Keeping the insects out of pigeonpea – key pests and strategies

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IPM, insect pest, pest management, pigeonpea, summer pulse

Take home messages

- Pigeonpea is currently being investigated as a summer pulse crop for growers in the northern region
- There are several major insect pests of pigeonpea that can severely limit pigeonpea grain yield and quality
- Developing integrated pest management strategies will be a key factor in determining the success of pigeonpea as a crop.

Overview

Grain growers in the northern region are increasingly seeking alternative summer grain crops to use in their farming system rotations. Pigeonpea has been suggested as a potential option and has attracted research investment from QDAF, the GRDC, and private agribusiness. A commercial pigeonpea variety is expected to be released in the coming years. In preparation for this, at QDAF we have been conducting research on pigeonpea's suite of insect pests to examine the extent and nature of pest damage, along with beginning to develop pest management strategies.

Background

Pigeonpea has a stigma of being highly susceptible to insect pests. Seasoned growers and agronomists would be familiar with the previous attempt at pigeonpea grain production in Southern Queensland during the 1980s. That effort coincided with the major cross-industry pest *Helicoverpa armigera* evolving resistance to all available insecticides. Four commercial pigeonpea varieties were released, but the nascent pigeonpea industry was doomed as growers could not effectively manage *H. armigera*. Pigeonpea crops at the time either experienced such substantial yield loss or were sprayed with insecticide so frequently that growing pigeonpea for grain was not economical. Eventually growing pigeonpea for grain was abandoned – with production peaking at approximately 8,000ha in 1986-1987 and declining rapidly thereafter (Ryan, 1998).

After pigeonpea production for grain ceased, the crop was adopted as a pest refuge as a part of the cotton industry's *Bt* resistance management plan. Pigeonpea refuges are planted alongside *Bt* cotton crops with the intention of delaying the evolution of *Bt* resistance in *Helicoverpa* spp.

What is different now?

In the decades since the '*Helicoverpa* resistance crisis' a suite of insecticides with different modes of action have come to market and are used to successfully manage *H. armigera* in broadacre and horticultural crops. Because these products can effectively control *H. armigera* and combined with the international demand for pigeonpea grain and the paucity of drought-tolerant summer legume options for growers, there is a push for pigeonpea in northern farming systems.

QDAF has been running a 'Pigeonpea initiative' project which has involved evaluating a range of pigeonpea genotypes along with starting to develop management packages for crop agronomy and crop protection. The QDAF germplasm collection consists of mostly extra-short duration determinate genotypes, these genotypes are faster and shorter than more traditional material which most growers and agronomists would be familiar with. In our preliminary trials some of these lines also have more succinct and synchronous flowering windows. Flowering is the most susceptible period to the key pests of pigeonpea and we expect that these lines are less susceptible to key pests. But the proof is in the pudding (or in this case, the pigeonpea) and we have been successfully managing insect pests in our pigeonpea field trials for several seasons.

Key pests

There is a suite of key insect pests of pigeonpea (Table 1), many of which are familiar to growers of other summer pulse crops. Pigeonpea crops may be attacked by pests throughout the crop's development, but the suite of insects infesting crops changes drastically as a function of crop phenology. Pest infestations which occur during the flowering through to podding stages are more likely to result in yield loss.

Helicoverpa armigera will likely be the major biotic yield constraint to pigeonpea production in the northern region. Moths typically infest pigeonpea crops at flowering and lay their eggs on flowers (Volp *et al.,* 2023, Volp *et al.,* 2024b). Very small caterpillars establish feeding sites inside pigeonpea flowers and as the larvae develop, they eventually start feeding on pods where they can cause substantial yield loss (Volp *et al.,* 2024b, Volp *et al.,* 2024a). The native species *Helicoverpa punctigera* is also a pest of pigeonpea, but surveys from refuges suggests that *Helicoverpa* spp. infestations in Australian pigeonpea mainly consist of *H. armigera* (Baker and Tann, 2014).

The bean podborer is another major pest of pigeonpea crops. Podborer is more problematic in coastal and tropical regions, however outbreaks can occur in inland production regions during high rainfall years (Brier *et al.,* 2008). Like the *Helicoverpa* spp., bean podborer infests crops at flowering and small caterpillars will inconspicuously feed inside flowers. As caterpillars develop, they form a silk web that can encompass leaves, buds, flowers, and pods. This cryptic feeding behaviour makes podborer difficult to detect with beatsheet sampling and difficult to control with certain insecticides.

The pest status of brown and green mirids in pigeonpea is uncertain. Mirids are a major pest of mungbean with very low thresholds (Brier *et al.,* 2008) and are regularly found in pigeonpea crops (Lawrence *et al.,* 2007). However, a series of QDAF trials has failed to demonstrate mirid-induced yield loss in pigeonpea. Whether this holds true with all pigeonpea varieties across all growing environments remains to be investigated.

Other pests include the pod-sucking bug species which includes the green vegetable bug, red-banded shield bug, and the small and large brown bean bugs. These pod-sucking bugs feed on pigeonpea pods and seeds, causing shrivelling and damage to grain. The composition of pod-sucking bug species within a crop varies geographically and seasonally, but the bugs are managed similarly.

The Asian pod fly is one of the most serious pigeonpea pests in India, where adults infest crops during podding and larvae damage pigeonpea seeds. The fly is present in the Northern Territory (Makinson *et al.,* 2005), but we have not yet encountered it in our southern QLD field trials. In India pod fly is typically more troublesome in long-duration pigeonpea varieties, as opposed to the short-duration types we are examining in the QDAF program (Reed and Lateef, 1990).

Table 1. Potential major insect pests of pigeonpea production in Australia. The eventual pest management paradigm in pigeonpea will be based around these key pests – particularly *H. armigera*. Many of these species are familiar to growers of other summer pulses.

Common name(s)	Species name	Nature of damage	Notes
Heliothis, cotton bollworm	*Helicoverpa armigera*	Bud, flower, and pod feeder	Resistant to several insecticides.
Heliothis, native budworm	*Helicoverpa punctigera*	Bud, flower, and pod feeder	Limited insecticide resistance problems.
Bean podborer	*Maruca vitrata*	Bud, flower, and pod feeder	More problematic in warmer climates, but population outbreaks can occur in southern inland regions during high rainfall years.
Brown mirid	*Creontiades pacificus*	Bud, flower, and pod feeder	Major pests of mungbeans with very low thresholds, but in pigeonpea trials we have not been able to demonstrate yield loss from mirids.
Green mirid	*Creontiades dilutus*	Bud, flower, and pod feeder	
Green vegetable bug	*Nezara viridula*	Pod feeder	The composition of pod-sucking bug species within a crop can vary. Red-banded shield bug can be difficult to effectively control.
Red-banded shield bug	*Piezodorus oceanicus*	Pod feeder	
Large brown bean bug	*Riptortus serripes*	Pod feeder	
Small brown bean bug	*Melanacanthus scutellaris*	Pod feeder	
Pod fly	*Melanagromyza obtusa*	Pod feeder	Key pest of global pigeonpea production. There is evidence pod fly is present in Australia, but we have yet to detect it in QDAF field trials.
Brown leafhopper	*Orosius orientalis*	Sap-sucking vector of phytoplasma	To what extent phytoplasma will be a problem in pigeonpea grain crops is unknown.
Cowpea bruchid/ cowpea weevil	*Callosobruchus maculatus*	Stored grain	Bruchids typically infest grain during storage and can cause severe damage to grain.

A bewildering pest of pigeonpea is the brown leafhopper. This small phloem-feeding insect is the most likely vector of phytoplasma, which we have observed at varying levels in summer pulses over the last 8 years (Sharman *et al.,* 2017). Typically, high levels of phytoplasma are recorded from pigeonpea refuges, but the incidence of phytoplasma in short duration pigeonpea in our field trials has been low. We don't know how this may change if pigeonpea is grown at a large scale. Leafhoppers are regularly recorded in summer pulse crops, but symptoms of phytoplasma are not always present at detectable levels. We have a very limited understanding about the ecology of the leafhopper and the disease, and there are limited management tactics available.

Finally, a significant post-harvest pest is the cowpea bruchid (or cowpea weevil). Bruchid infestations in pigeonpea grain tend to arise during storage rather than field-to-storage infestations. During grain storage, female bruchids lay their eggs on grain and then larvae cause damage by burrowing into the grain.

Our QDAF research commenced at the bottom of the conceptual IPM pyramid (Figure 1), with an emphasis on understanding what causes pigeonpea to be so susceptible to *H. armigera* and if we can develop less susceptible varieties. We have also been examining how accurately beatsheet sampling captures actual populations of *Helicoverpa* spp. and podborer. Finally, we have conducted numerous trials investigating yield-loss caused by pests – preliminary work for developing economic thresholds.

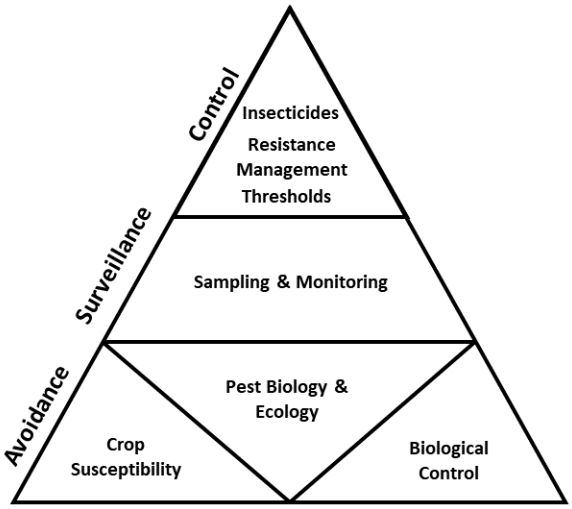

Figure 1. The pigeonpea 'IPM pyramid', a modified version of the generic IPM pyramid and other specific versions created for other pest-crop scenarios. A well-balanced pest management program is based on information and tactics from the bottom of the pyramid, enabling pest problems to be minimised and selection pressure placed on key insecticides to be reduced.

Where to from here?

If pigeonpea is to be adopted as a successful summer pulse in northern cropping systems, suitable pest management strategies must be available to industry. Such strategies may include:

- less susceptible varieties
- sampling and monitoring protocols
- economic thresholds
- biopesticides, and
- conventional insecticides.

Extension of research findings and published pest management guidelines for growers and agronomists are also essential to ensure the adoption of best management practices.

There is plenty of research to be undertaken to develop pest management strategies for the insect pests of pigeonpea. If pigeonpea is grown at scale, undoubtedly the goalposts will shift – sporadic pests will present themselves and if the crop expands into new areas the composition of pests in crops may change. Most of the currently required insecticides to control pigeonpea pests are registered in the crop, but future studies will be required to identify and fill any gaps along with generating emergency permits for sporadic or exotic pests.

As growers and agronomists of other summer pulse crops know – these crops can be highly susceptible to pests. But with adequate research investment, entomological advice, and pest management resources available, summer pulses can be grown successfully and profitably. Ultimately, research and collaboration among entomologists, agronomists, and growers will be critical to establish a new successful summer pulse industry.

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