

PROJECT SYNOPSIS SUITABLE FOR GENERAL PUBLICITY AND COGGO WEBSITE

Background

Weevils are estimated to cause Western Australian canola growers approximately \$1.8 million in annual production losses (Murray et al. 2013). Four main weevil species affect canola: vegetable weevil, desiantha weevil, Fuller's rose weevil, and small lucerne weevil. Agronomists report that desiantha weevil is one of the most common species, causing damage across the region from Geraldton to Esperance (PestFacts WA, www.dpird.wa.gov.au/online-tools/pestfacts-wa/pestfacts-wa-map).

Recommended control of desiantha weevil involves the application of synthetic pyrethroids (SPs), which kill adults either on contact or after ingestion. However, control failures are reported each year. Historically, these failures have been attributed to factors such as heavy stubble reducing insecticide contact and a lack of green plant material limiting ingestion.

Spray failures during 2019-2022 across multiple paddocks in the Albany and Esperance port zones have raised concerns that registered SP rates may no longer provide effective control. In these cases, sprays were applied under conditions expected to optimise efficacy, including late-afternoon application when weevils were active and minimal ground cover; however, control remained inadequate. One possible explanation for these failures is the development of resistance to SP insecticides.

Current management relies heavily on SP applications applied prior to and at canola germination. As a standalone strategy, this approach is unlikely to be sustainable.

Under a changing climate, improved understanding of environmental cues and host plant use will be critical for developing more effective and sustainable management strategies for this pest. Currently host plant associations of desiantha weevil are poorly understood in WA, larvae are documented to feed primarily on grasses, anecdotal evidence suggests they may also utilise canola as a host.

Improved management requires a better understanding of environmental and agronomic factors that influence desiantha weevil populations.

Project Aims

The aim of this study is to determine if desiantha weevil are resistant to current insecticides and to investigate their biology (host plants and environmental cues) to identify improved management options.

Milestones

1. Complete collections and bioassays of 10 Desiantha weevil populations to determine insecticide resistance status in the Albany and Esperance region
2. Investigate the impacts of plant hosts and the best control timings to help provide a management package for desiantha weevil

Milestone 1: Resistance testing

In consultation with agronomists, the chemical alphacypermethrin was chosen for resistance testing as most reported spray failures for desiantha weevils are to this insecticide.

For each resistance test, vials were coated with either alpha-cypermethrin diluted as specified in Table 1 or with water (control). The vials were left to dry for 24 hours, after which

a single weevil was introduced into each vial. Weevils remained in the vials for 24 hours and were deemed dead if they did not move of their own accord when released. Each treatment consisted of 10 replicates.

To determine the concentrations of alpha-cypermethrin to use for resistance screening, desiantha weevils were collected from North Moulyanning and exposed to all rates listed in Table 1. In the North Moulyanning population, mortality occurred at all alpha-cypermethrin treatments, except for one weevil that survived at the $\frac{1}{1000}$ field rate, indicating that this rate is likely close to the LD₉₀. The rates indicated with an asterisk (*) in Table 1 were selected for screening all other weevil populations for resistant

Table 1: Dilution of alpha-cypermethrin for resistance tests. * indicates rates chosen for surveillance for resistance

Equivalence in tank mix of 100L water	Target gai/mL
Field rate	0.0004*
$\frac{1}{8}$ of field rate	0.00005
$\frac{1}{16}$ of field rate	.000025
$\frac{1}{64}$ of field rate	0.00000625
$\frac{1}{100}$ of field rate	0.000004*
$\frac{1}{1000}$ of field rate	0.0000004*

Adult weevils were screened for resistance in 2023-2024 from the following localities:

- North Moulyanning
- North Kukerin
- Tarin Rock
- Esperance
- Mt Barker

All sites had a history of insecticide applications. Only North Kukerin had not received an application of alpha-cypermethrin during the season of collection.

At all localities screened for resistance there were no weevils surviving in the alpha-cypermethrin treatments. This includes North Moulyanning. Mortality in the control was less than 5% for all sites,

Due to the difficulty in collecting sufficient weevils for resistance testing, a trial was conducted to determine whether larvae of desiantha weevil could be field-collected and used for resistance testing.

Larvae and adults were collected from North Moulyanning, and a bioassay was conducted for each separately. Larvae were deemed dead if, when prodded, they did not move away from the stimulus. Like the adults, larvae only survived in the control, indicating it was possible to conduct bioassays on field collected larvae.

DPIRD taxonomist Andras Szito indicated that morphological identification of weevil larvae to species level is not possible and questioned whether all larvae collected in the field were indeed desiantha weevil. Field collections of presumed desiantha weevil larvae, collected in the absence of adults from wheat paddocks at North Kukerin and Tarin Rock, were subjected to molecular testing. Molecular testing confirmed that all collected larvae were desiantha weevil.

Field surveys of sprayed paddocks were conducted either by project staff or agronomists at the following localities:

- Esperance
- Newdegate,
- Mt Barker

- Gairdner
- Bremer Bay
- Cranbrook
- South Stirling
- Ongerup

No surviving desiantha weevils were found, suggesting insecticide applications were providing adequate control.

Due to the lack of spray failure reports during 2023-24 and the effort required to collect sufficient desiantha for a single resistance test further resistance screening was not conducted.

Milestone 2: Plant hosts of desiantha

Host plant trials were conducted in which eight mating pairs of desiantha adults were placed in pots containing a single host plant species. Pots were covered with mesh to prevent adults from escaping. After six months, the pots were emptied and carefully examined for neonate (newly emerged) adults, pupae, or larvae. No pupae or larvae were found.

Crop host plants, including pasture species, were grown from seed in soil collected from North Moulyanning, where weevil larvae were commonly found. Non-crop plant species were collected from the field and transplanted into pots containing soil from North Moulyanning. Each pot contained at least five plants. The species tested and summarised results from three experimental periods conducted between 2023 and 2025 are listed in Table 3.

Table 2: List of plant species to which mating pairs of *Desiantha* adults were added, the number of replicates per treatment, and the number of neonate adults observed from trials conducted 2023-2025

Host	Number of pot replicates	Number of neonate adults after 6 months
Barley (<i>Hordeum vulgare</i>)	8	1
Wheat (<i>Triticum aestivum</i>)	3	3
Oats (<i>Avena sativa</i>)	3	2
Lupins (<i>Lupinus angustifolius</i>)	5	1
Faba beans (<i>Vicia faba</i>)	3	0
Canola (<i>Brassica napus</i>)	6	0
Vetch (<i>Vicia sp.</i>)	5	1
Rye grass (<i>Lolium rigidum</i>)	3	0
Silver grass (<i>Vulpia spp.</i>)	2	0
Toad-rush (<i>Juncus bufonius</i>)	1	0
Sorrell (<i>Rumex acetosella</i>)	1	5
Capeweed (<i>Arctotheca calendula</i>)	3	7
Clover (<i>Trifolium sp.</i>)	5	0
Cudweed (<i>Gamochaeta spp</i>)	3	2

Based on the number of adults found in the pots and on the number of replicates trailed (Table 2), the following is a list of hosts of desiantha weevil in order of preference:

- Capeweed
- Sorrel
- Wheat

- Oats
- Cudweed
- Vetch
- Barley

It is likely that the desiantha weevil has a broader host range than is currently documented. In field observations, larvae have been found among the roots of canola crops, which is not a documented host. The canola crops observed were free of weeds at the time. Adult desiantha weevils were subsequently detected in the same location in the paddock in spring. However, under laboratory conditions, desiantha weevils were unable to complete their lifecycle on canola alone.

It is possible that immature weevil larvae can only develop to a certain life stage on their preferred hosts but are able to complete their lifecycle on non-preferred hosts. To test this, desiantha larvae were field-collected from North Moulyanning in August. It was attempted to collect larvae that were ~ 3-4 mm long, indicating they were 3-4th instar stage. Six larvae were placed into each pot containing a single plant species, in soil collected from North Moulyanning and with three replicates per treatment (total of 18 larvae per plant type tested). Each pot was planted with field-collected plants, along with a control treatment consisting no plants, only stubble. After 8 weeks, the number of adults and living larvae were assessed. No larvae were found.

Desiantha were able to complete their lifecycle in the absence of living plant material (Figure 1) and on all plant species tested. This suggests that if the preferred host plant is controlled, larvae at more advanced developmental stages may still survive to adulthood. However, as not all larvae developed into adults, including those placed onto what would be considered preferred hosts such as capeweed or wheat, indicates that significant larval mortality occurred during the trial.

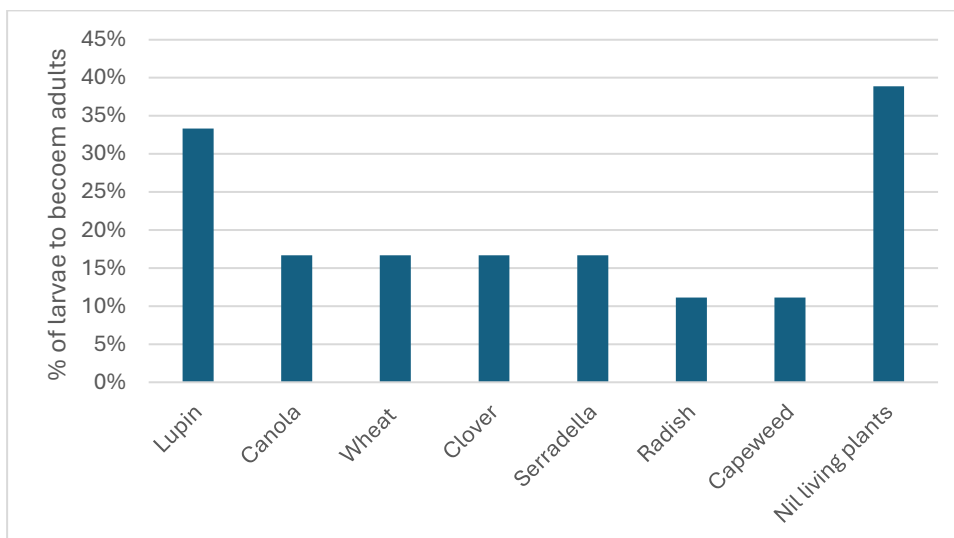


Figure 1: Percentage of field collected desiantha larvae to reach adult hood when placed into pots with field collected plants.

Milestone 2: Environment and desiantha movement

To determine when Desiantha weevils are active, automated pitfall traps were used. These traps were provided as part of the Grains Research and Development Corporation (GRDC) co-investment in the National Grains Diagnostics and Surveillance Initiative (NGDSI) remote sensing project. The pitfall traps remotely monitored insect captures and recorded environmental conditions such as temperature and humidity. Images collected by the system were uploaded via the mobile network; however, the camera was also capable of operating in the absence of mobile reception, with images stored locally until connectivity was restored.

The pitfall consisted of a white, 500 mL cup with an 8 cm wide rim, and contained no preserving liquid.

Images were captured four times daily (5:00 am, 11:00 am, 5:00 pm, and 1:00 am), and the pitfall traps were physically emptied every 14 days. Traps were strategically placed near weed hosts where adult *Desiantha* weevils had previously been observed. Deployments occurred at Tarin Rock in early April and at North Moulyanning in late April 2024.

At both sites, *Desiantha* weevils were detected in pitfall traps within two days of deployment.

Although the pitfall traps were operational only from April to July, images from the first 60 days were analysed to determine when pitfall traps captured weevils. Agronomists advised that crops are most vulnerable to adult weevil damage at this stage of the year and after July spraying would not usually occur.

Time of day was the most significant factor influencing pitfall trap catches. Of the 17 clear images that showed when a weevil was first captured in a pitfall trap, 61% were recorded between 5:00 pm and 1:00 am, indicating that this weevil is most active during this period (Figure 2).

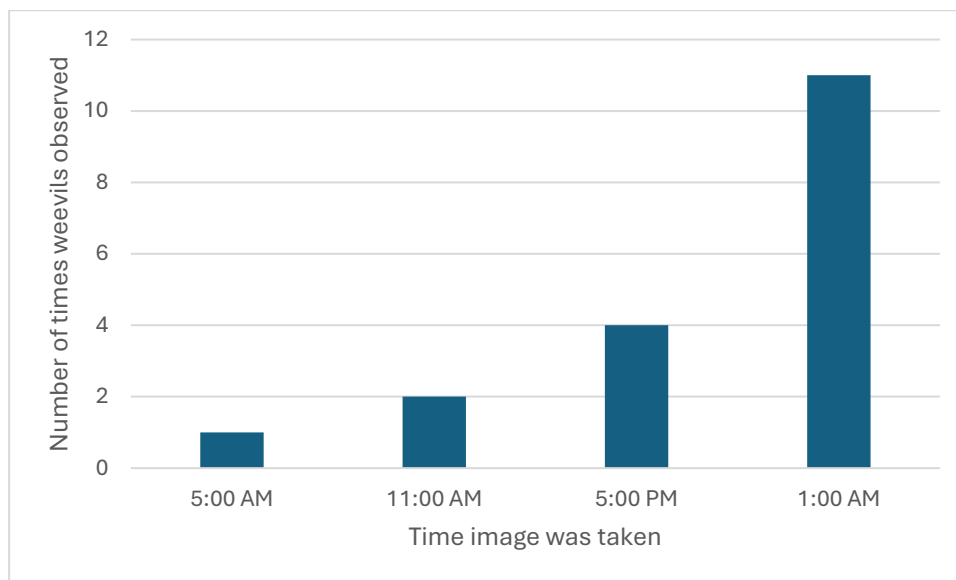


Figure 2: Frequency of desiantha weevils observed falling into pitfall traps based on image analysis

Visual surveys conducted at Tarin Rock and North Moulyanning found that, in spring, neonate adults were readily observed moving on the ground during the middle of the day. At Tarin Rock, it was estimated that there were over 100 desiantha adults per square metre in some areas during spring. However, when the same area was surveyed in late summer, only two weevils were found, sheltering under fallen logs and weeds. Similarly, at North Moulyanning, adult weevils were also difficult to locate during late summer. At this site, however, as soon as capeweed germinated and became established, particularly along fencelines, adult weevils were readily collected for trials.

Recommendations for Improving Desiantha Weevil Management

Current recommendations for desiantha weevil spray applications to be applied in the late afternoon, is the most practical. While peak weevil activity occurs between 5:00 pm and 1:00 am, undertaking control measures throughout during this period may not be feasible in most farming operations.

In order to improve management outcomes, growers can undertake two simple IPM strategies:

- Control host weeds within paddocks during the previous cropping season and between growing seasons
- Monitor paddocks in the year prior for adult weevils and consider sowing at the highest practical seeding rate

Desiantha weevils are easily observed in spring within paddocks, and their presence can serve as an early indicator of potential crop damage from this pest. However, in seasons when control is required, they can be difficult to locate in paddocks, as adults tend to shelter under debris and become less active during hotter periods.