COGGO Council of Grain Grower Organisations Limited ACN 091 122 039	**Final Report** **COGGO Research Fund for 2015 projects** **A project completion report covering the project. The acceptance of a satisfactory report against the objectives of the project, and agreement on the sharing of any commercial returns and/or IP will trigger payment within 4 weeks, by COGGO for any outstanding payments.**

This Final Report should be completed with reference to the Research and Intellectual Property Agreement (the Research Agreement) signed between the proponent and COGGO Pty Ltd.

1. Project information

Project title	**To find out if aphids can cause yield loss in canola under good growing conditions and whether aphid thresholds are applicable**
Commencement Date	January 2014
Completion Date	January 2016

Name of Proponent	Department of Agriculture and Food, WA
ACN/Legal Name or ABN	86 611 226 341 (WAAA)
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COGGO Use Only

Project Number	
Date Received	

2. Project results	This section provides a final report against the Project Aim and the Planned Outputs for the Project.

Achievement of the Project Aim	Brief statement of achievement in relation to the aim of the project

Project aim: To determine thresholds for spraying for aphid feeding damage on canola and include the impact that beneficial organisms are having on suppressing aphid numbers.

One glasshouse trial has been completed to test existing aphid thresholds on unstressed canola. This led to a field trial, funded by GRDC project DAW0027, Tactical Break Agronomy, to test the findings from the glasshouse trial.

One glasshouse trial was completed to determine if prophylactic sprays affect colonisation of canola by cabbage aphids and one glasshouse trial was completed to determine if predators can suppress the development of cabbage aphid colonies on the flowering spikes of canola.

Results from the field and glasshouse trials found that cabbage aphids caused yield loss to canola if aphids colonised the flowering spike. This caused flower drop and a decrease in the number of pods the plant formed. Assessment of the oil content was also found to have been significantly decreased. It was also found that the longer the aphid colony length was, the more yield loss occurred. From these trials a 'rule of thumb' was produced: for every 1 cm of aphid colony there was a 10% yield loss on that plant.

The presence of parasitic wasps did not cause a decrease in the length of the aphid colony. Wasps did however, decrease the rate of colonization of aphids onto new plants.

The application of prophylactic synthetic pyrethroids sprays at the big bud stage did not stop cabbage aphids from colonising canola at the same rate as plants sprayed with water.

Project Outputs		Please provide a report on the achievement, or otherwise, of the project outputs as per the planned outputs provided in the Project Proposal.
1	-	Output 1 (from Project proposal) Present findings at 3 farmer field days
		Comment: 9th September 2015: Landmark spring field day , Broome Hill, attendees 45 10th September 2015: Spring field day, Balidu, attendees 160 17th September 2015: Southern Dirt field day, Jindallup, attendees 50 1st March 2016: Agribusiness Crop Updates, attendees 40
2	-	Output 2 (from Project proposal) Write 1 media release and 1 publication aimed at agribusiness
		Comment: 1 media release on entire project and findings submitted for release 23rd June 2016 2 Crop Updates papers written, please see attachments 1 and 2 1 webinar completed see https://www.youtube.com/watch?v=RFoJaBFxTg8
3	-	Output 3 (from Project proposal) Write 1 final report on results to COGGO

		Comment: Final report was delayed so that the dissemination of results could be completed and for advice to growers regarding aphids to be timely.

Project results	Please provide brief statements on the results of the Project

This section should cover aspects identified in *Section 7.3* of the Research Agreement

- the results of the Project, including discoveries made and other achievements (including any Project IP and Project Confidential Information);
- the potential application of the outputs of the Project to the Western Australian grains industry and broader community;
- the actual or potential economic benefits flowing to the Western Australian grains industry and broader community from the Project;
- the difficulties encountered;
- the conclusions reached;
- the Researcher's recommendations for any further research;
- a list of scientific papers or publications resulting from the Project; and
- attach copies of any photos, diagrams or other artworks (including, if requested by COGGO, negatives, bromides or the like) which the Researcher has and which may be of assistance to COGGO in the dissemination of information concerning the Project to COGGO's stakeholders.

RESULTS

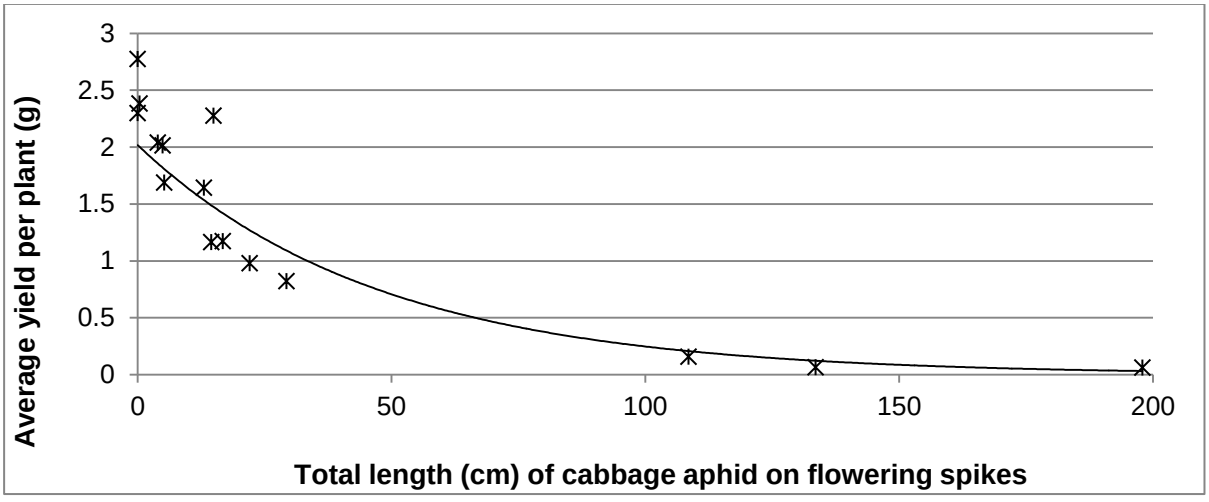
Potential yield loss from cabbage aphid feeding damage to canola

Results from the field and glasshouse trials found that cabbage aphid caused yield losses in canola if aphids colonised the flowering spike. Aphid colonies caused flower drop and a decrease in the number of pods the plant formed.

It was also found that the longer the aphid colony length was, the more yield loss occurred. From this trial, for every 1 cm of aphid colony there was a 2% yield loss on that plant for colonies up to 30 cm long.

The glasshouse trials also showed that canola yield can be variable (see Figure 1) however, plants with colony lengths of 3.5 cm or more had less yield than plants without aphids. This suggests that the threshold developed by Department of Agriculture entomologists during the 1990's of spraying canola when aphids colonies were 2.5 cm is accurate (refer to Attachment 1).

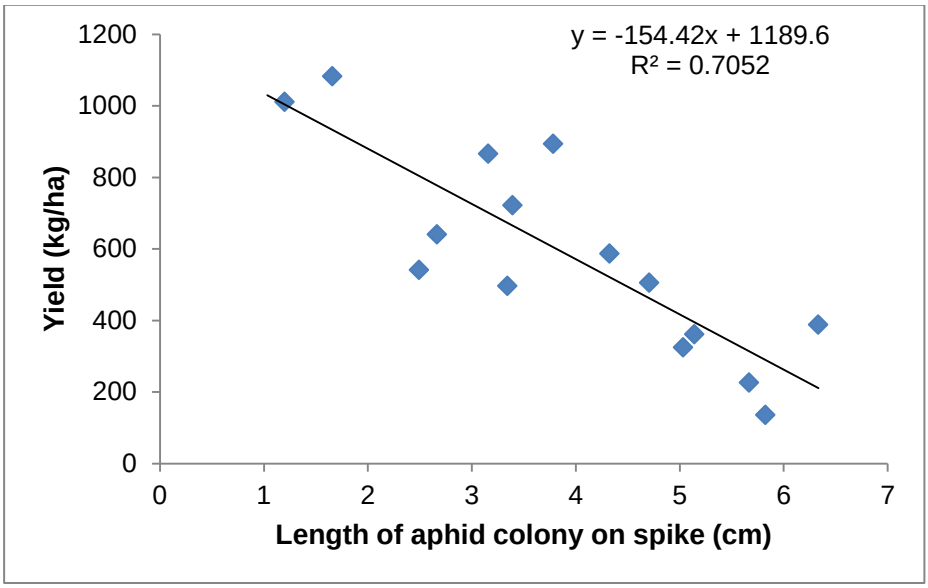
Figure 1: Length of aphid colonies plotted against average yield of a plant



Even though the field trial was not funded by this COGGO project, it was initiated based on the findings from this project. The field trial was conducted in Geraldton and had 98% of all flowering spikes infested with differing colony lengths of cabbage aphid. This trial found that cabbage aphid feeding did cause a decrease in oil content of canola. It also showed that the longer the colony length was, the greater the yield loss, and on average for every 1 cm of colony length there was a 10% yield loss (Figure 2). In the field the aphids appeared to have a greater effect than in the glasshouse. This may be due to increases in colony lengths after the plants were scored or better conditions in the glass house.

From these trials a general; 'rule of thumb' could be: for every 1 cm of aphid colony there was somewhere between a 2 and 10% yield loss.

Figure 2: Average length of colony in a single plot graphed against yield



This field trial was a small scale trial, with plots of only 7.2 m width and 20 m length, hence aphids were able to colonise all plots (Attachment 2).

In paddocks cabbage aphids colonise crop edges first. . Consequently, a border spray will prevent cabbage aphids from moving further into crops. However, those plants with cabbage aphids will have a yield loss of 2-10% for every centimeter of colony length. The proposed threshold is still 1 in 5 flowering canola plants (20%) of the crop infested with cabbage aphids, for an entire paddock to be sprayed.

Effect of prophylactic sprays on the colonisation of canola by cabbage aphids

There was no significant difference in the time to colonisation of plants sprayed with insecticides versus those sprayed with water. Thus prophylactic applications of insecticides are unlikely to suppress aphid colony development.

However, different adjuvants trialed showed that there may be an interaction between wetter and oil, as plants sprayed with wetter were colonised on average 7 days earlier than those sprayed with oil.

The interaction of crop stage was also investigated (see Attachment 3) as plants could not all be sprayed at the same growth stage. Aphids were found to colonise flowering canola plants significantly earlier (P=0.04) than plants at the big bud stage.

The rate of colony development on the plants was observed as parasitoid wasps were found in the glasshouse. "Pioneer" colonies ie those formed by a single female were found in most cases to have been parasitized.

The effect of predators to suppress the development of cabbage aphid colonies on the flowering spike of canola.

We were unable to source hoverfly larvae and aphidous ladybirds commercially and these could not be collected in sufficient number from the field. It was decided to concentrate on parasitic wasps which are more commonly found in broadacre crops than either ladybirds and their larvae or hoverfly larvae. Parasitic wasps at ratios of 2:1 aphids to parasitic wasps did not decrease the length of existing aphid colonies nor limit new colony lengths (Attachment 4).

Aphids were observed to 'wave' their legs to deter parasitic wasps from parasitising them and move their bodies to avoid the wasp.

The trial was not taken to yield as the plants presented with symptoms of tipple topple, a calcium deficiency.

Based on the observations from the prophylactic spray trial, parasitic wasps need to be present in the landscape prior to aphid arrival or be at ratios greater than 2:1, aphids to wasps. It is more likely that predators that consume aphids will decrease the rate of aphid colony length e.g. hoverfly larvae or ladybirds and their larvae.

CONCLUSIONS

There is a yield loss from cabbage aphids feeding on unstressed canola. The amount of yield loss is proportional to the colony length, the longer the colony the greater the yield loss on that plant, for every 1 cm of colony length there is on average a 2-10% yield loss. Colonies greater than 2.5 cm cause the most yield loss. The threshold of 20% infestation i.e. 1 in five flowering spikes with cabbage aphids still appears to be the appropriate if aphid colonies are increasing.

The application of prophylactic sprays at big bud will not stop aphids from colonising canola. However, if sprays need to be applied the use of oils as adjuvants may increase the time it takes for aphids to recolonise crops.

Parasitoid wasps will not suppress the length of an existing aphid colony, rather if they are present in the landscape they will parasitise aphids and reduce the colonisation of new plants or suppress the development of new colonies.

LIST OF PUBLICATIONS

Crop Updates: Does aphid feeding cause yield loss in unstressed determinate canola?
http://www.giwa.org.au/pdfs/CR_2015/Micic_Svetlana_Does_aphid_feeding_cause_yield_loss_in_unstressed_determinate_canola_FINAL.pdf

Crop Updates: Reassessing canola yield loss to aphids
http://www.giwa.org.au/_literature_209579/Micic,_Svetlana_et_al_-_Reassessing_canola_yield_loss_to_aphids

3. Project resources	This section describes use of the funding listed in the initial plan and any refunds due to COGGO

Expenditure of funds requested from COGGO	$ Total funds budgeted	$ Total funds expended (actual)	$ Total funds requested from COGGO*	$ Total COGGO funds expended	$ Refund due to COGGO of any unexpended COGGO funds
Salary/Contractors					

Operating costs					
Capital					
TOTAL	**100,000**				

*Funding provided by COGGO.

IMPORTANT: Return of unused funds to COGGO is required as per *Clause 3.3* of the Research Agreement.

4. Commercialisation	Insert details of the proposed commercialisation process,as applicable, with reference back to the planned commercialisation plan in the project proposal) for any outputs from the project. This should include recommendations for the commercialisation of the results of the project and the registration or other protection of Project IP and Project Confidential Information as per the Research Agreement.

N/A

It is understood that this may require further discussion and agreement with COGGO via its' agent GIWA, as per the undertakings given and terms agreed, in the project proposal. This can be the subject of an appended letter and attachments. In all cases such discussion and subsequent agreements need to be governed by *Section 8 Project IP, Improvements and Project Confidential information* of the Research Agreement.

5. Communication/ Extension	Insert details of how the communication and extension of the project outcomes has been achieved to date and recommendations for future activities to disseminate and promote adoption of the results of the Project.
	Presentation at Crop Updates 2016 on findings from this project: http://www.giwa.org.au/_literature_210995/Micic,_Svetlana_et_al_Reassessing_canola_yield_loss_PPT **Webinar: Aphids in your crops :** https://www.youtube.com/watch?v=RFoJaBFxTg8 **Talks at field days:** 9th September 2015: Landmark spring field day , Broome Hill, attendees 45 10th September 2015: Spring field day, Balidu, attendees 160 17th September 2015: Southern Dirt field day, Jindallup, attendees 50

Note: As per *Clause 7.3 (b) (ii)* of the Research Agreement COGGO may require the Researcher to produce an edition of the Final Report in a form suitable for general distribution. If so required by COGGO, the Researcher must produce a non-confidential version of the Final Report within 28 days of receiving a request to that effect from COGGO.

6. Certification

The Project Supervisor and the Research Organisation certify that all information contained in, and forming part of, this final project report is complete and accurate. The project supervisor and research organisation further warrant that the project complied with all the relevant guidelines affecting the conduct of research, for example in relation to ethics, bio-safety, environmental legislation, GMAC or National Health and Medical Research Council Codes.

Project Supervisor's signature _____

Name (in Capitals)

___ SVETLANA MICIC _____ Date: 12 July 2016

Research Organisation signature _____

Name and title of authorised signatory (in Capitals)

EMILY HARVEY EXTERNAL FUNDS LIAISON OFFICER

Date: 12 July 2016

Completed Final Project reports

Email to coggoresearchfund@giwa.org.au or mail to
COGGO Research Fund, GIWA, PO Box 1081, Bentley DC, WA 6983

For any further enquiries please email questions to coggoresearchfund@giwa.org.au

Or phone (08) 6262 2128

COGGO representative

For the purpose of this Project agreement contract, COGGO will be represented by Grains Industry Association of Western Australia (GIWA), or such other representative that is nominated by COGGO as authorised to operate on behalf of COGGO.

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Project Supervisor's signature HP Trim for SVETLANA MICIC

Name (in Capitals)

SVETLANA MICIC Date: 12 July 2016

Research Organisation signature

Name and title of authorised signatory (in Capitals)

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Does aphid feeding cause yield loss in unstressed determinate canola?

Svetlana Micic, Department of Agriculture and Food, WA

Laurie Wahlsten, Department of Agriculture and Food, WA

Key messages

Aphids can cause yield loss to unstressed canola, however, they need to be present on a flowering spike from flowering.

Aphid control when 20-50% of flower spikes were infested prevented yield losses.

Background

It is estimated that $16 million dollars is spent annually (Murray *et al.* 2013) for the control of aphids in canola crops in Western Australia. However, field trials conducted by DAFWA during the 1990's found that canola cultivars compensated for aphid feeding damage by producing more racemes and yield loss only occurred in moisture stressed canola crops (Berlandier and Cartwright 1998; Berlandier and Valentine 2001; 2003). Agronomists suggested that the indeterminate cultivars used in these trials were able to compensate for feeding damage better than determinant cultivars which are mainly grown today.

In 2011, trials were conducted to determine if aphid feeding damage can induce yield loss in canola under good growing conditions. These trials were conducted on determinate and indeterminate cultivars. When aphids were introduced pre-flowering, both cultivars had up to 75% yield loss compared to the control. In 2012, trials were repeated with the aim to find a threshold for spraying for aphids that arrive in canola crops at flowering. However, due to the variability in yield of the canola plants there were no significant yield differences between sprayed and unsprayed treatments. Therefore in 2014, we decided to repeat this experiment.

Aims

To determine if aphids cause yield loss to un-stressed canola at flowering

Method

Because aphid movement in the field is variable, a small scale experiment conducted in Albany using aphid proof cages in a glasshouse was used. This allowed the simultaneous introduction of cabbage aphids (*Brevicoryne brassicae*) to plants. Canola cultivar ATR Gem was grown in pots as per Brennan and Bolland (2007), to minimise variability in growth between plants.

Five aphids were placed on the flower buds on the top of the main stem of each canola plant at 10% flowering. Previous trials suggest that the threshold for aphid control is 20% or more of flowering spikes infested with aphids (Berlandier and Valentine 2003). Aphids were controlled using alphacypermethrin (100gai/L) applied at horticultural rates when the aphid populations had increased to cover 20, 50 or 90% of the flowering spikes.

Treatments

1. Canola with no aphids
2. Canola with aphids not controlled
3. Canola with aphids sprayed when 20% of flowering spikes were infested with aphid colonies of 2.5 cm or more
4. Canola with aphids sprayed when 50% of flowering spikes were infested with aphid colonies of 2.5 cm or more
5. Canola with aphids sprayed when 90% of flowering spikes were infested with aphid colonies of 2.5 cm or more

Results

The trials were conducted under glasshouse conditions in the absence of any predation and temperatures were also elevated by 5 to10^{o}C compared to the exterior of the glasshouse. This means the aphid populations were able to increase at a faster rate than is likely to be observed in the field.

No difference in branching

There was no significant treatment difference in the number of branches produced by the canola plants between treatments. This suggests the canola plants in aphid treatments were not producing more branches to compensate for feeding damage.

Yield loss?

Canola with aphid colonies had fewer pods on the main stem when compared to the nil aphid treatment (Figure 1). The aphid colonies were observed to coat the main stem and caused flower abortion. However, if the aphid colonies extended to pods that were already formed, these pods were not observed to abort.

If aphids were controlled there was no significant difference in the number of pods on the first order branches (Figure 1). In the uncontrolled treatments, aphids colonised at least 80% of all first order stems leading to increased flower abortion and less pod formation (Figure 1).

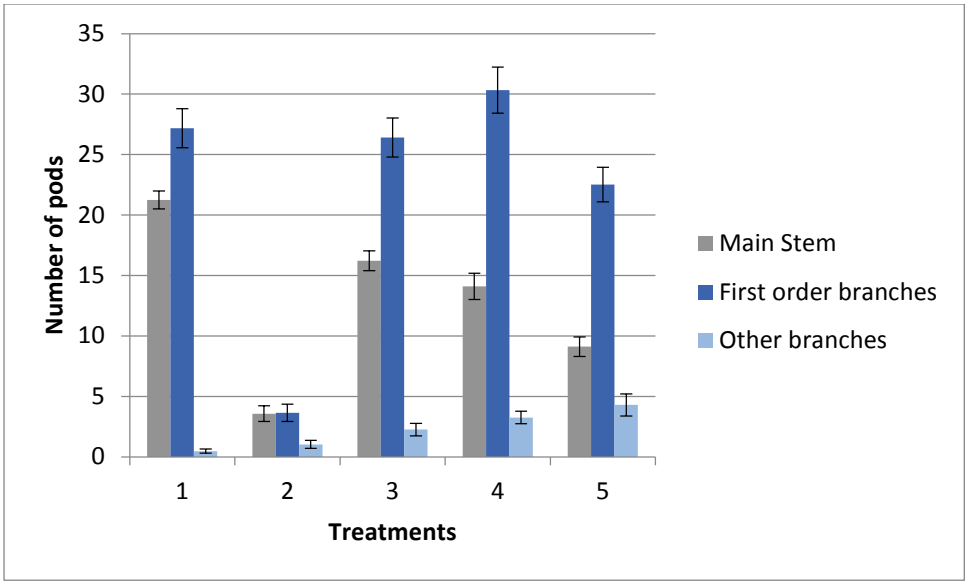

Figure 1: Number of pods on branches of canola plants ± standard error

All canola plants exposed to aphids produced significantly less seed on the main stem. According to Seymour (2011) the main stem is a major contributor to yield in low rainfall environs, however, it is only a minor contributor to the overall seed production of a canola plant in high rainfall areas. The first order branches produce the majority of the yield for canola in high rainfall environments. In this case, canola plants in the uncontrolled treatment and the late sprayed treatments produced significantly less seed (96% and 20% less) on the first order branches than the no aphid treatment.

Conclusion

Canola plants of the ATR Gem cultivar do not compensate for aphid feeding by producing more branches.

If aphid colonies are present from flowering, they do cause fewer pods to be produced on the racemes (flowering spikes) they have colonised. Consequently, these racemes have a lower yield.

Aphid control when 20-50% of flower spikes were infested prevented yield losses. Canola yield when control was applied at the 90% of flower spikes infested timing was much greater than no control but still resulted in about 20% yield loss under these conditions.

However, these findings are from a glasshouse trial where aphids were able to reproduce in the absence of predators and occurred in higher densities than may be found in the field. Consequently, these findings may not be the same in field grown canola. Further field trials are planned.

Key words

Aphid, Brevicoryne brassicae, cabbage aphid, canola, yield

References

Berlandier F, Cartwright L (1998) Effect of aphid feeding damage on canola yields in 1998 Crop Updates

Berlandier F, Valentine C (2001) Further evidence that canola crops are resilient to damage by aphids Crop Updates

Berlandier F, Valentine C (2003) Aphid damage to canola - not all cultivars are equal. Crop Updates

Brennan RF, Bolland MD (2007) Comparing the potassium requirements of canola and wheat Australian Journal of Agricultural Research 58(4) 359–366

Murray D, Clarke M, Ronning D (2013) The current and potential costs of invertebrate pests in grain crops [http://www.grdc.com.au/Resources/Bookshop/2013/02/The-current-and-potential-costs-of-invertebrate-pests-in-grain-crops]

Seymour M (2011) Defining economic optimum plant densities of open pollinated and hybrid canola in WA. [http://agvivo.com.au/wp-content/uploads/2010/12/Mark-Seymour.pdf]

Acknowledgments

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Reassessing canola yield loss to aphids

Martin Harries, Svetlana Micic and Mark Seymour, DAFWA

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.

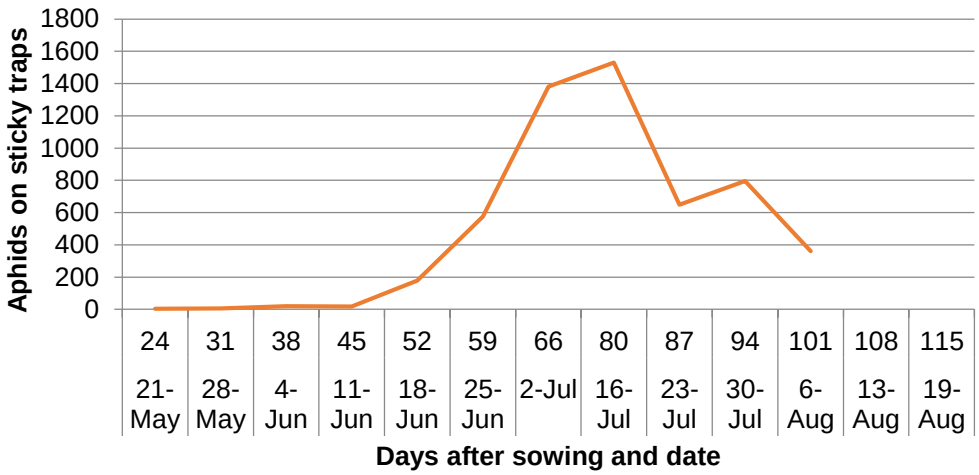

Figure 1. Number of aphids found on 4 gel traps, 1 located at each corner of the trial site

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.

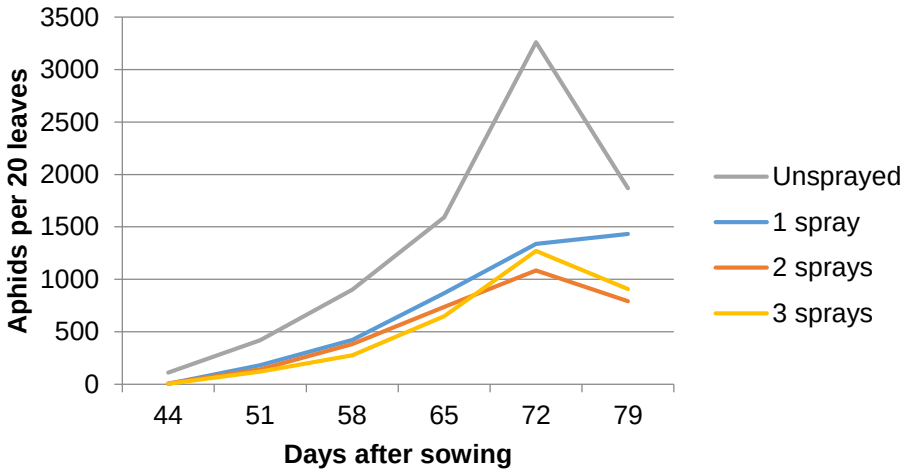

Figure 2. The number of aphids observed on 20 leaves. Note insecticide applied to all plots except Nil on 8th June (41 DAS) and to the 2 spray and control treatments on 14th July (72 DAS).

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.

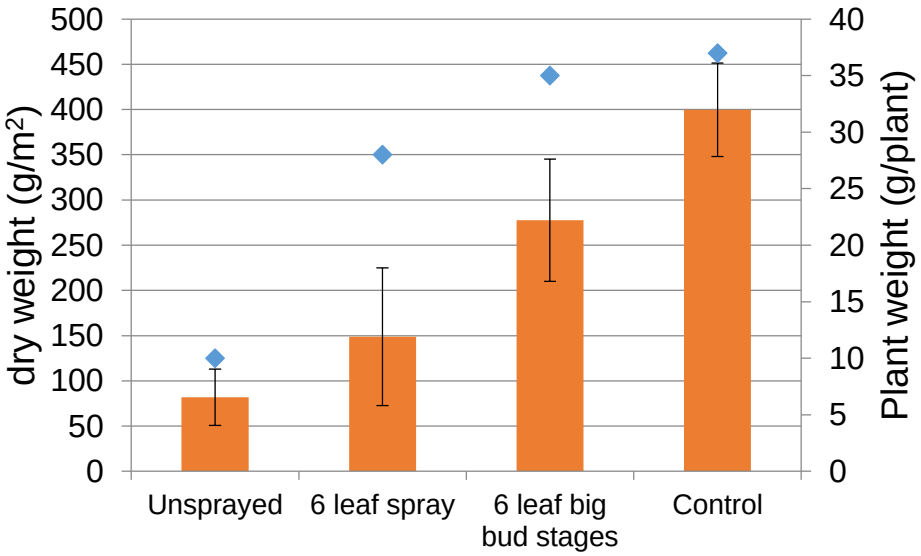

Figure 3. Total biomass production, (bars) and single plant weight, (points), August 13

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

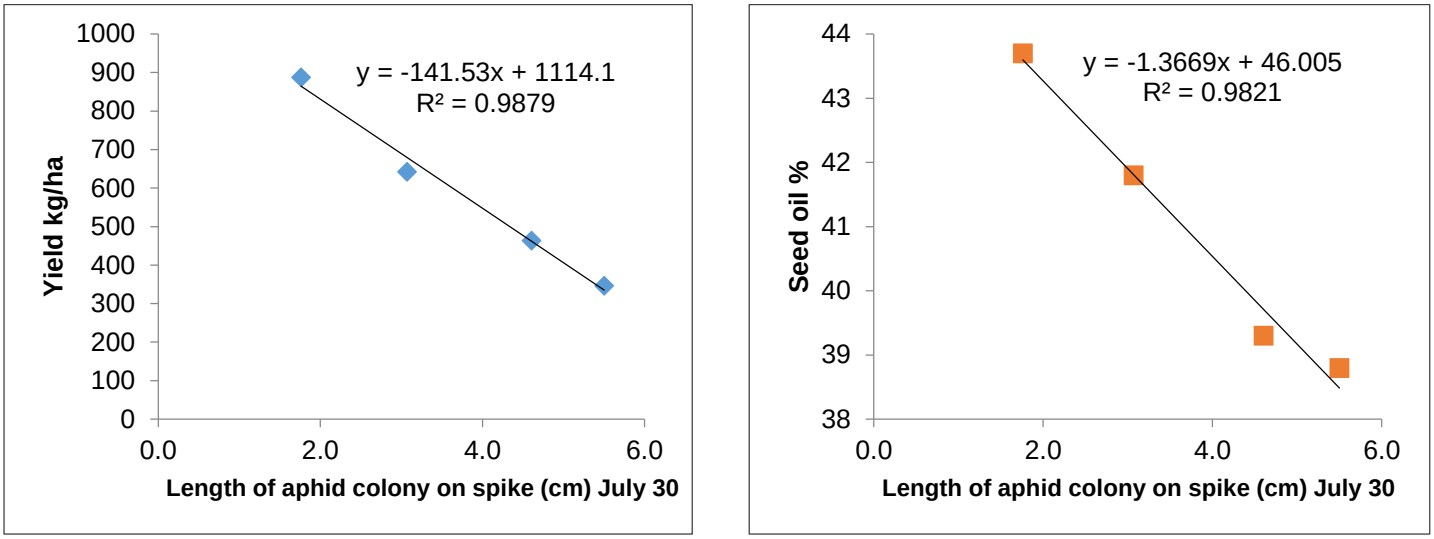

Figure 4. Relationship between average length of cabbage aphid colony on spikelet to yield loss and oil content.

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

References

Berlandier F, Cartwright L (1998) Effect of aphid feeding damage on canola yields in 1998 Crop Updates
Berlandier F, Valentine C (2001) Further evidence that canola crops are resilient to damage by aphids Crop Updates
Berlandier F, Valentine C (2003) Aphid damage to canola - not all cultivars are equal. Crop Updates
Jones R. A. C, Coutts B. A, Hawkes J (2007). Yield-limiting potential of Beet western yellows virus in Brassica napus. Australian Journal of Agricultural Research, 58, 788–801
Micic and Wahlsten (2015). Does aphid feeding cause yield loss in unstressed determinate canola? Crop Updates

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Does the application of prophylactic sprays at the same time as a nitrogen application decrease the colonisation of cabbage aphids on canola at flowering?

Background

Currently, growers and agronomists are spraying prophylactically for the control of aphids. Prophylactic sprays are usually timed to occur with the last application of nitrogen, in the belief that the spray will deter aphid colonisation at the flowering to podding crop stage. However, non-target pests are also exposed to sprays and can develop resistance more readily. For instance, green peach aphids are present in many canola crops and are very resistant to many commonly applied insecticides. These aphids are vectors for viruses and can be difficult to control in canola crops at emergence causing extensive crop losses.

In high rainfall areas last nitrogen application is usually applied when crops are at very early flowering (5-10%). In low rainfall areas last nitrogen (N) application is usually applied at bolting. Agronomists from low rainfall areas have suggested aphids are more of an issue and they regularly spray for them. Consequently, it is not uncommon for alphacypermethrin to be added into the tank mix for the prevention of aphids.

Experimental design

Five plants were planted into each pot, a total of 40 pots were planted. Canola seedlings were thinned out so that there was one plant per pot at the same growth stage. Canola was grown to the big bud stage and sprays as per the treatments below were applied. Due to inclement weather spraying had to be delayed, subsequently, plants were either still at big bud or flowering or had produced a flowering spike with unopened flowers when sprays were applied. Each treatment had 5 pots, which consisted of different numbers of plants at big bud, flowering and unopened flowers.

Treatments:

1. Water + oil
2. Water + wetter
3. Alphacypermethrin applied at 125 mL/ha + oil
4. Alphacypermethrin applied at 125 mL/ha + wetter
5. Sulfloxaflor applied at 100 mL/ha + oil
6. Sulfloxaflor applied at 100 mL/ha + wetter
7. Pirimicarb applied at 200 g/ha + oil
8. Pirimicarb applied at 200 g/ha + wetter

After spraying, the highest growing point of each plant was tagged. Plants were then placed randomly on 5 tables in the glasshouse. Winged aphids were released into the centre of each table and the aphid breeding tent at the centre of the glass house was opened, to allow winged aphids to move out.

Plants were monitored weekly for evidence of colonisation.

Results

Results were analysed using Residual Maximum Likelihood (REML) model due to the unbalanced data. Analysis of data showed there were no significant interactions. Consequently, a main effects model was run and indicated that:

- Insecticide treatments – no significant differences between the 3 insecticides or water

- Wetter or oil additives – plants sprayed with wetter were colonised quicker (27 days) than those sprayed with oil (34 days) p=0.056
- Crop growth stage – Flowering plants were colonised quicker (26 days) than plants at the Big bud (35 days) stage p=0.04 (5% lsd 8 days).

It was also noted that parasitoid wasps were present in the glasshouse. It was observed, that aphid colonies did not develop past 5-6 individuals, as adult females were parasitised before young were produced.

Conclusion

The application of prophylactic insecticides does not stop aphids from colonising plants. Plants sprayed with water had exactly the same rate of colonisation as plants sprayed with alphacypermethrin.

However, there may be an interaction between wetter and oil adjuvants, as plants sprayed with wetter were colonised on average 7 days earlier than those sprayed with oil.

If aphids are present in the landscape, they are more likely to colonise flowering canola plants than those at the big bud stage.

The effect of parasitoids to suppress the development of cabbage aphid colonies on the flowering spike of canola.

Background

Previous trials conducted by DAFWA have shown that early aphid colonisation of canola at the 2 to 7 leaf stage by cabbage aphids can lead to crop death. If aphids colonise a flowering spike of a canola plant, the longer the colony is on the flowering stem, the less flowers re produced. This leads to an aphid colonised stem having less pods than a stem with no aphids

Previous trials conducted by DAFWA have shown that aphids that colonise flowering spikes that have already formed pods do not cause yield loss.

Agronomists advise against spraying to suppress aphids if predators are present as the predators are expected to suppress colony development. However, how many predators do you need for there to be a suppression of aphids?

In caged experiments Gowling & van Emden (1994) showed up to 30% reduction in the peak population of cereal aphids exposed to parasitoids. Differences in population reductions between + or – aphid treatments occurred well before mortality from parasitoids happened. They observed that the aphids exposed to parasitoids moved off plants more often than aphids not exposed to parasitoids.

Similarly, Snyder and Ives (2003) found that parasitoids alone suppressed pea aphid densities but with a time delay (7+ days from on-set of feeding) so aphids reached high densities before the decline of the population occurred.

Experimental design

Five canola seeds were planted into each pot, a total of 96 pots were planted. Canola seedlings were thinned out so that there was one plant per pot at the same growth stage. At the 6 leaf stage aphids were added. At big bud stage, a count of all aphids on each canola plant was done and parasitised aphid mummies were added. Each mummy gives rise to a single parasitoid. The number of mummies added was based on a ratio of aphids to parasitoids as per the treatment schedule below. Ratios were chosen based on malaise trap catches of winged aphids to parasitoids, where the most caught was a 2:1 ratio of aphids to parasitoids.

Treatments:

1. 10 aphids to 1 parasitoid
2. 5 aphids to 1 parasitoid
3. 2 aphids to 1 parasitoid
4. Nil parasitoids

Colony length was measured weekly, until plants were ready for harvest.

Results

Results were analysed ANOVA. There was no significant difference in the length of aphid colonies between any of the treatments.

The parasitoids did not suppress colony growth and this could be due to conditions in glasshouse being conducive to aphid development.

Yield was not taken as plants showed symptoms of tipple topple, a calcium deficiency.

Conclusion

If cabbage aphid colonies are developed and growing, parasitoids at ratios of 2:1, aphids to parasitoids, are unlikely to limit the growth of an aphid colony. Parasitoids need to present in greater ratios than was conducted in this trial.