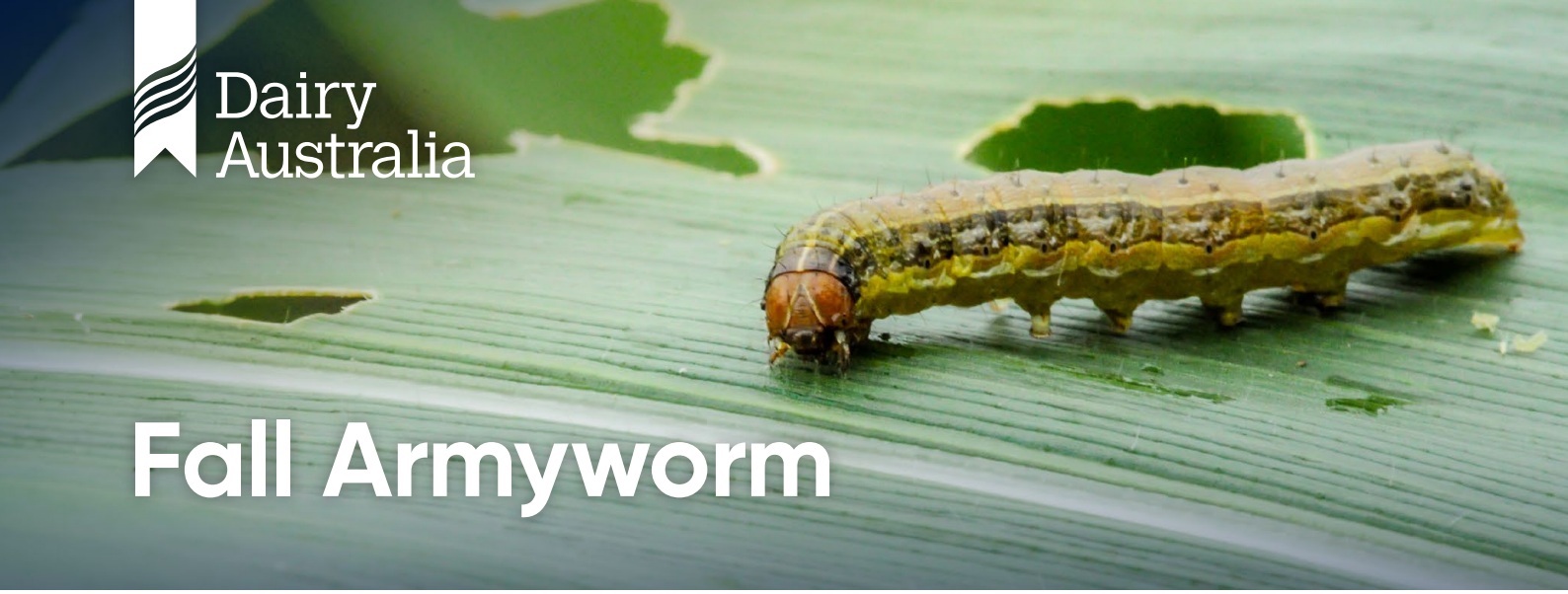


Fall Armyworm

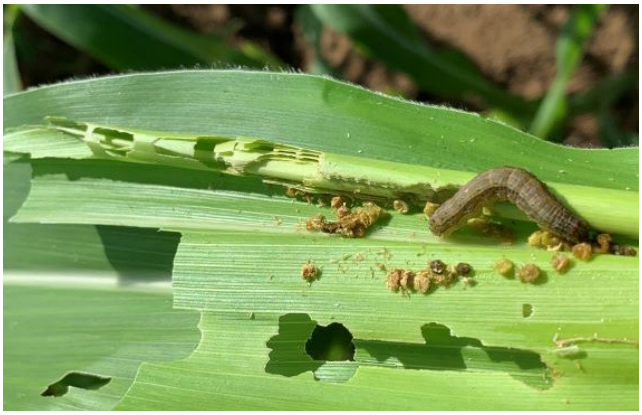
Fall Armyworm (FAW; *Spodoptera frugiperda*) is a tropical migratory pest that has been present in Australia since early 2020. It is more prevalent in warmer tropical regions, and therefore is of particular relevance to dairy farmers in Queensland and New South Wales. However, population build up has been observed in more southerly regions during periods of warmer weather through the summer months.

Attention

It is highly recommended to consult with your local agronomist if you suspect that Fall Armyworm might be present on your farm. Even if you are unsure or unable to definitively identify the presence of fall armyworm, it is still best to get advice from an agronomist with knowledge of the pest. This is especially true if you or your neighbours have a high value crop such as maize or forage sorghum that forms a substantial portion of your total feedbase investment.

FAW has a wide potential host range; however, species with whorls such as maize and sorghum are especially susceptible, which makes monitoring and control of this pest particularly important for dairy farmers that rely on these crops as part of their feedbase.

If infestation rates are high enough, FAW can have an extremely destructive effect on crops. Since first being identified in 2020 on Australian shores, FAW has become established as an endemic pest and eradication is not considered possible. Significant research efforts have focused on how best to manage and limit its impact across several primary industries, including dairy.



Damage inflicted on corn plants by Fall Armyworm. Image courtesy of the Department of Agriculture and Fisheries, Queensland.

Identification of Fall Armyworm

It has been quite challenging for Australian farmers and agronomists to clearly identify FAW, particularly at the larvae stage. Confusion with other species, in particular *Helicoverpa spp.* (also known as Heliothis), has been common but the attached quick guide from Plant Health Australia provides clear instructions from pages 5-9 on how to positively identify the presence of FAW.

planthealthaustralia.com.au/wp-content/uploads/2020/11/Fall-Armworm-Quick-Guide.pdf

While similarities with *Helicoverpa spp.* are often hard to discern, one clear difference is that FAW is likely to be present in much larger numbers than *Helicoverpa spp.* – and so the need to clearly distinguish between them.

Correct identification of FAW is important for several reasons and if you suspect there is an infestation on your property it is strongly encouraged to complete a thorough investigation with experienced agronomists to confirm its presence. From a pesticide resistance perspective, as well as protecting important crop beneficials, it is essential that the most effective pesticide is used at the correct rate and at the optimum time.

DELIVERING for DAIRY

Identifying larvae Stage

This one-page factsheet from **theBeatsheet.com.au** is an excellent visual representation of commonly confused larvae from several similar species including FAW.

thebeatsheet.com.au/wp-content/uploads/2020/06/Armyworm-larvae-May20.pdf

Derived from Beatsheet poster - Armyworm larvae

Identifying armyworm larvae

Armyworm species are members of the noctuid family and have many similarities during their lifestages. In general:

- Moths are grey or brown with a 35-40 mm wingspan; wing patterns can vary from mild to very mottled/patterned.
- Eggs are laid in masses. *Spodoptera* spp. cover the mass with a layer of scales, creating a furry appearance.
- Newly hatched caterpillars usually have a pale or translucent body and dark head, and develop more distinctive colours/patterns as they grow.
- Older larvae (30-40 mm long) provide the best chance of visual identification. Even then, individuals can very widely.

Caterpillars with a wide host range (narrow and broadleaf)

Armyworms

Dayfeeding armyworm
Spodoptera exempta

Also known as African armyworm; body is darker at high population densities.

Lesser armyworm
Spodoptera exigua

Also known as beet armyworm; often yellow or pinkish underneath.

Fall armyworm
Spodoptera frugiperda

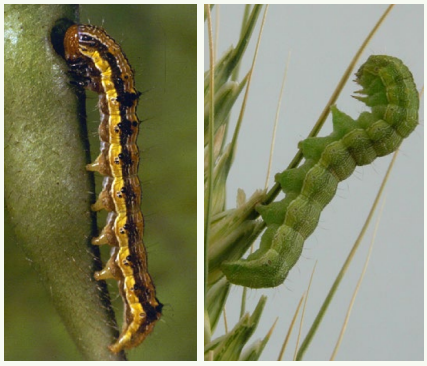
Variable colours; short hairs; pale 'Y' marking on head; raised dots in a trapeze and square patterns on back.

Cluster caterpillar
Spodoptera litura

Variable colours; yellow/orange lines with dark crescent-shapes along the back and a row of dark dots along each side.

Similar-looking caterpillars

Helicoverpa
H. armigera and H. punctigera (30-35 mm)



Variable colours; hairs along back and sides.

Cutworms
Agrotis spp. (50 mm)

Dark larvae; mostly ground-dwelling.

Loopers
multiple species (30-40 mm)

Variable colours; distinctive 'looping' movement.

Armyworms that occur in cereals and grasses

Common and Northern armyworm *Mythimna convecta and M. separata*

Common and Northern armyworm *Mythimna convecta and M. separata*

Medium-sized larvae

Helicoverpa

Fall armyworm

Cluster caterpillar

Lawn armyworm
Spodoptera mauritia

Similar crescent markings to cluster caterpillar but without the rows of dark circles along the sides.

Produced with support from: GRDC Grains Research & Development Corporation. Queensland Government

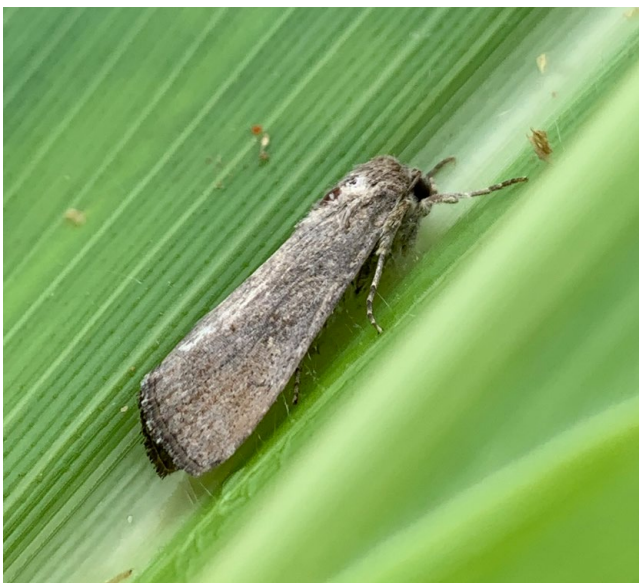
Last updated May 2020

Identifying adult stage

The following page of the NSW Department of Primary Industries website also provides some good tips on how to correctly identify FAW.

www.dpi.nsw.gov.au/biosecurity/plant/insect-pests-and-plant-diseases/fall-armyworm

Fall Armyworm adult male moth. Image courtesy of Beatsheet. Photo taken by Melina Miles (Department of Agriculture and Fisheries, Queensland).



Fall Armyworm adult female moth. Image courtesy of Beatsheet. Photo taken by Melina Miles (Department of Agriculture and Fisheries, Queensland).

Threshold rates of Fall Armyworm to trigger control strategies

There are currently no locally derived thresholds to guide management of FAW due to lack of time to assess the impact on maize in Australia. Guidance from the USA recommends checking 20 consecutive plants in a row and count the number of larvae per plant.

Make sure to open the whorl/cobs in older plants. Repeat at five sites in the field. The threshold for control is reached in the United States when three or more larvae are found per plant in maize in the vegetative state, or 20 per cent of whorl stage plants have one or more larvae.

In Australia, FAW larvae thresholds can be region specific and are not clearly defined. However, in general it is wise to take a conservative approach even if just a few FAW larvae have been identified in your crop, as infestations can grow rapidly. At a minimum, speak to an experienced local agronomist or Department of Primary Industry for advice if FAW is identified. From that point consider whether any action is necessary, and the costs of that action.

For sorghum, the Department of Agriculture and Fisheries (DAF), Queensland recommends using this economic threshold calculator for *Helicoverpa spp.* infestations to determine whether the cost of control equals the value of potential crop loss: **thebeatsheet.com.au/economic-threshold-calculators/economic-thresholds-helicoverpa-in-sorghum**

It is important to consider the economics of control options versus the potential yield loss likely to occur. In some cases, the cost of control options may exceed the value of the lost yield if threshold infestation levels of FAW are not fully met.

Incursion rates of Fall Armyworm

The Queensland Government's Beatsheet website contains a useful interactive page that is regularly updated with FAW moth counts from several pheromone traps laid around the state to monitor infestation numbers.

thebeatsheet.com.au/key-pests/fall-armyworm/faw-pheromone-traps/#qld

As stated on the website, it is important to note that the primary function of pheromone traps is not to provide definitive counts but to act as an 'early warning' for potential egg lays of FAW. In-crop sampling is required to accurately assess the presence of eggs and larvae.

In New South Wales, there was an initial pheromone moth trap program that has been sporadically updated to provide info on FAW counts – this info can be accessed here: **dpi.nsw.gov.au/biosecurity/plant/insect-pests-and-plant-diseases/fall-armyworm**

Biological control of Fall Armyworm

Research into non-chemical control options of FAW is ongoing but there have been some promising strategies implemented in some circumstances.

The advantages of successful biological pest control are numerous and include:

- avoidance of any negative impacts of pesticides on other beneficial insects that may aid in control of FAW
- reduced risk of pesticide resistance from unnecessary applications of chemical pesticides
- reduced risk of pesticide misuse and reduced social licence risk for the industry.

The biggest factor influencing whether farmers should use biological control options or chemical control is the level of infestation of FAW.

Knowing when not to use chemical sprays for FAW is just as important as knowing when to spray and which chemical options to use.

More detailed information on biological control of pests is available here: **thebeatsheet.com.au/key-pests/biological-control**

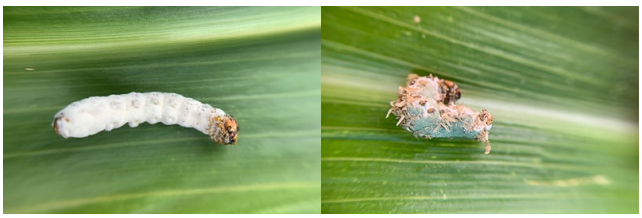
From a FAW perspective, the main biological control options are:

- disease causing organisms (pathogens)
- beneficial arthropods (parasitoids)

Several predators, parasitoids and pathogens have been identified from FAW in Australia, including egg parasitoids (Trichogramma sp and Chelonus sp.), larval parasitoids (Cotesia sp, Tachinid flies), pupal parasitoids (Heteropelma sp.), predatory bugs, spiders and pathogens (Metarhizium rileyi).

Commercial formulations of FAW-specific nucleopolyhedrosis virus (Fawligen® and Spodovir® Plus) are available under permit for FAW control in a number of crops. They are likely to be most suitable in situations where control of a modest infestation of FAW is the aim, as opposed to situations where they are present in large numbers and chemical pesticide interventions are likely necessary.

There are also some promising results currently being obtained by DAF Queensland around the use of Metarhizum fungal pathogens as a biological control mechanism with research well advanced into this particular strategy; however it is not commercially available as of yet (November 2023).



Fall Armyworm larva killed by Metarhizium rileyi. The fungus can be white (just hyphae) or green (sporulating). Image courtesy of Beatsheet.

Timing of application of insecticides for FAW control

When applying chemical or biological insecticides to forage crops for the control of FAW, you need to consider plant growth stage, FAW life cycle stage, withholding period after chemical application and time of day of application.

Any control method decision should be made with best management practices in mind and must form part of an Integrated Pest Management (IPM) system, so as not to build up a resistance in a control method making it harder to control FAW or other species such as *Helicoverpa spp.*
in future incursions. As with any chemical treatment, growers need to be mindful of off target damage, and in this case, reduction in the number of beneficial insects. Best management practices to include in your IPM are:

- Rotate insecticides that belong to different modes of action groups.
- Consider Biological control methods:
  - Biological virus sprays.
  - Introduction of beneficial insects such as Trichogramma SP.
- Consider off target impacts – beneficial insects and pollinators.
- Regular crop monitoring for level of infestations and economic thresholds.
- Appropriate timing – sprays should target egg and larval stages of FAW.
- Best time of day to spray – FAW caterpillars (instar 1-6) do not like UV light so during the day they will be sheltered deep within the whorl of the growing maize or sorghum host plant.
- They come out at night to feed on the plant, but they will also feed within the sheltered growing point during the day. It has been observed that by spraying a chemical insecticide later in the day with a feeding agent or wetter has delivered best results.

Case study

Jason Bake, dairy farmer in Crossmaglen, New South Wales

Jason Bake milks 400 cows with his family on their farm in Crossmaglen, close to Coffs Harbour on the Mid-north NSW coast. The farm is predominately pasture-based but Jason grows a substantial portion of maize silage each year as part of the overall feedbase on the farm.

The advent of FAW in the last few years has added a new challenge to achieving a high yielding, high quality crop of maize silage. The overall impact of FAW has been relatively modest on the farm, certainly relative to other parts of Australia further north in Queensland, but Jason has remained ultra vigilant to the threat posed by this novel pest.

He has worked closely with the Local Land Services team and his agronomist in NSW on installing pheromone traps to monitor fall army worms over the last few seasons:

"We haven't detected massive numbers so far; five or six moths was the most we caught in the traps, but regular monitoring is just one of the steps we take to mitigate the threat of Fall armyworm," said Jason.

"Fall Armyworm is a greater threat to our maize crop in summer and we have shifted towards sowing much earlier in the year. From December at one stage a few years ago to October over recent seasons – and now we target sowing once soil temperature reach 14°C and the winter crop has been removed."

Sowing early in the season, particularly in the southern parts of Queensland and all of NSW, capitalises on the break of the FAW larvae lifecycle in the cooler winter period.

By contrast, sowing in November or December is likely to mean FAW larvae lifecycles are well established – this making newly emerged plants more susceptible to damage from the pest.

Responsible use of chemical pesticides is another aspect of FAW control that Jason is passionate about:

"While we aren't getting massive numbers of FAW moths in our pheromone traps, I am more focused on using biological control methods to avoid harming 'beneficial' insects that are natural predators of FAW," Jason explained.

"In addition, we have to also control Heliothis pests, which we do routinely each year now using a virus treatment called Vivus-Max. It's also important that we don't contribute to pesticide resistance for pests such as Heliothis via unnecessary or incorrect use of chemical pesticides."

Jason keeps a close eye on developments in the control of FAW to be as well prepared as possible in the case of a large outbreak on his farm.

> "We have a number of different tools in the arsenal now thanks to the efforts of the industry in the last few years," he said.

"These include trichogramma (parasitoid wasps), *Fawligen* – which is a good option to apply before the tassel stage of growth when FAW larvae are at the first instar – and ultimately, chemical pesticide options if it gets to that stage.

"I am also monitoring developments in seed treatment to provide protection from FAW in the early stages of the plant's life. Ultimately, identification and monitoring is the key basis of our approach, which then provides us with quality information to make the best possible decision."

Choosing between maize and sorghum if FAW is present

Southern Australia

In southern growing environments (south of Dubbo), FAW is likely to be a sporadic pest, meaning it cannot survive over winter easily in these regions. Incursions of FAW will not tend to be every season and if an incursion does occur, it will be present later in the season following an incursion in northern regions. Generally, the further south you go the later in the summer period the incursion will occur, as they need to migrate south on the prevailing winds.

With this in mind, the decision process on what to grow in these areas should not be solely based around whether an incursion of FAW will occur. The decision process, like in most areas, should be based on solid business practices around what your feed requirements are now and into the near future.

You need to consider how you will meet these feed requirements (homegrown feed is the cheapest form), if your system handles summer cropping with maize or sorghum, and when you're likely to plant the summer crop.

FAW incursions tend to happen later in the season so by planting early and getting a good healthy plant stand occurring you are more likely to have a successful crop. However, if FAW or *Helicoverpa spp.* (Heliothis) do arrive later in the season you should be prepared to protect your feedbase investments by doing one or more control methods.

Given the incursions of FAW are more likely to be late in the summer growing season, the incursion level is likely to be low to medium and only require 0-3 control methods.

Northern Australia

In the northern growing areas (north of Dubbo) there is a greater likelihood of having a higher level of incursion by FAW due to the warmer winter months, with the level of incursion increasing the further north you are located. Far-north Queensland (Atherton Tablelands) will experience earlier and higher incursion levels relative to southeast Queensland and northern NSW. There are two things to consider in the northern growing areas:

1 Time of planting – a spring planting with silage harvest around the end of the calendar year is more likely to experience a low to moderate incursion level and only require 1-3 control measures. Later plantings in the early new year will have a greater likelihood of FAW incursion and therefore a higher level (3-6) of control methods.

2 Forage type. Fall Armyworm has demonstrated crop feeding preferences – maize is more susceptible than sorghum to incursions and damage by FAW.

Forage selection will also be determined by your forage yield and quality needs and availability of irrigation water or forecast rainfall.

If sorghum is damaged in the early stages of growth, it is more likely to grow through the damage and won't have any significant effect on the seedhead due to its open nature. Maize can be potentially destroyed if attacked in the early growth stages with a high incursion level, resulting in lower yields and quality.

If maize if attacked later in the growth stage, then there is also a risk of damage to the cob and the development of mycotoxins in the subsequent silage. Therefore, if you are planning to grow maize in the northern regions, an earlier planting time will reduce the risk and number of control measures, therefore reducing the cost of production and potential quality issues.

Sorghum (forage and grain varieties) can be grown as an alternative to maize for silage with a lower risk of damage from FAW and a reduced cost of production and risk of quality issues.

Decision making tools for forage crop selection

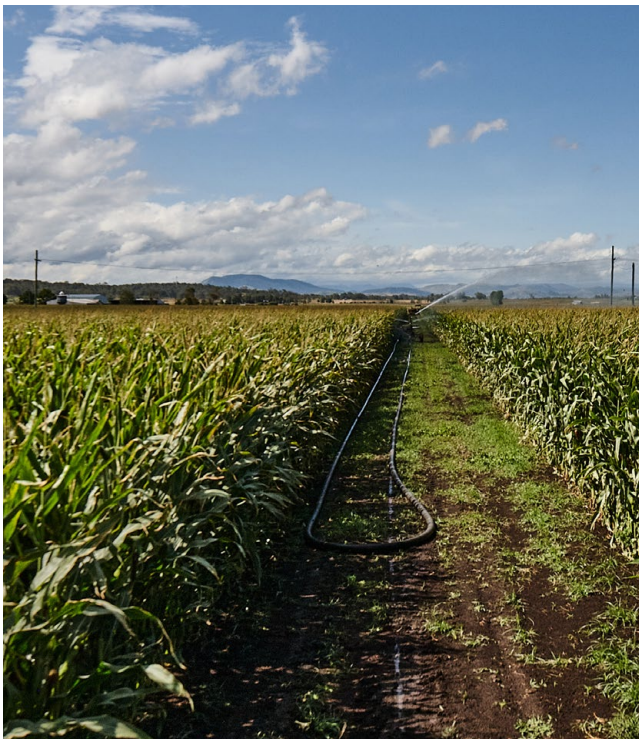
Decide when you require feed and how much you require first. Your decisions then need to be based around your system – can you handle maize or do you need an alternative such as sorghum?

It is advised that a feed budget be completed with different forage options to determine the impact in your production system.

There are a number of forage cost calculators available to download and use from the internet to calculate the impact on the cost of production of forage crops. An example is provided below of the likely impact on the cost of forage production from a range of incursion levels and increasing control methods required for Maize silage.

Example Feed Cost – Maize Silage

To view 'Maize cost with FAW treatment', visit **dairyaustralia.com.au/issues-and-emergencies/fall-armyworm**



Links to forage cost calculators

1 DAFQ: Dairy forage cost calculators – **https://northernaustraliandairyhub.com.au/resources/feedbase-nutrition/agronomy**

2 Pioneer – **Corn for Silage Growing and Harvesting Costs Calculator | Pioneer® Seeds Australia (pioneerseeds.com.au)** – cannot add additional management tasks such as FAW sprays.

List of Fall Armyworm chemical control options registered for use in Australia (updated February 2024)

To view 'Fall Armyworm control pesticide and withholding table summary', visit **dairyaustralia.com.au/issues-and-emergencies/fall-armyworm**

Above is a list of the active chemical constituents that are registered for use in Australia for control of FAW. Also included in this table are the permit links, the permit expiry dates and the relevant withholding periods.

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