Contribution of leaves to the yield of sunflowers – Gurley 2015–16

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Key findings

- Sunflower yields were very low at this site in 2015–16, averaging 0.24 t/ha, and overall variability was very high.
- The total removal of leaves at the budding stage had the largest impact on plant structures; plant height, head diameter and arc length.

Introduction

Sunflowers are generally considered a minor crop in the 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.

Site details

Location	'Kyntyre', Gurley
Co-operator	Doug Clark
Soil nutrition	The site was soil cored before sowing to determine starting nutrition (Table 1). Starting nitrogen levels were found to be 112 kg N/ha to 1.2 m deep.
Starting soil water and rainfall	The site was soil cored before sowing and found to have 103 mm of plant available water (PAW) to 1.2 m deep. A total of 284.5 mm of in-crop rainfall was recorded at the experiment site (Table 2). This was largely received as one large fall of over 50 mm in mid-November and another large fall of 68.5 mm in early January. The intensity of these summer storm events meant they were not as effective as they could have been if these volumes had been received over a more prolonged period.
Sowing date	9 September 2015
Fertiliser	42 kg/ha Granulock Z applied at sowing
Hybrid	Ausigold 62
Harvest date	23 February 2016

Table 1. Soil chemical characteristics.

Characteristic	Depth (cm)				
	0–10	10–30	30–60	60–90	90–120
pH (1:5 $CaCl_2$)	6.1	7.0	7.8	7.9	8
Nitrate nitrogen (mg/kg)	6	8	11	11	2
Sulfur (mg/kg)	2.7	3.1	18.8	131.7	195.7
Phosphorus (Colwell) (mg/kg)	16	4	2	<2	3
Organic carbon (OC) (%)	0.49	0.43	0.34	0.28	0.12

Table 2. In-crop rainfall at 'Kyntyre', Gurley in 2015–16.

Month	September	October	November	December	January	February
Rainfall (mm)	0	17	94	2	69	104

Treatments

The experiment aimed to quantify the contribution of different sunflower leaves to yield and oil quality through applying 12 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 – 3 and 4 November

Start of flowering (R 5.1) – 25 November

Flowering Complete (R6.1) – 7 and 8 December

Results

Plant height

Five plants in each plot were measured for height before harvest – from ground level up to the point of attachment at the back of the head. The average plant height in the experiment was 118.7 cm. The removal of all leaves at the budding stage resulted in plants with around half the height of those without leaves removed (Table 3). No other treatment affected plant height.

Head diameter and arc length

Five plants in each plot had head diameter and arc length measured before harvest. 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 9.1 cm, which illustrates the likely low grain yields from such a small-sized head.

There were significant treatment differences based on defoliation (Table 3). The control, budding top 1/3, budding bottom 1/3 and start of flowering top 2/3 treatments had the largest head diameters. The total loss of leaves at the budding stage resulted in the smallest head diameter at 1.5 cm.

The average arc length was 12.1 cm and there were significant differences between defoliation treatments. Removing all leaves at budding had the largest impact on arc length, reducing it to 2.5 cm. The remaining defoliation treatments did not significantly affect arc length compared with the non-defoliated control (Table 3).

Table 3. Affect from defoliation treatments on sunflower plant structures.

Treatment	Plant height (cm)	Head diameter (cm)	Head arc length (cm)
Control – no leaves removed (0/3)	129.5	12.1	13.0
Budding – remove all leaves (3/3)	66.4	1.5	2.5
Budding – remove top 10 leaves (1/3)	123.6	11.3	13.6
Budding – remove top 20 leaves (2/3)	113.9	7.9	10.5
Budding – remove bottom 10 leaves (1/3)	126.9	10.2	11.7
Start of flowering – remove top 10 leaves (1/3)	122.5	9.1	12.0
Start of flowering – remove top 20 leaves (2/3)	126.1	10.5	13.5
Start of flowering – remove all leaves (3/3)	121.4	7.5	16.1
Start of flowering – remove bottom 10 leaves (1/3)	121.0	9.7	12.5
Flowering complete – remove top 10 leaves (1/3)	126.7	9.9	13.2
Flowering complete – remove top 20 leaves (2/3)	121.9	10.0	13.2
Flowering complete – remove all leaves (3/3)	123.8	9.3	13.9
l.s.d. ($P = 0.05$)	23.49	2.04	3.50

Grain yield

Yield was very low at this site in 2015–16, on average 0.24 t/ha. The coefficient of variation for grain yield was very high and, as such, no other grain yield data can be reported as the level of variability was too high.

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 32.0 grams. The largest impact on grain weight was obtained by removing all leaves at budding or at the start of flowering, and removing the top 20 leaves at budding, which all had the lowest 1000 grain weights (data not shown).

The average hectolitre weight in the experiment was 42.9 kg/hL, which is well above the receival standard of 32 kg/hL. The largest differences were between removing all leaves at budding, which had the high test weight of 46.4 kg/hL and removing the bottom 10 leaves at budding, which had the lowest test weight at 39.3 kg/hL (data not shown).

Conclusions

Grain yields at this site in 2015–16 were very low as a result of dry growing conditions, averaging only 0.24 t/ha and being quite variable across the site. Hence no yield data for individual defoliation treatments have been reported. Defoliation treatments had a significant effect on plant structures, namely plant height, head diameter and arc length. Totally removing leaves at the budding stage had the largest effect on plant structures.

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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