Management strategies for faba bean aphid

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Key findings

- The faba bean aphid (FBA, *Megoura crassicauda*), first detected in multiple New South Wales (NSW) sites, expanded its range rapidly in 2022, causing problems in early planted crops in NSW. It has become established in NSW and Victoria, and its presence expanded into south-east Queensland and Tasmania.
- The insecticides tested (imidacloprid, pirimicarb and pymetrozine, applied alone and combined treatments) reduced FBA numbers in field conditions compared with the control, where intensive damage, predators, and parasitoids were observed. Imidacloprid seed treatment effectively controlled FBAs on emerged faba beans, particularly when combined with foliar treatments in the field experiment.
- Effective FBA management involves controlling green bridge and volunteer plants before the growing season, monitoring pests and beneficial insects, and applying insecticides based on established thresholds if available.

Background

Aphids are major pests of field crops if in moderate to high numbers. They can cause damage by direct feeding, forming dense colonies, producing honeydew, and, most notably, transmitting viruses (Duric and van Leur, 2022). The yield losses can be substantial, particularly if aphids infest young plants in autumn. Aphid landing rates in winter crops depend on the availability of summer hosts, such as pasture species, weeds, and volunteer crops. Temperature, moisture, day length, and wind all play a role in aphid migration alongside host plant availability.

The FBA was first recorded in Australia in 2016 in Sydney (Hales et al. 2017), and it was discovered in 2017 in a faba bean crop in northwest NSW. Before 2022, outbreaks of FBA occurred from late winter to spring. However, in late May and early June 2022, the FBA was detected for the first time in established and volunteer faba beans in northwest NSW. The aphid then spread to southern and central New South Wales and Victoria, becoming established there. It also reached southeast Queensland and eventually Tasmania (Faba bean aphid factsheet, 2024). Despite their initial recording in Australia in 2016, the FBA population has evidently survived and built up in recent years, likely utilizing alternative hosts such as pasture legumes, volunteer faba beans, and woolly pod vetch (*Vicia villosa*) on roadsides to persist through winter.

The preferred hosts of FBA are faba beans and common vetch. The aphid also reproduces on common peas, beans, and lentils. While it can survive on lucerne and subterranean clover, they act as alternative hosts. FBA often establish themselves by forming dense colonies at the tips of faba bean plants, progressively moving downwards. This infestation leads to a range of detrimental effects, including wilting, stunting, necrosis, and defoliation. Additionally, FBA act as vectors, transmitting viruses like bean leafroll virus (BLRV) and pea seed-borne mosaic virus (PSbMV) (Duric et al. 2021).

Most infestations recorded in 2022 were well-established, vigorous colonies requiring chemical control. As such, we conducted field studies to assess and compare the effectiveness of the various chemical control options against FBA in faba beans.

Methods

To assess the efficacy of commercial products for FBA control in faba beans, imidacloprid, pirimicarb and pymetrozine were tested in field conditions.

Four replicates in a randomised complete block design with 6 treatments were compared:

- untreated control (Con)
- imidacloprid seed treatment (Imi)
- pirimicarb foliar spray (Pir)
- pymetrozine foliar spray (Pym)
- combined imidacloprid seed treatment and pirimicarb spray (Imi/Pir)
- combined imidacloprid seed treatment and pymetrozine spray (Imi/Pym).

The rates applied are listed in Table 1 and are in

Table 1 Insecticides assessed and application rates in grams of active ingredient applied per hectare (g a.i/ha).

Active ingredient (a.i.)	Formulation	Application rate	Recommended field rate	Mode of action	Critical use comments
Imidacloprid	600 g/L	120 mL/100 kg of 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 interval is 14 days. Do not apply more than 2 applications/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	9B group insecticide	Minimum retreatment interval is 14 days. Withholding periods: 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/crop. Do not apply consecutive applications.

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

Faba bean seed was treated with imidacloprid before planting and both treated and untreated seeds were planted. After the plants had reached the 3 pairs of unfolded leaves growth stage, FBAs were introduced on treated and untreated plants to establish colonies. FBA colonies were bred beforehand in a glasshouse in controlled cages to ensure a consistent aphid source.

Once aphid colonies developed in the field plots, 10 plants were chosen randomly and marked in each plot to count live adult aphids and nymphs (baseline count on day 0). Foliar insecticides were then applied on the same day. Over the next 4 weeks, the same marked plants were monitored 2, 7, 14, and 27 days after foliar treatment (except for imidacloprid seed treatments, where data refer to days after infestation).

A linear mixed effects model (LMM) was used to analyse data. To identify specific treatment groups with significant differences in aphid survival and progeny production, pairwise least significant difference (LSD) tests with Bonferroni adjustment were conducted. Additionally, Henderson-Tilton's formula was used to calculate the efficacy of the treatments against FBA adults and nymphs:

$$\% \ efficacy = \left(1 - \frac{n \text{ in } Co \text{ starting population} \times n \text{ in } T \ 2,7,14,27 \ DAT}{n \text{ in } Co \ 2,7,14,27 \ DAT \times n \text{ in } T \text{ starting population}}\right) \times 100$$

n = adult aphid numbers, T = treated, Co = untreated, DAT = days after treatment
(for imidacloprid treatments in field conditions, data refer to days after infestation)

Results

While the aphid colonisation rate appeared lower on imidacloprid seed-treated plants compared with untreated plants on day 0 (Figure 1 and 2), this was not a significant difference. All treatments reduced aphid populations on days 2, 7, 14, and 27. There were significant differences in all insecticide treatments within each pairwise comparison of FBA adults (Figure 1) and nymphs (Figure 2), except on day 2, where there was no difference between the pymetrozine treatment and the control for both adults and nymphs. In contrast, populations in the control had either stable adult counts or gradually increased nymph counts until the final observation on day 27.

Untreated plants in control plots suffered significant damage, including the presence of honeydew, necrotic lesions and stunted growth. Notably, a new symptom was observed in these plots: a distinct curving of the upper stalk in areas of dense aphid colonisation (Figure 3). Interestingly, while beneficial predators, such as white-collared ladybirds (Hippodamia variegate), were present in the control plots and actively feeding on the aphid colonies, no such predators were found in the insecticide-treated plots. Mummified FBA were identified for the first time, which is a valuable discovery given the limited knowledge about FBA predation and parasitism (Figure 4).

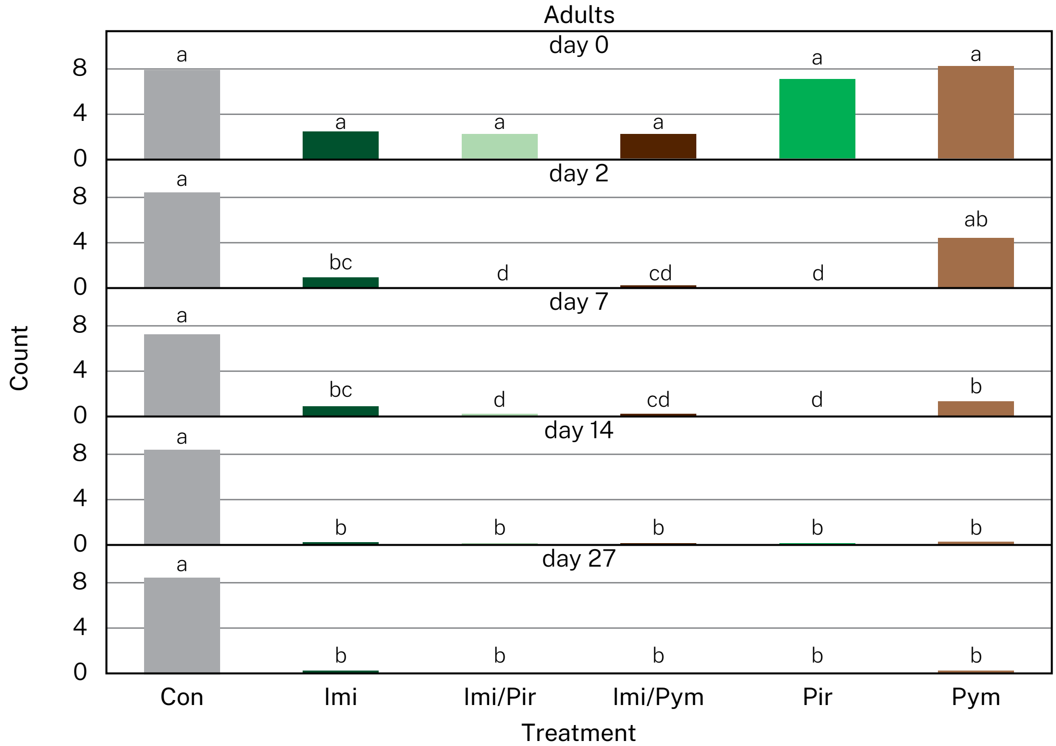

Figure 1 Pairwise comparisons of FBA adult survival following insecticide treatments. Data represent survival on day 0 and days 2, 7, 14, and 27 after foliar treatment. For seed treatments with imidacloprid, data refer to days after infestation. The model treated 'day' and 'treatment' as fixed effects and 'repetitions' as a random effect. Data within the row marked by the same lowercase letter did not differ significantly at the 5% level.

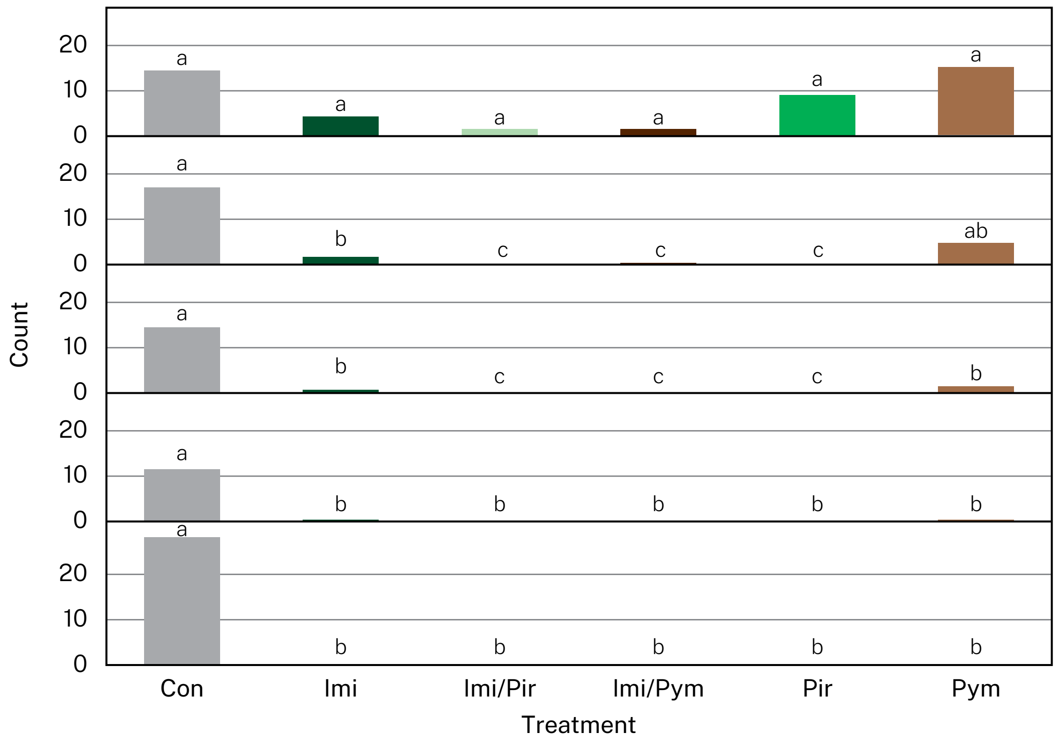

Figure 2 Pairwise comparisons of FBA nymph production following insecticide treatments. Data represent production observed on day 0 and days 2, 7, 14, and 27 after foliar treatment. For seed treatments with imidacloprid, data refer to days after infestation. The model treated 'day' and 'treatment' as fixed effects, and 'repetitions' as a random effect. Data within the row marked by the same lowercase letter did not differ significantly at the 5% level.

Figure 3 Faba bean plant infested with faba bean aphid causing stalk curving.

Figure 4 Mummified aphid found in a faba bean aphid colony.

The low aphid population on day 0 likely explains the moderate efficacy of imidacloprid seed treatment at day 2 (68.9% for adults, 63.8% for nymphs) (Figure 5). Imidacloprid's efficacy increased by day 14, five weeks after germination, reaching 87.4% for adults and 97.9% for nymphs. This delayed but useful suppression was supported by our previous glasshouse experiments (Duric et al. 2023), which showed that FBAs are susceptible to imidacloprid. This indicates that imidacloprid could prevent early aphid infestation and delay colonisation.

All foliar and combined seed-foliar treatments effectively suppressed FBA populations and prevented later re-infestations. Pirimicarb had exceptional efficacy, averaging 99.9% for adults and 100% for nymphs, with similar results in the imidacloprid-pirimicarb combinations (Figure 6). This aligns with previous findings (Duric et al. 2023) and highlights the effectiveness of pirimicarb. While pirimicarb is considered a selective insecticide, new research (Knapp et al. 2023) raises concerns about its toxicity to beneficial insects such as parasitoid wasps, which are key biological control agents for aphids.

Compared to previous glasshouse experiments that showed pymetrozine's slow action with 20.67% efficacy for adults by day 3 (Duric et al. 2023), in this field trial, efficacy increased by day 2 (47.4% for adults, 68.9% for nymphs). This rapid onset could be due to environmental factors in the field. The insecticide potency was maintained throughout the experiment, with efficacy reaching 97% and 99.8% for adults and nymphs, respectively, by day 27. Combined with the seed treatment, the average efficacy of pymetrozine remained consistently high at 93.9% for adults and 98.7% for nymphs.

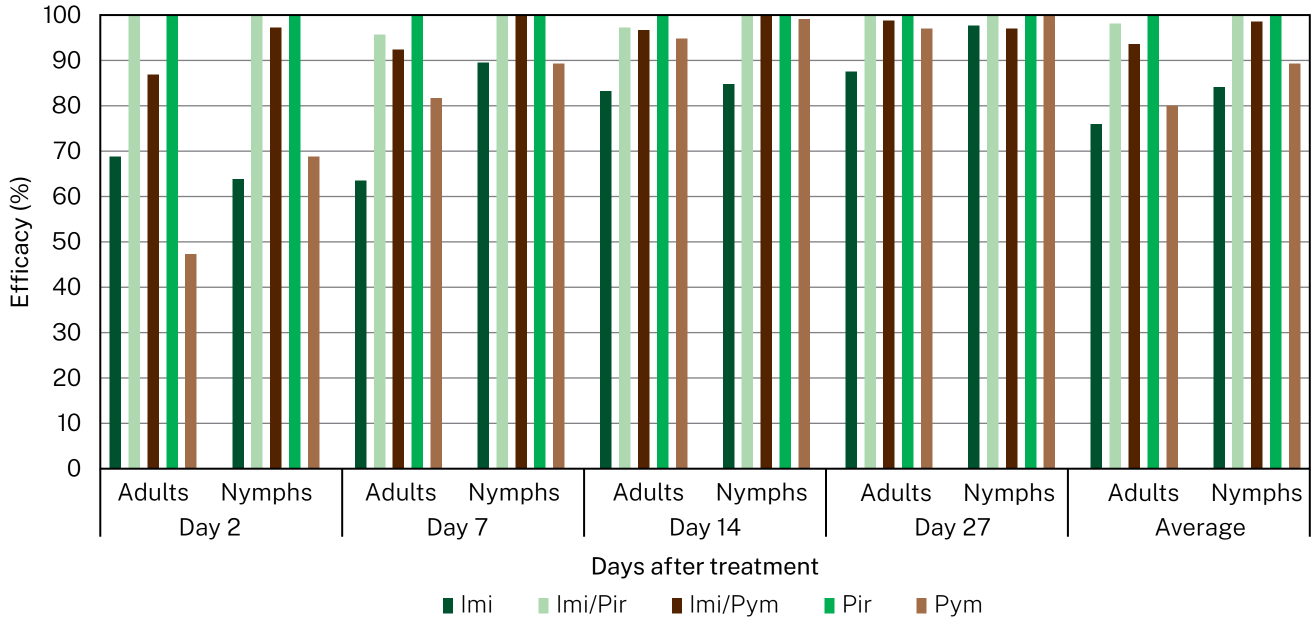

Figure 5 Efficacy (%) of insecticides on faba bean aphid adults and nymphs 2, 7, 14 and 27 days after foliar treatment. For seed treatments with imidacloprid, data refer to days after infestation.

Conclusions

The FBA is established in New South Wales and Victoria, having spread to Queensland and been recorded in Tasmania. FBA are highly invasive pests that transmit viruses to pulse crops. Monitoring their populations and implementing management strategies are essential to minimise their effects on pulse crops.

The results of the field study on effective insecticide treatments for managing FBA showed that both imidacloprid seed and foliar insecticides, pirimicarb and pymetrozine, alone and combined treatments, reduced populations. The results indicate that insecticide efficacy differs significantly (except for the pymetrozine treatment on day 2). No reinfestation occurred in any treatment, while colony numbers increased in the control. The presence of predatory species and parasitised aphids was recorded in the control.

Generally, effective aphid management should involve managing the green bridge and volunteer plants before the season begins, monitoring both pests and beneficial insects during the growing season, and applying insecticides based on economic thresholds where feasible. It is crucial to implement chemical rotations throughout the growing season, opting for products with diverse modes of action and those chemicals with less effect on beneficials.

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