Aphids in faba beans - an update with a review of management strategies of faba bean aphid

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Take home message

- Aphid activity was low in faba beans in 2022.
- The faba bean aphid - FBA (*Megoura crassicauda*) was recorded in multiple sites in New South Wales and spread in Queensland and Victoria.
- Tested chemicals reduced FBA numbers compared to the control. Both foliar treatments, pirimicarb and pymetrozine, were highly effective. Likewise, imidacloprid seed treatment was observed to have a high effect on FBA numbers on emerged faba beans. In addition, pirimicarb is a selective insecticide which is mild for beneficial insects and is therefore recommended to be included in FBA management strategies.
- In general, aphid management needs to be based on controlling green bridge and volunteer plants before season, monitoring pests and beneficials during season, and insecticide application with respect to economic threshold where possible.

Background – Aphid update in northern NSW

Aphids are considered major pests of field crops if observed in moderate to high numbers. They can cause damage by direct feeding, forming dense colonies, producing honeydew, and most notably by transmitting plant viruses (Duric & van Leur, 2022). The yield losses could be substantial, particularly if aphids infest young plants in autumn.

Aphid landing rate generally depends on the availability of hosts over summer, such as summer growing pasture species, weeds, and volunteer crops. Apart from host resources, aphid migrations are affected by abiotic factors, including temperature, moisture, photoperiod, and wind direction. The 2021/22 summer was wetter than average in NSW, and the moisture, together with favourable temperatures, supported development of a green bridge. A green bridge can provide shelter and food sources for aphids over summer in the form of volunteer crops and weeds that grow around or within cropping areas.

Even though the green bridge was well-established and high aphid numbers were recorded in lucerne in March 2022, unfavourable weather conditions caused a decline in numbers before the winter season. Low numbers of incoming aphids were recorded in faba beans (Figure 1); as such, early sown faba beans generally had relatively low levels of virus infection.

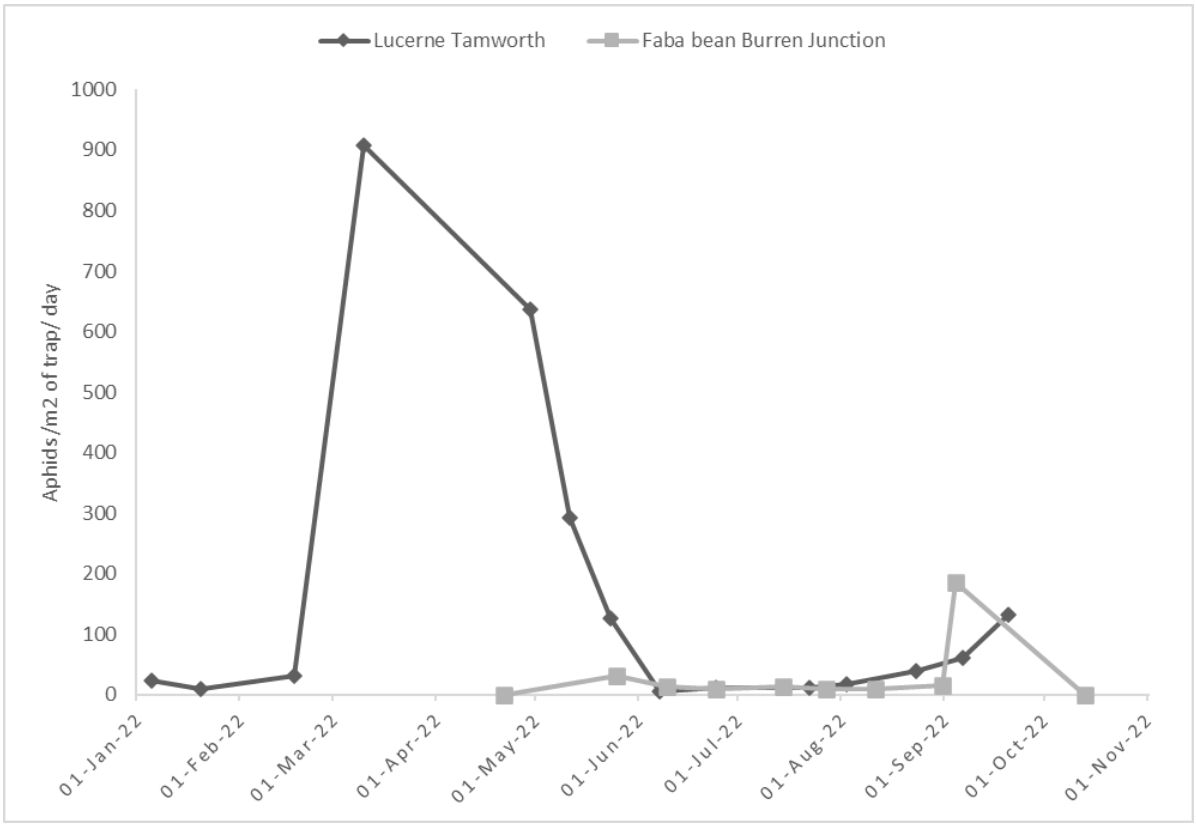

Figure 1. Aphid numbers on yellow sticky traps in lucerne and faba bean in 2022
(The aphid numbers are transformed as number of aphids/ m^2 of trap/ day)

In contrast to the population trends observed in other pulse aphids, faba bean aphids (FBA - *Megoura crassicauda*) were detected in multiple sites in Darling Downs (Queensland), northern, central, and southern New South Wales, and Victoria (Julia Severi - Cesar, pers. Comms). Based on our previous studies, FBA are known to form dense colonies starting at the tips of faba bean plants and moving downwards, causing additional damage such as necrosis, wilting, stunting, and defoliation (Duric et al., 2021). In addition to the invasive behaviour of FBA, they can act as vectors for viruses such as *Bean leafroll virus* (BLRV) and *Pea seed-borne mosaic virus* (PSbMV). Apart from faba beans, FBA preferentially feed on vetches, and reproduce on common peas, common beans, and lentils, while lucerne and sub clover are suitable alternative hosts.

Prior to 2022, outbreaks of FBA occurred from late winter to spring. However, in 2022, FBA was detected for the first time in early established faba bean and volunteer faba beans in north-west NSW. Clearly, the populations have survived and built up over the past six years, since it was first recorded in Australia (Hales et al, 2017). It is likely that FBA used alternative hosts such as pasture legumes, volunteer faba beans, and woolly pod vetch (*Vicia villosa*) on roadsides to survive outside of the winter season.

The majority of infestation sites reported well-established and vigorous colonies, requiring chemical control in 2022. As such, further studies on management options of FBA are being conducted, the results of which will be communicated to the industry before the 2023 winter season.

Methods

The objective of this study was to analyse the efficacy of different readily available chemical products for the control of FBA in faba beans. Rates used in the table below are given in grams active ingredient (g a.i.) applied per ha. As this study was conducted in glasshouse conditions, additional caution should be taken when applying chemicals in the field.

The host plants, faba beans (Warda), were sown in a standard potting mix. Four treatments were used: control, imidacloprid, pirimicarb, and pymetrozine (Table 1). Imidacloprid was applied as a seed treatment prior to sowing, while the remaining insecticides were sprayed onto plants after the development of second leaves of faba beans. The control plants remained untreated.

Table 1. Descriptions of insecticides used in the experiment and application rate in field conditions.

Active ingredient (a.i.)	**Formulation**	**Application rate**	**Recommended field rate**	**Type of pesticide**	**Critical use comments**
Imidacloprid	600 g/L	120 mL/100 kg of faba bean seed		4A group Insecticide	Do not graze or cut for stock feed within 16 weeks of sowing.
Pirimicarb	800 g/kg	128 g a.i./ha	160–190 g/ha	1A group Insecticide/ Aphicide	Minimum retreatment intervals 14 days. Do not apply more than 2 applications per crop. Withholding Period: Do not harvest, graze or cut for stock food for 21 days after application.
Pymetrozine[1]	500 g/kg	100 g a.i./ha	200 g/ha for faba bean aphid	9B group Insecticide	Minimum retreatment interval 14 days. Withholding Period: Harvest: Not required when used as directed. Grazing: Do not graze or cut for stock food for 21 days after application Do not apply after BBCH 70 Do not apply more than 2 applications per crop. Do not apply consecutive applications.

[1] Permit no PER85363 allows minor use of pymetrozine in faba beans until 31 August 2026 for control of specified aphid species. The permit is valid in all states and territories except Victoria.

After the foliar spray was absorbed, all plants were re-planted in boxes with 0.5% agar. Each plant was infested with 10 wingless adults, and the boxes were covered with aphid-proof mesh. The number of live adults and nymphs was observed 3, 7, and 14 days after treatment (DAT). The experimental design was a randomised complete block with four replicates.

To determine the effect of pesticide treatment and host plant on aphid survival and progeny production, the data were analysed by Generalized linear mixed model (GLMM) with poisson link before performing the analysis of variance (ANOVA). Means were transformed and separated at 5 (%) level of significance. Henderson-Tilton's formula was used to calculate percentage efficacy of the treatments against FBA adults:

$$\%\, efficacy = \left(1 - \frac{n\ in\ Co\ starting\ population \times n\ in\ T_{\ 3,7,14\ DAT}}{n\ in\ Co_{\ 3,7,14\ DAT} \times n\ in\ T\ starting\ population}\right) \times 100$$

n = adult aphid numbers, T = treated, Co = untreated, DAT = days after treatment.

Results and discussion

Significant differences existed between the insecticide treatments in the mean number of FBA adults and nymphs (Table 2). All insecticide treatments resulted in reduced aphid populations. In contrast, the populations in the control treatments increased gradually up to the final observation (14 DAT).

Table 2. Mean number of faba bean aphid adults and nymphs on faba beans observed 3, 7 and 14 days after treatment (in the case of the seed treatment 'imidacloprid', DAT can be interpreted as 'Days After Infestation')

Treatment	3 DAT			7 DAT			14 DAT		
	Mean No of nymphs	Mean No of adults	% Efficacy	Mean No of nymphs	Mean No of adults	% Efficacy	Mean No of nymphs	Mean No of adults	% Efficacy
Pirimicarb	0 a	0 a	100	0 a	0 a	100	0 a	0 a	100
Imidacloprid	2 b	3.7 b	48.28	0 a	0 a	100	0 a	0.2 a	98.68
Pymetrozine	9.2 bc	5.7 b	20.69	0.2 a	0 a	100	0 a	0 a	100
Control	27.5 c	7.2 b	-	64.5 b	7.7 b	-	31.3 b	16.8 b	-

Means within columns followed by the same lower case did not differ significantly at 5 (%) level of significance.

Data analysis indicated the FBA populations significantly decreased with the foliar treatments. Pirimicarb was highly effective (100% efficacy). Based on our results reported previously (Duric, 2022), such high efficacy was expected. In addition to its high efficacy in reducing FBA populations, pirimicarb is fast-acting and a selective aphicide, which has mild toxic effect on various beneficial insects and predatory mites (McDougall et al., 2022).

Pymetrozine is a slow-acting chemical. Three days after treatment FBA populations were reduced, with only 20.67% efficacy in faba beans. However, the insecticide was highly efficient at 7 and 14 DAT, with 100% efficacy. It is important to rotate chemicals throughout the growing season, using chemicals with different modes of action. Here, the slow-acting nature of pymetrozine recommends it as a suitable alternative treatment.

Imidacloprid seed treatment did not provide a knockdown effect 3 DAT (days after treatment for foliar sprays, interpreted as days after infestation for seed treatments), but was found to be highly effective 7 DAT in faba bean (100%) with high levels of efficacy maintained to 14 DAT (98.68%). Clearly, FBA are susceptible to imidacloprid which could be used to prevent early aphid infestation and delay colonisation.

The efficacy data are presented in a graph for easier comparison of tested treatments (Figure 2).

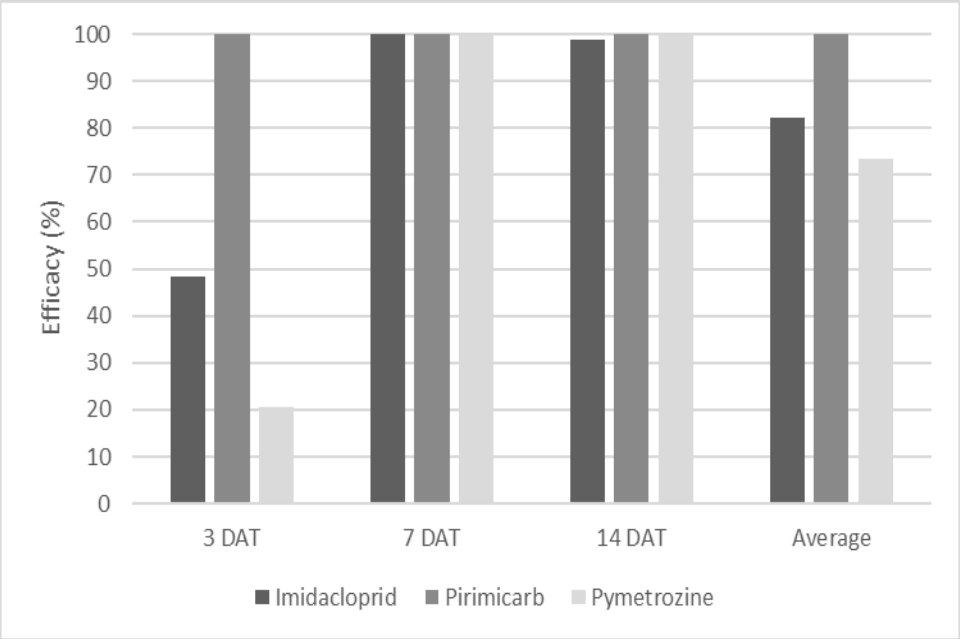

Figure 2. Efficacy (%) of insecticides on faba bean aphid adults in faba bean 3, 7, and 14 days after treatment

Conclusion

Low aphid numbers were recorded in pulses in 2022; however, FBA established in northern NSW and spread to Queensland, southern NSW, and Victoria. As FBA are highly invasive and act as virus vectors, it is essential to monitor and manage their populations in order to minimise their impact on pulse crops and practice non-chemical control before and during the growing season.

We have conducted this study to evaluate the potential value and uses of market-available insecticides for controlling FBA populations and, as such, provide data to inform management strategies for FBA. The results of this study indicate that the efficacy of the tested insecticides differs significantly, providing further insight into the suitability of different chemicals.

While imidacloprid as a seed treatment was relatively slow-acting compared with the pirimicarb foliar treatment, it successfully reduced FBA population numbers at 7 and 14 DAT in faba beans.

In all observations, the efficacy of pirimicarb was high. In addition to its high efficacy, pirimicarb has a mild impact on beneficial insects, recommending it for use in FBA control. Pymetrozine was likewise effective 7 and 14 DAT and is a potential alternative foliar treatment and supplement of pirimicarb during the growing season. Together, these chemicals are potential candidates for a management program of FBA.

The results of this study provide preliminary data to inform management strategies for FBA populations using readily available insecticides, in the case when monitoring confirms developed colonies and preventive actions do not adequately control FBA populations. As this study was conducted under glasshouse conditions, future research is required to evaluate the effect of seed and foliar treatments on FBA in the field condition.

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