Contribution of leaves to the yield of sunflowers – Pine Ridge 2015–16

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Key findings

- Sunflower grain yield averaged 1.07 t/ha at this site with the highest yields obtained from the control and the treatments where only the bottom one third (1/3) of leaves were removed.
- The total leaf removal treatments had the largest effect on yield, at worst yielding only 0.16 t/ha.
- Removing all leaves at budding or at the start of the flowering growth stages had the largest effect on plant structures.
- Total leaf removal at the end of flowering had the largest effect on 1000 grain weight and test weight.

Introduction

Sunflowers are generally considered a minor crop in the NSW northern grains region. However, they play an important role in providing a broadleaf summer crop rotation option. An individual sunflower plant produces on average between 2000–6,000 cm^2 of leaf area, which drives yield and oil content.

Identifying which leaves contribute most towards yield and oil content helps growers make decisions about disease, pest and general crop management in sunflower crops. Whether it is because the crop is infected with a disease such as powdery mildew or has insect damage e.g. loopers, the end result is a need for growers and advisors to know where and when to spend money in crop protection to achieve the best economic return on investment of maintaining green leaf area.

This experiment was one of three sunflower leaf-loss sites conducted in the 2015–16 season, with the other sites being located at Gurley and Willow Tree.

Site details

Location	'Windy Station', Pine Ridge
Co-operator	Peter Winton, Romani Pastoral Company
Soil type and nutrition	The site was soil cored before sowing to determine starting nutrition (Table 1). Starting nitrogen levels were 122 kg N/ha to 1.2 m deep.
Starting soil water and rainfall	The site was soil cored before sowing and found to have 270 mm of plant available water (PAW) to 1.2 m deep. A total of 157.5 mm of in-crop rainfall was recorded at the experiment site (Table 2).
Sowing date	18 September 2015
Fertiliser	42 kg/ha Granulock Z applied at sowing
Hybrid	Ausigold 62
Harvest date	17 February 2016

Table 1. Soil chemical characteristics.

Characteristic	Depth (cm)				
	0–10	10–30	30–60	60–90	90–120
pH (1:5 $CaCl_2$)	7.49	7.85	8.11	8.29	9.07
Nitrate nitrogen (mg/kg)	8.29	6.27	6.45	7.39	12.9
Sulfur (mg/kg)	8.1	9.2	14	26.6	18.36
Phosphorus (Colwell) (mg/kg)	53	14.8	23.9	38.2	48.7
Organic carbon (OC) (%)	2.33	2.03	1.92	1.89	1.8

Table 2. In-crop rainfall at 'Windy Station', Pine Ridge in 2015–16.

Month	September	October	November	December	January	February
Rainfall (mm)	0	0	24	21	100	12

Treatments

The experiment aimed to quantify the contribution of sunflower leaves to yield and oil quality through the application of twelve leaf defoliation treatments.

Defoliation treatments (12)

1. Control – no leaves removed (0/3)
2. Budding (2 cm bud) – remove all leaves (3/3)
3. Budding (2 cm bud) – remove top 10 leaves (1/3)
4. Budding (2 cm bud) – remove top 20 leaves (2/3)
5. Budding (2 cm bud) – remove bottom 10 leaves (1/3)
6. Start of flowering (R5.1) – remove top 10 leaves (1/3)
7. Start of flowering (R5.1) – remove top 20 leaves (2/3)
8. Start of flowering (R5.1) – remove all leaves (3/3)
9. Start of flowering (R5.1) – remove bottom 10 leaves (1/3)
10. Flowering complete (R6.1) – remove top 10 leaves (1/3)
11. Flowering complete (R6.1) – remove top 20 leaves (2/3)
12. Flowering complete (R6.1) – remove all leaves (3/3)

Treatments were applied by cutting off the leaves using secateurs, but leaving the leaf axil intact. Treatments were applied on:

Budding cuts – 26 November

Start of flowering (R5.1) – 9 December

Flowering complete (R6.1) – 21 December

Results

Plant height

Five plants in each plot were measured for physiological maturity – taken from ground level up to the point of attachment at the back of the head. The average plant height in the experiment was 131.7 cm. No defoliation treatment affected plant height.

Head diameter and arc length

Five plants in each plot had had head diameter and arc length measured at physiological maturity. Head diameter was measured across the back of the head and arc length across the front face of the head. The average head diameter was 14.1 cm. There were significant treatment differences based on defoliation (Table 3). The smallest head diameters were recorded from removing all leaves at either budding or the start of flowering at 6.9 cm and 8.8 cm, respectively. There was very little difference statistically between many of the treatments.

The average arc length was 21.2 cm and there were significant differences based on the treatments. Removing all leaves at budding and the start of flowering had the largest impact on arc length reducing it to 9.7 cm and 16.2 cm respectively. The remaining defoliation treatments had no significant impact on arc length compared with the non-defoliated control (Table 3).

Table 3. Impact of defoliation treatments on plant structures.

Treatment	Plant height (cm)	Head diameter (cm)	Head arc length (cm)
Control – no leaves removed (0/3)	130.6	16.3	23.5
Budding – remove all leaves (3/3)	121.7	6.9	9.7
Budding – remove top 10 leaves (1/3)	132.1	17.7	24.1
Budding – remove top 20 leaves (2/3)	133.5	13.1	18.8
Budding – remove bottom 10 leaves (1/3)	136.5	15.7	24.3
Start of flowering – remove top 10 leaves (1/3)	135.1	17.1	24.5
Start of flowering – remove top 20 leaves (2/3)	128.7	15.6	19.0
Start of flowering – remove all leaves (3/3)	128.7	8.8	16.2
Start of flowering – remove bottom 10 leaves (1/3)	136.1	17.1	25.7
Flowering complete – remove top 10 leaves (1/3)	134.3	16.1	24.3
Flowering complete – remove top 20 leaves (2/3)	134.0	15.1	22.1
Flowering complete – remove all leaves (3/3)	129.1	13.1	22.5
l.s.d. ($P = 0.05$)	n.s.	3.88	4.11

Grain yield

The average yield was quite low at the site in 2015–16 compared with that normally expected for sunflower crops on the Liverpool Plains, with an experiment average of 1.05 t/ha. There was, however, a large range in the yields as a result of the treatments. Removing the bottom 1/3 of leaves at budding had the highest yield at 2.07 t/ha, however, there was no significant difference in the top four yielding treatments (Figure 1). The lowest yields were obtained from the total leaf removal treatments at 0.16 t/ha.

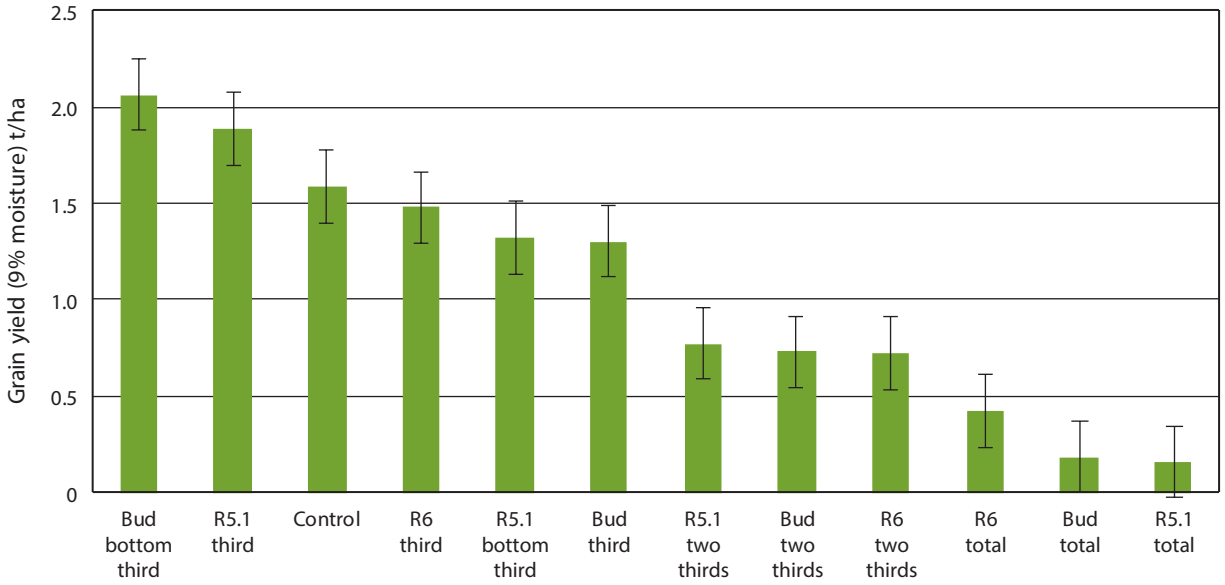

Figure 1. Grain yield of sunflowers 2015–16. R5.1 = start of flowering; R6 = flowering complete.

Grain quality

Sub samples from each plot were collected at harvest and analysed for 1000 grain weight and test weight. Oil contents were not available at the time of publication.

The average 1000 grain weight in the experiment was 47.1 grams. The largest effects on grain weights were obtained in treatments were all leaves were removed, while the smallest impact on grain weight was obtained when only the top 10 leaves were removed (data not shown).

The average hectolitre weight in the experiment was 39.2 kg/hL, which is well above the receival standard of 32 kg/hL. The largest reduction in test weight resulted from removing all leaves at the end of flowering (data not shown).

Conclusions

Grain yields at this site in 2015–16 were, on average, 1.07 t/ha. Removing the bottom 1/3 of leaves had the least impact on grain yield (2.07 t/ha), while removing all leaves had the largest impact (0.16 t/ha).

There were also significant effects on plant structures from the defoliation treatments, namely head diameter and arc length. Removing all leaves at budding or at the start of the flowering growth stages had the largest effect on plant structures. However, removing all leaves at the end of flowering had the largest impact on 1000 grain weight and test weight.

Results from this experiment suggest that the bottom 1/3 of leaves on a sunflower plant is the most expendable.

This experiment is one of a series conducted during the 2015–2017 seasons, comparing the effect of leaf loss on crop yield and quality. These results should be considered carefully until an across-sites and-seasons analysis is completed on the entire data set.

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