Reassessing canola yield loss to aphids

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Key messages

- Heavy infestation of aphids caused significant yield loss to canola in a high rainfall environment
- The length of cabbage aphids on spikelets at flowering was directly proportional to yield loss
- The function yield (kg/ha) = -141x + 1114 where x= spike length colonised in cm explained yield loss R^2 0.9
- Aphid colonisation also reduced seed quality: oil content and seed size

Aims

1) To determine the extent of yield loss caused by high levels of aphid infestation on canola in the Northern Agricultural Region
2) To re-investigate management guidelines

Background

Concerns are increasing that the yield loss of canola to aphids is being underestimated. There are two main mechanisms which cause yield loss;

1) Feeding damage, by species such as Cabbage Aphid (CA) which colonise flowering and podding spikelets. Previous trials reported canola to be tolerant of aphid damage with little yield loss unless plants were water stressed (Berlandier and Cartwright 1998; Berlandier and Valentine 2001). In 2003 a threshold for aphid control of 20% or more of flowering spikes infested with aphids was reported (Berlandier and Valentine 2003). More recent work concluded that aphids can cause yield loss to unstressed canola, however they need to be present on spikelets from flowering. From these trials it was recommended to control aphids when 20 to 50% of flower spikes were infested to prevent yield loss (Micic 2015).

2) Infection with virus, of particular concern is Green Peach Aphid (GPA) transmitting Beet Western Yellows Virus (BWYV). In 2014 this virus caused widespread damage to South Australian crops and anecdotal evidence indicates an increase in the occurrence of this virus in WA. Jones et al. 2007 reported yield loss due to BWYV and aphid feeding damage of up to 50%. Greatest yield loss occurred when infection occurred early in plant growth (before flowering) and 100% of plants were infected. The evolution of GPA populations resistant to commonly used insecticides is a concern as poor aphid control will lead to increased BWYV transmission.

Method

A trial was conducted at DAFWA's Woorree research station in Geraldton which included 4 treatments based on different insecticide strategies to control aphids as described below:

Treatment 1 = Nil (no insecticide)

Treatment 2 = 1 spray: Sulfoxaflor (Tansform®) applied at 6 leaf stage = control of aphids to stop early virus infection

Treatment 3 = 2 spray: Sulfoxaflor (Transform®) at 6 leaf stage and big bud stage = control of aphids until podding

Treatment 4 = 3 spray: control: Insecticide applied at 6 leaf stage, big bud stage and, flowering = no aphids

The design was randomised in two banks with 4 replicates (16 plots). Plots were 20m long by 7.2 m wide. The middle 3.2 m of each plot was harvested such that the outside of each plot acted as a buffer.

Several measurements were taken:

Aphid yellow sticky traps were placed at each corner of the trial and monitored weekly to detect flights. GPA, CA and Winged aphid numbers were recorded from 20 plant leaves per plot weekly from June 11 to July 16. The length of CA colonisation of the inflorescence was recorded on July 16 and 30. Leaves were sent to DAFWA plant pathology for virus testing in early July. Whole plot ratings were taken on August 6 and 13. Establishment, total biomass production, single pant weight, seed yield and seed quality characteristics were also recorded.

Table 1. Operation dates

Operation	Date	Details
Seeding	27/4/15	Hyola 404RR
Fertiliser	27/4/2015	100 kg/ha Agstar extra deep banded and Urea 50 kg/ha
Insecticide	8/6/2015	Transform® insecticide treatments 2, 3 and 4
Fertiliser	11/6/2015	NS41 @ 70 kg/ha
Insecticide	14/7/2015	Transform® insecticide treatments 3 and 4
Insecticide	5/8/2015	Insecticide treatment 4
Insecticide	11/9/2015	Affirm® insecticide, Diamond backed moth control
Harvest	9/10/2015	

Results

Aphid numbers

Aphids were found on yellow sticky traps from May 28. Numbers increased rapidly from early June to the third week in July and then declined rapidly, Figure 1.

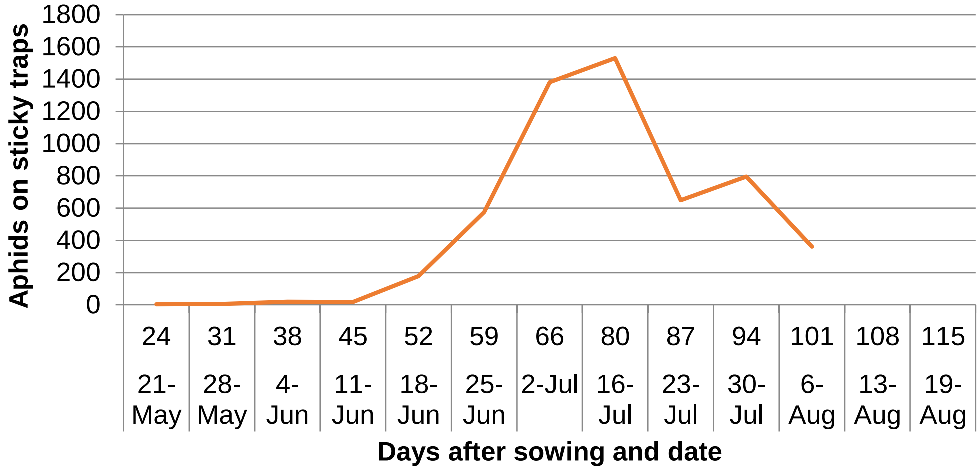

Figure 1. Number of aphids found on 4 gel traps, 1 located at each corner of the trial site

Counts of aphids on 20 plant leaves showed that the early insecticide application, 42 days after sowing was effective in reducing aphid numbers in treatments 2, 3 and 4. Aphid numbers increased in the unsprayed treatment in the same manner as recorded in the aphid traps with a sharp decrease in the population in mid-July. Aphid numbers increased in all treatments until the application of insecticide to treatments 3 and 4 at 72 DAS, Figure 2.

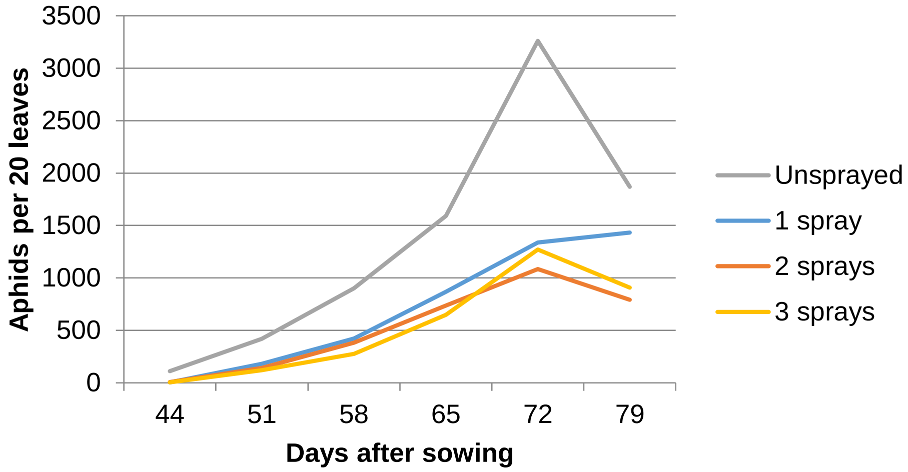

Figure 2. The number of aphids observed on 20 leaves. Note insecticide applied to all plots except Nil on 8th June (41 DAS) and to the 2 spray and control treatments on 14th July (72 DAS).

The species composition of the aphid population was approximately half Green Peach and half Cabbage Aphid as of July 16 when leaf counts stopped. From mid-July the length of the inflorescence that was colonised by aphids was measured, and these were found to be predominantly Cabbage Aphids. Applied treatments gave expected responses and it should be noted that aphid pressure at the site was very high; of 576 observations of spikelets taken at random only 3 spikelets were free of aphids. Hence this was well above the 20% and 50% spray thresholds previously reported and despite 3 insecticide applications CA did colonise the control treatment, although significantly less than the other treatments (P<0.001), Table 2.

Table 2. Length of stem infested with aphids (cm)

	Date	16-Jul	23-Jul	30-Jul
Treatments	DAS	79	86	93
Unsprayed		3.2	4.7	5.5
1 spray: 6 leaf		2.6	3.8	4.6
2 spray: 6 leaf big bud stage		1.7	2.4	3.1
3 spray: Control (nil aphids)		2.1	1.9	1.8
Lsd		1.1	0.8	1.2
		NS	P<0.001	P<0.001

Plant growth

Biomass cuts confirmed our visual observations of significant differences in plant growth between treatments (P<0.001). Both total biomass and single plant weight were inversely proportional to aphid numbers observed, Figure 3.

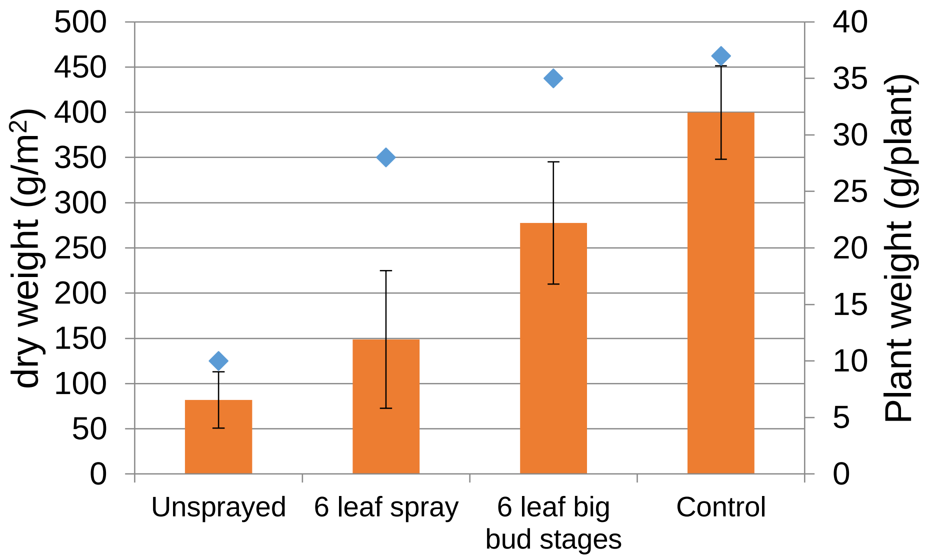

Figure 3. Total biomass production, (bars) and single plant weight, (points), August 13

Virus

Elisa testing of plant leaves in early July indicated that all treatments had BWYV ranging from 7.5% to 12% of plants infected. There was no statistical difference in percentage of plants affected between treatments.

Yield and Quality

Yield was reduced when aphids were not controlled, with the unsprayed treatment yielding 39% of the control treatment. The trend was for greater yield with each additional application of insecticide although these differences were not significantly different in some cases, Table 5. The function yield (kg/ha) = -141x + 1114 where x= spike length colonised in cm explained yield loss R^2 0.9, Figure 4.

The yield results for some of the untreated plots were surprisingly high. Many plants in these plots looked almost dead in early August but a reduction in aphid landings after this time and a mild finish to the season meant that plants in this treatment re-shot and produced yield from very late flowers. Oil% was significantly reduced with increasing aphid pressure, Table 5. As with yield a linear relationship fitted the data y (Oil%) = -1.3669x + 46.0 where x is the average length of spikelet colonised in cm, Figure 4. Seed weight was significantly reduced with increased aphid pressure, Table 4. Again a linear relationship was a good fit, y (1000 seed weight in grams) = -0.2866x + 4.1455 R^2 0.9.

Table 4. Seed yield (kg/ha), oil concentration in seed (%) and 1000 seed weight (g)

	Yield (kg/ha)	Oil%	1000 seed wt. (g)
Unsprayed	347	38.8	2.5
6 leaf spray	464	39.3	2.9
6 leaf big bud stages	643	41.8	3.3
Control (nil aphids)	888	43.7	3.6
Lsd	294	2.2	0.5
F Prob	P<0.05	P<0.05	P<0.05

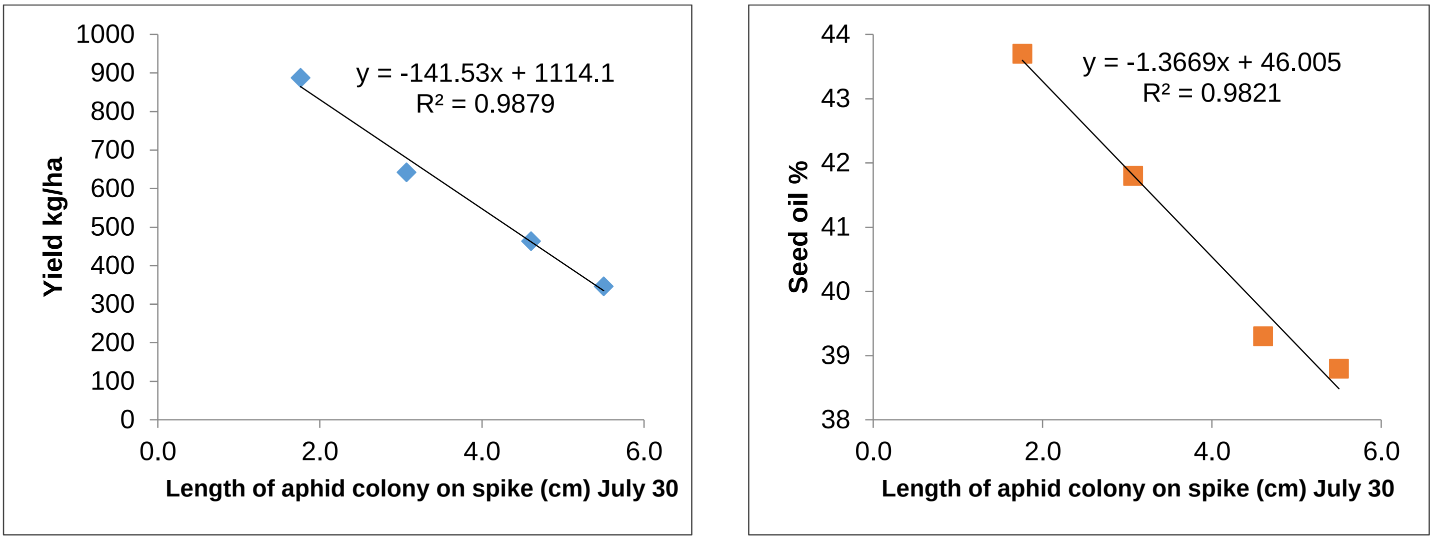

Figure 4. Relationship between average length of cabbage aphid colony on spikelet to yield loss and oil content.

Conclusion

It is likely that the main cause of damage was from feeding by CA. The functions fitted for yield, oil, and seed weight decline by average length of spikelet colonised will be used to refine management recommendations and provide a more accurate method of assessing the requirement for management of aphid feeding damage. The current threshold for cabbage aphids to cause damage to a canola plant is for 2 cm or more of cabbage aphids on flowering spikes, with 20-50% of flowering spikes with aphids. In this trial nearly 100% of plants had cabbage aphids and green peach aphids.

These results reinforce the need to plan ahead for aphid control. Cultural practices such as maintaining good stubble cover and establishing a thick canopy quickly to minimise bare ground and early aphid landings along with delayed sowing should be considered. Using cultural methods in conjunction with insecticides will extend the useful life of the newly registered insecticide Transform®. Also it should be noted that Transform® is registered to be used no more than twice per season to reduce the risk of resistance.

Key words: Aphid, canola, Green Peach aphid, Cabbage aphid

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