32 t/ha at Ouyen and 2.47 and 4.19 t/ha at Rupanyup (Table 6). Relative rankings of varieties varied between sowing dates and sites. At Curyo, PBA Jumbo2 was the highest yielding variety sown May 4 (4.04 t/ha) and June 2 (3.40 t/ha), but at Ouyen, its yield was mid-range (2.63 t/ha) and significantly less than the breeding line CIPAL1504 (3.32 t/ha). Conversely, CIPAL1504 was the lowest yielding line at Curyo (1.75 t/ha, May 4 and 2.37 t/ha, June 2) indicative of its susceptibility to BGM. PBA Bolt also performed relatively poorly due to its BGM susceptibility, with yields 50% and 22% less than PBA Jumbo2 at Curyo sown May 4 and June 2, respectively. At Ouyen, it was notable that PBA HurricaneXT was the highest yielding of the released varieties, similar to PBA Ace and PBA Jumbo and PBA Blitz was lowest. This may indicate differential tolerance to soil types as the soil was significantly sandier than at Curyo and no group B chemicals had been used at that site for several years. It has been observed in industry that PBA HurricaneXT appears

to perform better than other varieties over sand hills. Further work is planned to investigate potential adaptation. At Rupanyup, similar trends to Curyo for grain yields were observed.

Harvest indices ranged between 0.16 and 0.44, with later sowing and the central Mallee site generally being higher (Table 7). This is reflective of the relative biomass differences discussed above.

- Grain Weight: Grain weights were generally consistent with seed size ranking of the variety. PBA Jumbo2, PBA Jumbo and PBA Blitz were largest and PBA HurricaneXT smallest (Table 8). Relative rankings of varieties were similar between sowing dates and sites.
- Profitability: Lentils were highly profitable in 2016, even when significant levels of disease were experienced. The data presented does not take into account additional fungicide costs associated with varieties that are more susceptible as no sprays were applied. Profitability ranged from \$900/ha to \$2600/ha, obviously reflecting the trends in grain yield.

Table 3. Establishment (plants/m²) of lentils at the various sites and sowing dates in 2016. Note: Target plant density was 120 plants/m².

Variety	Rupanyup		Curyo		Ouyen
	May 13	June 15	May 4	June 2	May 6
PBA Jumbo2	105	92	100	101	95
CIPAL1602	118	108	111	122	122
PBA Blitz	121	98	113	96	109
PBA Ace	91	97	106	100	97
CIPAL1301	119	117	118	129	121
PBA Jumbo	103	106	109	96	109
PBA HurricaneXT	119	105	122	131	112
CIPAL1422	105	103	116	98	103
PBA Flash	108	106	105	106	94
PBA Greenfield	101	105	103	99	110
CIPAL1521	121	114	110	116	112
CIPAL1502	114	107	118	111	115
CIPAL1522	123	110	115	127	105
CIPAL1504	110	107	120	108	112
PBA Bolt	112	107	103	112	108
PBA Giant	108	93	121	106	120
<i>Average</i>	<i>111</i>	<i>105</i>	<i>112</i>	<i>110</i>	<i>109</i>
LSD (<i>P</i> <0.05)	14	13	12	18	17
CV%	6	3.2	3.3	2.2	9.2

Table 4. Botrytis grey mould disease score (0 – no disease; 100 – dead) for lentils at Rupanyup and Curyo and Herbicide damage (0 – no symptoms; 100 – crop death) from Brodal® in 2016.

Variety	Botrytis Grey Mould				Herbicide Damage
	Rupanyup		Curyo		Ouyen
	May 13	June 15	May 4	June 2	May 6
PBA Jumbo2	0	0	0	0	27
CIPAL1602	27	2	25	10	17
PBA Blitz	17	5	0	8	20
PBA Ace	13	2	46	15	30
CIPAL1301	53	10	38	38	13
PBA Jumbo	33	2	25	15	8
PBA HurricaneXT	43	7	42	18	13
CIPAL1422	3	2	4	3	17
PBA Flash	50	13	46	32	32
PBA Greenfield	5	0	0	2	20
CIPAL1521	40	8	54	28	22
CIPAL1502	63	8	46	28	12
CIPAL1522	37	8	50	23	12
CIPAL1504	73	12	79	52	8
PBA Bolt	63	12	75	35	23
PBA Giant	30	10	29	23	15
<i>Average</i>	<i>34</i>	<i>6</i>	<i>35</i>	<i>21</i>	<i>18</i>
LSD ($P<0.05$)	16	6	18	11	ns
CV%	12.4	5	9.1	8.3	47.9

Table 5. Biomass at maturity (t/ha) of lentils at the various sites and sowing dates in 2016.

Variety	Rupanyup		Curyo		Ouyen
	May 13	June 15	May 4	June 2	May 6
PBA Jumbo2	13.23	9.13	10.59	9.22	6.49
CIPAL1602	13.37	11.51	12.89	9.80	7.18
PBA Blitz	15.08	8.89	11.36	8.43	5.79
PBA Ace	13.49	9.46	11.17	9.72	7.85
CIPAL1301	9.82	10.60	10.23	9.12	7.10
PBA Jumbo	12.85	9.57	9.45	7.74	7.33
PBA HurricaneXT	10.73	8.75	8.92	8.17	6.84
CIPAL1422	13.87	9.17	11.83	8.91	7.20
PBA Flash	10.06	8.98	10.80	10.35	6.62
PBA Greenfield	15.16	8.85	11.95	9.47	7.41
CIPAL1521	12.82	9.17	9.68	9.08	6.29
CIPAL1502	11.70	10.75	9.54	9.32	7.64
CIPAL1522	12.39	9.33	10.76	11.31	8.11
CIPAL1504	10.15	10.41	8.12	8.39	8.77
PBA Bolt	9.97	8.96	8.22	8.27	6.54
PBA Giant	11.02	9.94	10.97	10.34	7.03
<i>Average</i>	<i>12.23</i>	<i>9.59</i>	<i>10.41</i>	<i>9.23</i>	<i>7.14</i>
LSD ($P<0.05$)	3.38	ns	2.48	1.67	ns
CV%	12.1	3.8	10.8	5.8	16.7

Table 6. Grain Yield (t/ha) of lentils at the various sites and sowing dates in 2016.

Variety	Rupanyup		Curyo		Ouyen
	May 13	June 15	May 4	June 2	May 6
PBA Jumbo2	4.19	3.71	4.04	3.40	2.63
CIPAL1602	3.99	3.86	3.16	3.34	2.78
PBA Blitz	3.99	3.31	3.64	2.97	1.82
PBA Ace	3.42	3.27	2.81	3.09	2.97
CIPAL1301	3.43	3.43	2.38	2.86	2.81
PBA Jumbo	3.30	4.01	1.92	2.84	2.83
PBA HurricaneXT	2.78	3.48	2.56	2.71	3.06
CIPAL1422	2.86	3.14	2.85	2.43	3.14
PBA Flash	3.16	3.21	2.92	2.31	2.73
PBA Greenfield	2.29	3.24	2.62	3.33	2.79
CIPAL1521	3.04	3.07	2.61	2.82	2.71
CIPAL1502	2.77	3.60	2.23	2.37	2.98
CIPAL1522	2.33	3.26	2.58	3.12	2.44
CIPAL1504	2.68	3.23	1.75	2.37	3.32
PBA Bolt	2.73	3.24	2.04	2.63	2.48
PBA Giant	2.47	2.85	2.32	2.68	2.54
<i>Average</i>	<i>3.09</i>	<i>3.37</i>	<i>2.65</i>	<i>2.83</i>	<i>2.75</i>
LSD ($P<0.05$)	0.74	0.51	0.77	0.57	0.44
CV%	7.3	10.4	8.3	10.3	9.5

Table 7. Harvest Index of lentils at the various sites and sowing dates in 2016.

Variety	Rupanyup		Curyo		Ouyen
	May 13	June 15	May 4	June 2	May 6
PBA Jumbo2	0.32	0.40	0.28	0.37	0.41
CIPAL1602	0.31	0.34	0.25	0.35	0.38
PBA Blitz	0.27	0.38	0.32	0.35	0.32
PBA Ace	0.25	0.35	0.24	0.32	0.37
CIPAL1301	0.37	0.33	0.24	0.31	0.48
PBA Jumbo	0.26	0.42	0.20	0.37	0.39
PBA HurricaneXT	0.27	0.41	0.29	0.34	0.46
CIPAL1422	0.22	0.35	0.24	0.27	0.44
PBA Flash	0.32	0.36	0.28	0.23	0.40
PBA Greenfield	0.16	0.38	0.22	0.35	0.38
CIPAL1521	0.23	0.34	0.29	0.31	0.44
CIPAL1502	0.25	0.34	0.24	0.26	0.37
CIPAL1522	0.19	0.35	0.25	0.28	0.31
CIPAL1504	0.27	0.31	0.21	0.29	0.37
PBA Bolt	0.27	0.37	0.26	0.32	0.39
PBA Giant	0.23	0.29	0.22	0.26	0.36
<i>Average</i>	<i>0.26</i>	<i>0.36</i>	<i>0.25</i>	<i>0.31</i>	<i>0.39</i>
LSD ($P<0.05$)	0.09	ns	ns	0.07	ns
CV%	9.1	13.2	16.7	8.4	24.7

Table 8. Grain Weight (g/100 seed) of lentils at the various sites and sowing dates in 2016.

Variety	Rupanyup		Curyo		Ouyen
	May 13	June 15	May 4	June 2	May 6
PBA Jumbo2	4.39	4.46	4.27	4.11	4.96
CIPAL1602	3.87	3.78	3.79	3.64	4.05
PBA Blitz	4.72	4.56	5.15	4.72	5.20
PBA Ace	3.97	3.91	4.15	3.76	3.98
CIPAL1301	3.91	3.75	3.93	3.70	3.90
PBA Jumbo	4.54	4.44	4.31	4.11	4.47
PBA HurricaneXT	3.32	3.26	3.18	3.13	3.30
CIPAL1422	3.68	3.73	3.72	3.74	3.92
PBA Flash	4.20	4.20	4.23	4.08	4.20
PBA Greenfield	4.56	4.80	4.37	4.68	4.62
CIPAL1521	3.51	3.39	3.46	3.26	3.72
CIPAL1502	4.18	4.11	4.19	3.95	4.24
CIPAL1522	4.22	4.22	4.37	4.09	4.43
CIPAL1504	4.35	4.16	4.20	4.18	4.10
PBA Bolt	3.93	3.86	3.86	3.74	3.77
PBA Giant	6.25	6.21	6.34	6.20	6.55
<i>Average</i>	<i>4.23</i>	<i>4.18</i>	<i>4.22</i>	<i>4.07</i>	<i>4.34</i>
LSD ($P<0.05$)	0.15	0.16	0.19	0.15	0.15
CV%	1.3	0.5	0.5	0.8	2.1

Table 9. Estimated Gross return (\$/ha) of lentils at the various sites and sowing dates in 2016. *Based on Costs of \$330/ha and grain price of \$700/t.*

Variety	Rupanyup		Curyo		Ouyen
	May 13	June 15	May 4	June 2	May 6
PBA Jumbo2	2604	2267	2499	2049	1511
CIPAL1602	2464	2375	1880	2005	1613
PBA Blitz	2464	1986	2219	1751	946
PBA Ace	2064	1960	1637	1830	1751
CIPAL1301	2070	2070	1332	1671	1638
PBA Jumbo	1982	2479	1012	1655	1652
PBA HurricaneXT	1617	2107	1459	1569	1814
CIPAL1422	1673	1869	1662	1368	1870
PBA Flash	1880	1915	1716	1284	1578
PBA Greenfield	1271	1939	1506	1999	1622
CIPAL1521	1796	1818	1493	1645	1567
CIPAL1502	1606	2191	1230	1331	1759
CIPAL1522	1301	1951	1474	1854	1379
CIPAL1504	1547	1928	892	1331	1994
PBA Bolt	1580	1939	1100	1513	1408
PBA Giant	1397	1664	1290	1543	1445
<i>Average</i>	<i>1832</i>	<i>2029</i>	<i>1525</i>	<i>1650</i>	<i>1597</i>
LSD ($P<0.05$)	518	359	540	398	237
CV%	8.6	12.1	10.1	12.4	12.2

Sowing Dates x Sowing Rates

- In seeding rate trials at Rupanyup, there was a significant interaction between plant density and BGM intensity (Fig 1). When sown May 13 the moderately susceptible breeding line CIPAL1301 showed increasing levels of disease as plant density was increased. This correlated to decreasing yield with increased plant density, from 4.08 t/ha at 40 pl/m² to 2.90 t/ha at 200 pl/m². In comparison, PBA Jumbo2, had a smaller reduction in yield at the highest sowing rates from 4.36 t/ha at 40 pl/m² to 3.96 t/ha at 200 pl/m². When sown June 15 CIPAL1301, still showed increasing levels of disease as plant density was increased, but this did not correlate with grain yields, which were not significantly different across sowing rates. PBA Jumbo2 showed highest yields at the 160 pl/m² treatment.

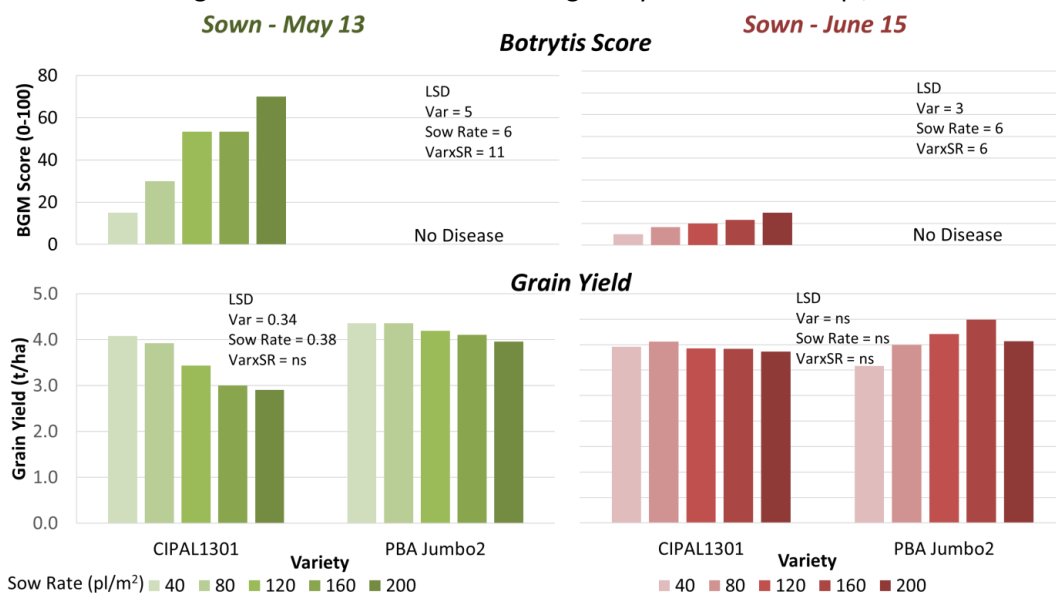


Figure 1. Botrytis grey mould disease score (0 – no disease; 100 – dead) and grain yield of CIPAL1301 and PBA Jumbo2 sown at 5 seeding rates and 2 sowing dates at Rupanyup in 2016.

- The seeding rate trials at Curyo, showed a significant interaction between plant density and BGM intensity (Fig 2). When sown May 4 the moderately susceptible breeding line CIPAL1301 showed increasing levels of disease as plant density was increased. This correlated to decreasing yield with increased plant density, from 2.95 t/ha at 40 pl/m² to 1.95 t/ha at 200 pl/m². In comparison, PBA Jumbo2, had a smaller reduction in yield at the highest sowing rates 4.13 t/ha at 120 pl/m² to 3.54 and 3.65 t/ha at 160 and 200 pl/m², respectively. When sown June 2 sown CIPAL1301, still showed increasing levels of disease as plant density was increased, but this did not correlate with grain yields, which were not significantly different across sowing rates. PBA Jumbo2 showed highest yields at the 120 and 160 pl/m² treatments.

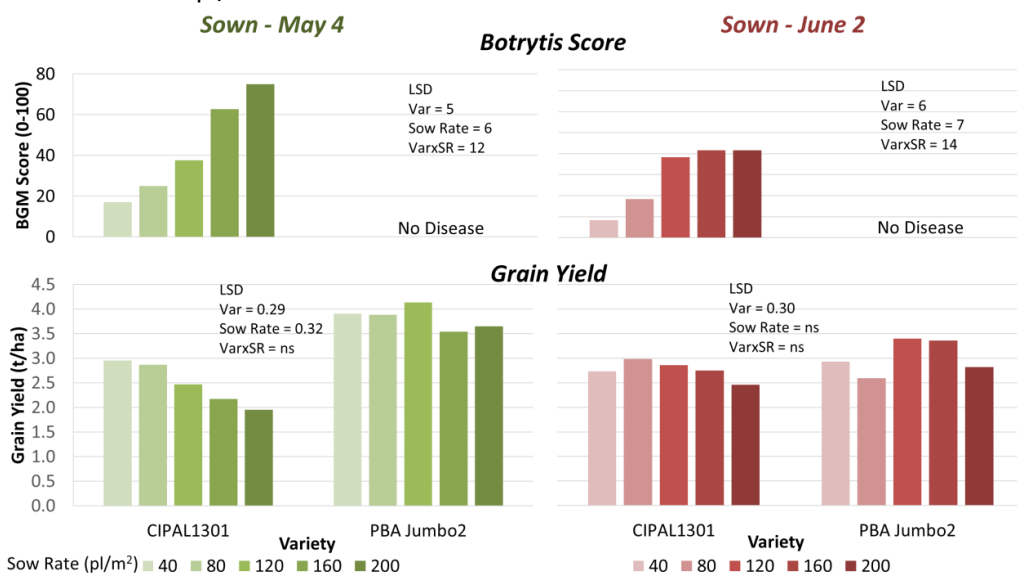


Figure 2. The botrytis grey mould score and grain yield of CIPAL1301 and PBA Jumbo2 sown at 5 seeding rates and 2 sowing dates at Curyo in 2016.