Sunflower contribution of leaves to grain yield and quality – Pine Ridge 2014–15

Loretta Serafin, Mark Hellyer and Peter Perfrement

NSW DPI, Tamworth

Key findings

The more area of leaf removed, the greater the yield loss in sunflowers.

The greatest effect on yield was from total leaf defoliation at the start of flowering or the end of flowering, which reduced yield by 1.16 t/ha (78%) and 1.02 t/ha (66%) compared to the control.

Removing the top 10 leaves at the end of flowering had no effect on grain yield or any of the quality parameters measured.

Introduction

Sunflowers are a minor crop in the northern grains region. However, they play an important role in providing a broadleaf summer crop rotation option. Sunflower leaves are the power plant driving yield and oil contents. The sunflower plant produces on average between 2,000–6,000 cm^2 of leaf area.

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

Site details

Location:	**"Windy Station", Pine Ridge**
Co-operator:	**Peter Winton**
Sowing date:	**23 September 2014**
Plant Population:	**Target of 35,000 plants/ha**
Fertiliser:	**50 units N as anhydrous ammonia and 100 kg/ha of Pasture S42**
Harvest date:	**27 February 2015**
Hybrid:	**Ausigold 62**
Planter:	**Monosem precision planter**

Starting soil water

The site was cored pre-sowing to establish starting soil water, which was measured as 125 mm of plant available water (PAW) to 1.2 m deep.

Starting nutrition and nematodes

The site was cored just before sowing to determine starting soil nutrition (Table 1). The available soil nitrate N was estimated at 128 kg N/ha to 1.2 m deep. Soil nematode testing using PreDicta B® found no *Pratylenchus thornei* and 0.7 *Pratylenchus neglectus* per g soil, which represents a low-risk population level.

Table 1. *Starting soil nutrition at "Windy Station", Pine Ridge*

Depth (cm)	Nitrate (mg/kg)	Colwell P (mg/kg)	Colwell K (mg/kg)	Sulfur (mg/kg)	Organic carbon (%)	Conductivity (dS/m)	pH Level ($CaCl_2$)
0–10	14	72	593	5.9	1.46	0.130	6.5
10–30	10	19	305	6.8	1.06	0.209	7.5
30–60	9	19	232	17.3	0.69	0.266	7.7
60–90	7	32	241	13.1	0.69	0.315	8.0
90–120	5	38	254	17.0	0.52	0.372	8.0

Treatments

The trial aimed to quantify the contribution of sunflower leaves to yield and oil quality by applying nine leaf defoliation treatments.

1. Control
2. Budding – total leaf loss
3. Budding – remove top 10 leaves (1/3)

4. Start of flowering – remove top 10 leaves (1/3)

5. Start of flowering – remove top 20 leaves (2/3)

6. Start of flowering – total leaf loss

7. Flowering complete – remove top 10 leaves (1/3)

8. Flowering complete – remove top 20 leaves (2/3)

9. Flowering complete – total leaf loss.

Treatments were applied on the following dates:

- Budding – 24 November, 2014
- Start of flowering – 15 December, 2014
- Start of grain fill – 22 December, 2014

Each treatment was applied by cutting off the leaves using secateurs, but leaving the leaf axil intact.

Results

Plant structures

No treatment affected the sunflower plant height, however, head diameter and head arc length were both affected (Table 2).

The greatest effects on head diameter were from total leaf removal at the start of flowering or at the end of flowering. Removing the top 10 leaves at either budding, the start of flowering or the completion of flowering had no effect on head diameter compared with the control. Neither did removing the top 10 leaves at the completion of flowering.

There were minimal impacts on head arc length from the treatments, with only the total leaf loss at budding or the start of flowering resulting in reduced arc length (Table 2).

Table 2. *Sunflower plant structure impacts from nine leaf defoliation treatments*

Treatment		Head diameter (cm)	Head arc length (cm)
1.	Control	16.13 ab	20.00 a
2.	Budding – total leaf loss	11.65 cd	15.33 b
3.	Budding – remove top 10 leaves (1/3)	14.33 abc	22.02 a
4.	Start of flowering – remove top 10 leaves (1/3)	17.27 a	22.07 a
5.	Start of flowering – remove top 20 leaves (2/3)	13.40 bc	20.17 a
6.	Start of flowering – total leaf loss	9.80 d	17.13 b
7.	Flowering complete – remove top 10 leaves (1/3)	16.47 a	22.07 a
8.	Flowering complete – remove top 20 leaves (2/3)	15.07 ab	21.40 a
9.	Flowering complete – total leaf loss	11.87 cd	20.80 a
Values followed by the same letter are not significantly different (P = 0.05)			

Grain yield and quality

The average grain yield across the trial was 0.97 t/ha. Total leaf defoliation at the start of flowering or the end of flowering had the greatest effect on yield, which was reduced by 1.16 t/ha (78%) and 1.02 t/ha (66%) compared with the control (Table 3). Removing the top 10 leaves at the end of flowering did not affect grain yield or any of the quality parameters.

Total leaf removal at the start or end of flowering also had the greatest effect on test weight and oil content (Table 3).

Table 3. *Impact of leaf defoliation treatments on grain yield (at 9% moisture) and quality*

Treatment		Grain yield (t/ha)	1000 grain weight (g)	Test weight (kg/hL)	Oil content (%)
1.	Control	1.54 a	54.79 a	44.61 ab	41.6 ab
2.	Budding – Total leaf loss	0.74 c	38.83 e	44.75 a	42.37 a
3.	Budding – remove top 10 leaves (1/3)	1.18 b	53.83 ab	43.07 c	41.47 ab
4.	Start of flowering – remove top 10 leaves (1/3)	1.24 b	51.08 abc	43.83 abc	41.1 ab
5.	Start of flowering – remove top 20 leaves (2/3)	0.81 c	47.51 cd	43.31 bc	39.4 c
6.	Start of flowering – Total leaf loss	0.35 d	44.77 d	38.44 e	37.4 d
7.	Flowering complete – remove top 10 leaves (1/3)	1.38 ab	50.01 abcd	43.23 bc	41.33 ab
8.	Flowering complete – remove top 20 leaves (2/3)	0.92 c	48.71 bcd	40.99 d	40.7 bc
9.	Flowering complete – Total leaf loss	0.52 d	37.52 e	34.49 f	36.67 d
Values followed by the same letter are not significantly different (P = 0.05)					

Summary

Total leaf loss at the start or end of flowering had major impacts on yield and grain quality parameters compared with the control. Not only were grain yields reduced by 66–78%, there was also a significant effect on oil content, which was sufficient to cause major reductions in grain price as the oil content fell below the receival standard of 40% for oilseed sunflower.

In contrast, removing the top 10 leaves at the end of flowering did not affect grain yield or any of the quality parameters. This could have potential implications around the need for disease and insect control around this growth stage.

Repeating this trial at other locations and in other seasons will help to validate this preliminary data set.

Acknowledgements

This research was co-funded by NSW DPI and GRDC under project DAN00197: Tactical agronomy for minor oilseeds – sunflower, safflower and linseed. Thanks to Peter Winton "Windy Station" and Peter McKenzie for assistance with the site. Thanks to Nuseed and Neil Weier for supplying trial seed. The technical assistance of the following NSW DPI staff are gratefully acknowledged: Delphi Ramsden, Michael Dal Santo, and former staff: Nicole Carrigan and Angus Hombsch.