

Defining optimum plant population and row configuration for sunflower in northern NSW

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Abstract

Sunflower (*Helianthus annuus*) production in Northern NSW is highly variable depending on commodity price, seasonal climatic conditions and grower confidence in crop performance. The major production regions are the Liverpool Plains and Moree in North West NSW. Commodity price and climatic conditions are beyond control; however other factors can be influenced. Development of an agronomic package to improve the reliability of crop performance, both yield and oil content is an important way of improving grower confidence. Four experiments were conducted in 2004-5 and 2005-6 focused on determining dryland plant populations, with treatments of 15, 25, 35, 45 and 55,000 plants/ha. No significant difference in yield was determined. Target plant populations of 25-35,000 plants/ha for the Liverpool Plains and 20-25,000 plants/ha for Moree were suggested as optimal at the time. In 2007-8 two experiments at Quirindi, Liverpool Plains and Moree tested row configurations of 75 cm solid, 75 cm single skip, 150 cm super wide, 100 cm solid and 100 cm single skip across three plant populations of 27, 37 and 46,000 plants/ha. At Quirindi, yields from the 75 cm solid, 100 cm solid and 75 cm single skip were comparable. At Moree the slightly wider 100 cm solid, 100 cm single skip and 75 cm single skip were comparable. In 2014-15, one trial was established at Pine Ridge to examine the interactions of population, row configuration and hybrid. Three plant populations; 25, 35 and 45,000 plants/ha; three row configurations of 75 and 100 cm solid plant and 150 cm super wide and three sunflower hybrids were used. No interactions were evident between the three factors, however the highest yields were obtained from the 35 and 45,000 populations and the 75 cm solid plant.

Key words

row spacing, plant density, Liverpool Plains, Moree

Introduction

Sunflower (*Helianthus annuus*) production in northern NSW is highly variable, but on average 30,000 ha is sown each season. The area sown reached a low point in 2002-3 of 8,920 ha followed soon after by a high in 2005-6 of 79,200 ha (Scott 2012). The two major regions of sunflower production in northern NSW are on the Liverpool Plains; stretching south from Gunnedah to Willow Tree; and Moree; typically east of the Newell Highway.

Two of the most important agronomic decisions made by growers and advisors prior to planting their sunflower crops relate to the optimum plant population to be established and the ideal row configuration for their region. In the Moree region there is a stronger focus on reducing the risk of crop failure and improving reliability, while the focus on the Liverpool Plains is on maximising yield. These different approaches are largely a reflection of each regions inherent climatic difference as Moree receives less rainfall and higher temperatures than the Liverpool Plains.

Over the last ten years a range of trials have been conducted, initially in 2004-2006 targeted at identifying the ideal dryland plant population in each region, however in 2007-8 the trials were expanded to include row configuration as another key management decision. In 2014-15 it was decided to begin development of one robust data set to examine the interactions between plant population, row configuration and hybrids.

Current recommendations for sunflower in the Moree region are to target established plant populations of 20-25,000 plants/ha using a 100 cm solid plant or single skip configuration and for the Liverpool Plains to sow on a 75 cm solid plant aiming to establish 25-35,000 plants/ha (Moore 2014).

Methods

2004-5 and 2005-6 seasons

In the 2004-5 season trials were planted at Pine Ridge and Tamarang on the Liverpool Plains. The Pine Ridge trial was sown in the early planting window (September) and the Tamarang trial in the late planting window (Dec- Jan). In the 2005-6 season two early plant trials were conducted, one at Mallawa, west of Moree and the second at Pine Ridge on the Liverpool Plains. All of the trials were sown using the monounsaturated hybrid Ausigold 61.

The trials were planted using a cone seeder on 91cm plant spacing. A series of five target plant populations were included in each trial, 15, 25, 35, 45 and 55,000 plants/ha. The target plant populations were achieved through hand thinning early post emergence. Each trial consisted of five treatments with three replications in a fully factorial design. Plots consisted of four rows of plants, each plot being 18 m in length and 3.6 m in width. All of the plots within each trial were harvested using a K.E.W plot header. Grain yields and oil contents were measured for each plot.

2007-8 season

In the 2007-8 season trials were planted in two locations, Quirindi on the Liverpool Plains and Biniguy, east of Moree. The trials were planted using a Monosem precision planter and were partially factorial. In the trial at Quirindi, three plant populations of 27, 37 and 46,500 plants/ha were targeted on a 75 cm solid configuration. In addition five row configurations of 75 cm solid, 100 cm solid, 75 cm single skip, 100 cm single skip, 150 cm super wide were also included. In the Biniguy trial, four row configurations of 75 cm solid, 100 cm solid, 75 cm single skip and 100 cm single skip were included. Two replicates were included of each treatment. Plots were 100m long and 8 rows wide. The centre two rows of each treatment plot in both trials were harvested using a K.E.W plot header. Grain yields and oil contents were measured for each plot.

2014-15 season

One early sowing data trial was planted in 2014-15 at Pine Ridge on the Liverpool Plains. The trial was sown using a Monosem precision planter. The trial at Pine Ridge was fully factorial designed to investigate interactions between three row configurations of 75 cm solid plant, 100 cm solid plant and a 150 cm super wide, three target plant populations of 25, 35 and 45,000 plants/ha and three hybrids; Hyoleic 41, Ausigold 62 and an experimental line. The plots were 10m long and 4 plant rows wide. There were three replicates of each treatment with the centre two rows of each plot harvested using a K.E.W plot header to measure grain yield. Oil contents were not available at the time of publication.

Results

2004-5 and 2005-6 seasons

In 2004-5 and 2005-6 seasons there was no significant difference in yield for any of the five plant populations included in the four trials. Yield in the Liverpool Plains trials, at both Pine Ridge and Tamarang were on average 2.6 and 2.1 t/ha respectively (Table 1). Both yields are considerably higher than the long term average for the Liverpool Plains of 1.5 t/ha. At the Pine Ridge site, oil contents were highest at the 25,000 plant population. Oil contents were well above the receival standard of 40% for all populations.

Table 1. Effect of plant population on yield and oil content on the Liverpool Plains 2004-5

Plant population (/ha)	Yield (t/ha)		Oil Content %	
	Pine Ridge	Tamarang	Pine Ridge	Tamarang
15,000	2.53	2.18	42.4 ^b	43.59
25,000	2.63	2.24	45.1 ^a	43.85
35,000	2.70	2.14	43.6 ^b	43.50
45,000	2.57	2.09	43.0 ^b	43.40
55,000	2.57	1.84	43.7 ^b	44.31
Lsd	n.s.	n.s.	1.35%	n.s.

In the 2005-6 trials average yields were 1.90 t/ha at Mallawa, west of Moree and 1.65 t/ha at Pine Ridge (Table 2). There was no significant impact of varying plant population or oil contents in either of these trials.

Table 2. Effect of plant population on yield and oil content at Mallowa, Moree West and Pine Ridge, Liverpool Plains in 2005-6

Plant population (/ha)	Yield (t/ha)		Oil Content (%)	
	Mallowa, Moree	Pine Ridge	Mallowa, Moree	Pine Ridge
15,000	1.80	1.82	41.49	37.13
25,000	1.99	1.71	39.08	40.13
35,000	1.92	1.73	41.20	40.60
45,000	1.91	1.44	41.02	40.13
55,000	1.87	1.54	41.93	38.01
Lsd	n.s.d	n.s.d	n.s.d	n.s.d

Source: Belfield, Ferguson and Serafin. Personal communication.

2007-8 season

There was no significant difference in the grain yield or oil content from varying plant population in the 75 cm solid plant treatment at Quirindi where average yields of 2.2 t/ha and oil contents of 40.41% (Table 3).

Table 3. Effect of plant population on yield and oil content at Quirindi 2007/8

Plant population (/ha)	Row Spacing (75 cm)	
	Yield (t/ha)	Oil Content %
27,000	2.25	39.69
37,000	2.24	40.03
46,500	2.04	40.41
Lsd	n.s.	n.s.

Varying row configuration resulted in differences. The highest yields were obtained from the 75 cm solid plant or single skip treatments and the 100 cm solid plant. The super wide (150 cm) and 100 cm single skip treatments yielded significantly less (Table 4). There was no significant difference in the oil contents at the 75cm row spacing. Oil contents were significantly reduced in the 100 cm single skip treatment compared to the 100 cm solid plant.

Table 4. Effect of row spacing on yield and oil content at Quirindi 2007/8

	75 cm Row Spacing		100 cm Row Spacing	
	Yield (t/ha)	Oil Content %	Yield (t/ha)	Oil Content %
Solid Plant	2.39 ^a	41.29	2.19 ^a	39.49 ^a
Single Skip	2.15 ^a	39.79	1.51 ^b	37.78 ^b
Superwide Row (150 cm)	1.99 ^b	39.05	-	-
Lsd	0.26	n.s.d	0.20	1.13

In a lower yielding environment at Moree, there was a significant impact of varying row configuration on yield and oil content (Table 5). The 75 cm solid plant treatment yielded less than the other four configurations. There was no significant difference between the solid or single skip 100 cm configuration or the 75 cm single skip. The 100 cm single skip treatment produced lower oil content but was still above the 40 % receival standard.

Table 5. Effect of row configuration on yield and oil content at Moree 2007/8

Row spacing (cm)	Yield (t/ha)	Oil Content (%)
Solid – 100	1.19 ^a	43.92 ^a
Single skip – 100	1.14 ^a	42.40 ^b
Single skip – 75	1.11 ^a	44.02 ^a
Solid – 75	0.78 ^b	43.73 ^a
Lsd	0.15	1.01

Source: Belfield and Serafin, Personal Communication 2010

2014-15 season

The 2014-15 trial at Pine Ridge produced significant differences for yield with the lowest population; 25,000 plants/ha being lower yielding than the other treatments (Table 6). There was no difference in yield with the

35 and 45,000 plant/ha treatments.

Table 6. Effect of varying plant population on yield at Pine Ridge 2014/15

Plant population (/ha)	Yield (t/ha)
25,000	2.32 _b
35,000	2.88 _a
45,000	2.84 _a
Lsd	0.16

The narrowest row spacing, 75 cm solid plant produced the highest yield, whereas there was no difference in the yield from the 100 cm solid or super wide treatments (Table 7). While the trial included a fully factorial design to evaluate any interactions between hybrid, plant population and row configuration no interactions were significant.

Table 7. Effect of row configuration on yield at Pine Ridge 2014/15

Row configuration (cm)	Yield (t/ha)
Solid – 75	2.99 _a
Solid – 100	2.66 _b
Super wide – 150	2.42 _b
Lsd	0.27

Conclusion

A series of four trials in the 2004-6 seasons showed no response to varying plant population between the range of 15 – 55,000 plants/ha at sites where average yields were above the long term regional average. A response in oil content was only detected at one site, where the plant population of 25,000 plants/ha produced the highest oil content. Anecdotal results at that time, from these two regions, Moree and the Liverpool Plains suggested plant populations of 20-25,000 and 25-35,000 plants/ha respectively for each region.

Results from trials in the 2007-8 season in both regions generated further preliminary recommendations. On the Liverpool Plains it was suggested to sow on a 75 cm solid plant, 75 cm single skip or a 100 cm solid plant to achieve higher yields. Again no significant differences from varying plant populations were identified. In contrast at Moree slightly wider row configurations of 100 cm solid plant, 100 cm single skip or a 75 cm single skip produced the highest yields.

The 2014-15 trial at Pine Ridge produced a significant response to varying plant population. The 35 or 45,000 plants/ha treatments produced the highest yields as did the 75 cm solid plant configuration. The lack of significant response to varying plant population at six of the seven trials most likely demonstrates the compensatory mechanisms of sunflower, that is altering head diameter, head arc length and plant height.

Based on the data presented in this paper, there is no reason to alter current plant population recommendations of 20-25,000 plants/ha for Moree and 25-35,000 plants/ha for the Liverpool Plains. Higher plant populations require additional seed costs for no additional return from grain yield and it is difficult to achieve uniformity with lower populations of around 15,000 plants/ha. Similarly the row configuration recommendations of 75 cm solid plant for the Liverpool Plains and 100 cm solid plant or single skip for Moree remain. Both of these confirm the most common current commercial practice of sunflower growers in these regions. Additional trials are planned for both regions to continue to investigate any interactions between plant population, row configuration and hybrid selection.

References

- Belfield S, Ferguson N and Serafin L. (2010) Personal communication.
- Moore N, Serafin L, and Jenkins L, (2014). Summer Crop Production Guide, NSW Department of Primary Industries.
- Scott JF, (2012). Grains Report 1993-2012, NSW Department of Primary Industries.