Growing maize and sorghum in southern Queensland

Lessons from two years of farming with fall armyworm

First detected in northern Queensland in February 2020, fall armyworm (FAW; *Spodoptera frugiperda*) is now considered endemic. This is part of a series of case studies examining how Queensland agronomists and broadacre growers highly impacted by FAW have adapted.

FAW is a tropical species, and although able to establish in subtropical and temperate environments, tends to do so only during warmer months. International reports that uncontrolled FAW can cause more than 50% yield loss in maize and impact a wide range of other plant species caused understandable concern by at risk industries about the arrival and spread of this pest. In southern Queensland, the current expectation is that FAW will establish where favourable environmental conditions exist but will be significantly less active in the winter months.

First experiences with FAW

Growers and agronomists in southern Queensland didn't detect FAW in damaging numbers in crops until December 2020, and there was minimal impact that season as the majority of maize crops were finished by the time FAW populations built up. During the 2021 summer crop, agronomists and growers began to experience FAW damage, however all agronomists surveyed agreed that early sown crops had not needed spraying and got through without major damage or crop loss, although some growers had felt the need to do something and had sprayed against advice.

Despite FAW being detected in many sorghum crops across the Darling Downs, all those spoken with said that they had not needed to apply sprays for control in sorghum as they saw no evidence of major damage. It was also noted that FAW populations naturally declined in sorghum crops around head emergence, whether this is due to plant palatability, predation or some other factor was unknown.

"I've seen FAW in sorghum but they seem to just disappear when sorghum comes out in head so no need to spray" – Agronomist, Dalby

Pre-flowering sorghum damaged by FAW

Maize planted on the Darling Downs in December 2021 received multiple sprays (typically Affirm® and Vantacor®), and while agronomists and growers were happy with the level of control achieved by the available chemistry, they still experienced yield reductions of up to 20% in these crops. While the reported timings of these sprays varied among survey participants, between 6-10 leaf was common for a first spray, with a second either shortly prior to or after tassel.

Agronomists mentioned experiences with some of the later planted corn (January plant), particularly in isolated crops away from the main corn growing areas, where no noticeable FAW damage was observed, indicating that not all later crops may be subjected to high FAW activity.

Lessons learned so far:

1. Successful control of FAW can be achieved with chlorantraniliprole (e.g. Altacor®), spinetoram (e.g. Success® Neo) and emamectin benzoate (e.g. Affirm®).
2. Despite detections across the Darling Downs, there was no evidence of FAW major damage to sorghum.
3. Early planted maize has seen minimal impact. Avoid planting maize late.

Adopting lessons in FAW management

All agronomists surveyed noted that their number one recommendation to growers for FAW management in southern Queensland was to plant early and avoid the build-up of FAW. There was often a 'background presence of low numbers', but not at levels worth spraying as they were unlikely to cause economic loss.

This early plant recommendation has been readily adopted by opportunistic and dryland maize growers in southern Queensland. Some have decided to remove maize as an option as it gets later in the season, while others are willing to take the chance based on existing regional pressure at time of planting.

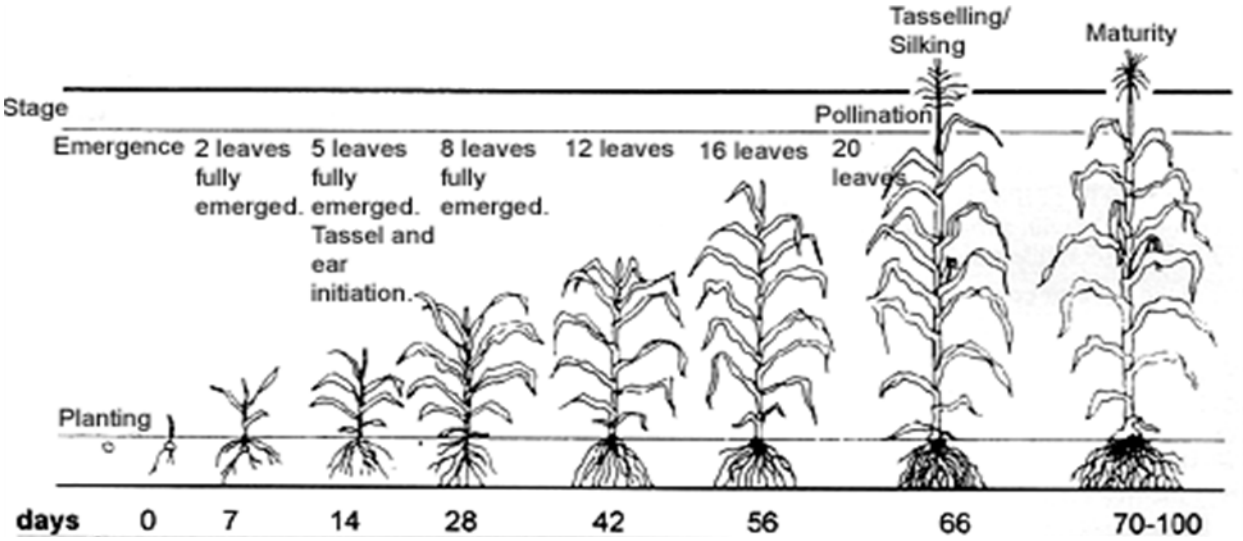
A significant time commitment of time to inspect crops regularly for FAW was required, particularly in wet conditions where paddock access could be challenging for monitoring and spraying. Some agronomists had made recommendations to spray late corn which in hindsight may not have been needed.

Despite the general lack of spraying for FAW, agronomists proactively trialled a number of non-chemical options, including nucleopolyhedrovirus (NPV) formulations (e.g. Fawligen®) and attract and kill products (e.g. Magnet®).

Similar to the experiences in northern Queensland, they found that the lack of rainfastness of Magnet® meant that it was logistically challenging in wet summer conditions where it may need multiple re-applications.

Consequently, it was unlikely to form a part of their long-term control options, while NPVs like Fawligen® were seen as being logistically suitable, particularly by irrigated maize growers where application via pivot (overhead irrigation) 'seemed ok'.

"We trialled using Magnet® but lots of summer showers meant it washed off and needed constant re-application, so gave up on that" – Agronomist, Pittsworth



Traditional corn growth stages and timings for northern NSW (Source: NSW DPI)

There has been minimal impact of FAW on maize profitability in early planting windows, and grower and agronomist experiences have been largely positive. None surveyed believed that maize growers had decided to stop growing the crop altogether because of FAW. Reduced maize production in 2020-22 is more likely a result of previous drought years (2017-2020), limited water availability, maize and cotton prices and marketing options. Several agronomists had clients who had elected to grow maize for the first time in the last couple of years because of planting convenience and standability (giving greater flexibility in harvest timing). Some agronomists expect an increased area of maize grown in coming years when conditions are favourable for early planting to minimise FAW risk.

Growers who persist with late season maize plantings because of marketing, farming system or opportunistic reasons face a potential impact on crop profitability arising from the increased control costs of two insecticide applications (Affirm® and Vantacor®), and up to 20% reduction in yield even when spraying for FAW.

The economic impact of FAW on dryland and irrigated maize is examined below in Tables 1 & 2. With no need for additional sprays and no observed yield loss impact on early plant maize in southern Queensland has been minimal to none. However, while late planted dryland and irrigated crops are still expected to generate positive gross margins, their profitability is expected to be significantly reduced by $300/ha and $550/ha for dryland and irrigated crops respectively.

Table 1. Fall armyworm impact on dryland maize gross margins in SQ using long term average costs and prices

DRYLAND	Pre-FAW	Post FAW (early plant)	Post FAW (late plant)
Yield (t/ha)	4	4	3.2
Price ($/t)	$300	$300	300
Total income:	**$1,200**	**$1,200**	**$960**
Fallow management	$56	$56	$56
Planting	$174	$174	$174
Nutrition	$175	$175	$175
Crop protection	**$66**	**$66**	**$146**
Harvesting	$213	$213	$213
Other	$24	$24	$24
Total costs ($/ha)	**$708**	**$708**	**$788**
Gross margin ($/ha)	**$492**	**$492**	**$172**

Table 2. Fall armyworm impact on irrigated maize gross margins in SQ using long term average costs and prices. .

IRRIGATED	Pre-FAW	Post FAW (early plant)	Post FAW (late plant)
Yield (t/ha)	8	8	6.4
Price ($/t)	$300	$300	$300
Total income:	**$2,400**	**$2,400**	**$1,920**
Fallow management	$56	$56	$56
Planting	$174	$174	$174
Nutrition	$280	$280	$280
Crop protection	**$66**	**$66**	**$146**
Harvesting	$213	$213	$213
Other	$44	$44	$44
Total costs ($/ha)	$833	$833	$913
Gross margin ($/ha)	**$1,567**	**$1,567**	**$1,007**

Most agronomists felt comfortable with the control options currently available, particularly Affirm® and Vantacor®, with good control achieved. They were also content that the wider industry in SQ had largely adapted to the FAW risk by utilising early planting, and were confident in their ability to identify FAW, and recognise the symptoms of FAW infestations. Agronomists with prior experience of insecticide resistance perceived an increased risk of insecticide resistance to key chemistry developing if insecticide options were overused or mismanaged. Importantly, the key chemistry being used to control FAW is vital to the management of a range of insect pests, including Helicoverpa, in other broadacre crops.

There were questions about how the population dynamics of FAW may change in drier summer conditions given they had only experienced wet summers since FAW arrived. Would local dry conditions alter the build-up phase, and would drier conditions further north change the timing or size of FAW immigration into southern areas?

While early planting had been a successful strategy, there were likely to be seasons with wetter than normal conditions where 'early' planting would be delayed by at least a month, reducing its effectiveness as a management tactic. Being able to predict the seasonal severity of outbreaks was also raised by agronomists as a vital planning and risk management tool for FAW.

"The question is how bad are they going to be this year, is there any way of predicting or do we just have to react season to season?" – Agronomist, Dalby

Researcher comments

The rapid shift to early planting for maize by growers, specifically to avoid FAW impact, has been impressive. The advantage that spring planting presents has been reiterated consistently by agronomists, seed companies and DAF, resulting in the widespread uptake of this strategy. Growers and agronomists in the southern growing regions have exploited the lower FAW pressure and seasonal lull in activity perfectly. With just two years of experience with FAW, agronomists and growers are justifiably nervous about whether this very effective strategy will hold up every year.

The principle of avoiding high FAW pressure by planting early is sound, but there is limited understanding at present of how warmer winters or abundant winter-spring host availability (crop and non-crop) might influence the timing and abundance of FAW in southern Queensland's growing regions. The timing and contribution of migrating FAW will vary between years, as will the contribution of local populations that may/may not overwinter locally.

With experience and targeted research, our understanding of local FAW population dynamics will improve and inform grower risk assessments. In the meantime, research to develop guidelines for preventing economic loss in sorghum and maize (economic thresholds) is underway, as are studies of natural enemy impact and robust crop scouting methods. Incrementally, robust management strategies that consider seasonal differences will be available to industry.