FIELD PEAS
FOR TRAP CROPPING IN CENTRAL QUEENSLAND

Paul Grundy and Sherree Short

Plant Science, Queensland Department of Primary Industries & Fisheries

LMB 1, Biloela Qld., 4715.

Summary

Central Queensland currently enjoys an ascochyta blight free status, however the use of chickpeas as a winter trap crop has created a potential risk for the introduction of the disease. To address this problem we have evaluated alternative winter active legumes over the last three seasons for their suitability to be substituted for chickpeas as a spring trap crop in central Queensland. Field peas have been identified as being highly attractive to egg laying *Helicoverpa* spp. moths during each season and it is now our recommendation that growers in CQ use field peas (cvs Alma or Glenroy) for their spring trap crop.

Introduction

A strategic trap cropping program targeting *Helicoverpa* spp on cotton has been implemented in central Queensland since the beginning of winter in 1997. Growers typically plant 1-2% of their cropping area to a trap crop of chickpea in winter and pigeon pea in summer (Sequeira 2001).

Similar trap cropping strategies have been implemented in southern regions where chickpeas are utilised as a spring trap crop to capture *Helicoverpa armigera* populations that emerge from diapause at that time. However, a potential problem with the use of chickpeas is their susceptibility to ascochyta blight, a seed-borne fungal disease (Slatter & Lucy 2002).

At present CQ is free of ascochyta blight. However, the local Pulse industry has expressed concern that the use of chickpea as a spring trap crop in CQ may inadvertently lead to the introduction of ascochyta. In response to these concerns we decided to evaluate a number of winter active legumes for their potential to be substituted as a winter trap crop under CQ conditions and thus alleviate any cross-industry conflict. The major focus for this study was to observe the number of eggs laid versus larvae numbers on each trap crop, as it was suspected that the high larvae numbers so often observed in chickpeas may be due to a lack of beneficial heliothis egg-eating insects, allowing a higher proportion of the total eggs laid to survive.

Materials and Methods

Comparing Heliothis Attraction to Legume Species

Two experiments were conducted within a 20 ha field of wheat, *Triticum aestivum* (L.) (cv Kennedy) near the township of Biloela, central Queensland (24°22'S, 150°06'E) during the winter and spring of 2001 and 2002. In each experiment, treatment plots with dimensions 20m x 20m and 1m row spacing were arranged in a randomised block design with four replicates of each treatment. The plots were separated by 15 m buffer strips sown to wheat on all sides. In the 2001 experiment, legume treatments of chickpea (cv Amerthyst), field peas, *Pisium sativum* (L) (cv Alma) and two varieties of vetch, *Vicia sativa* (L.) (cv's Namoi and Popani) were compared. In the 2002 experiment, comparisons were made between treatments of chickpea (cv Amerthyst), field pea (cv Alma) and faba beans, *Vicia faba* (L) (cv Fiord). The plots and buffers were planted on 26 June 2001 and 4 July 2002.

In the early crop stages, sampling for *Helicoverpa* spp. was done at approximate 10 day intervals. The sampling frequency was increased once *Helicoverpa* spp. activity was observed to increase in the treatment plots. The data were expressed as numbers of insects' m^{-1} for each treatment.

H. armigera was the dominant species, with only low numbers (<30%) of *H. punctigera* observed each season. Visual counts of *Helicoverpa* spp. eggs and larvae were made on two separate sets of randomly selected 1-m lengths of crop foliage in each treatment replicate. When sampling for eggs, four 1-m lengths of foliage was cut from each plot and returned to a field laboratory for close inspection.

The treatment plots were destroyed by cultivation on 3 and 9 October respectively for the 2001 and 2002 experiments.

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The fate of Heliothis Eggs laid on different trap crops

The fate of eggs laid on chickpea and field pea (these two treatments were chosen as eggs were the most abundant) was investigated during each. White eggs were individually tagged and revisited each day over a period of one week to determine survivorship through the egg and early larval stages. A total of 960 white eggs (60 in each treatment replicate in each experiment) were monitored. The positions of individual eggs were recorded by marking the adjacent leaf surface with a fine tipped, non-toxic pilot felt pen. The corresponding leaf node or branch was also flagged with coloured tape to allow ease of location each day.

On-farm evaluation of field pea trap crops

Following the 2001 experiment, field pea was substituted for chickpea as the trap crop in several locations in central Queensland to compare *Helicoverpa* spp. activity under commercial conditions.

In the 2002 season, two trap crops of field peas were planted in the last week of June in the cotton irrigation area surrounding the township of Theodore (24°55'S, 149°58'E). In 2003, three trap crops of field peas were planted during the last week of June and first week of

July. The trap crops were planted in an area of 2-3 hectares at each site. *Helicoverpa* spp. abundance on these field pea trap crops was compared with nearby chickpea trap crops in the same region, all within a radius of 15 km.

Visual counts of *Helicoverpa* spp. eggs and larvae were made on 4 randomly selected 1-m lengths of foliage in each trap crop using the methods described above. Samples were taken every 4-8 days. Data were expressed as larvae and eggs m^{-1}.

Analysis of data

Count data for *Helicoverpa* eggs and larvae at each sampling date were analysed using a repeated measurements analysis using the method of residual maximum likelihood (REML) with antedependence covariate structure of order 1 with the Genstat computer program (GenStat 2000 for Windows. Release 4.2. Fifth Edition. VSN International Ltd., Oxford). This model was used to assess treatment by time interactions. Differences at each sample date were determined by comparing the treatment predicted means using the standard error of differences.

Results

Comparing Heliothis Attraction to Legume Species

Field peas attracted significantly more (P<0.01) eggs than all other treatments including chickpea in the 2001 and 2002 assessment (Fig. 1 & 3).

In contrast, *Helicoverpa* spp. larvae densities were significantly higher (P<0.01) in chickpea compared to the other treatment legumes in 2001 with the same significant trend (P<0.01) repeated in 2002 (Figs 2 & 4).

In both experiments few *Helicoverpa* spp. eggs were observed on field pea plants prior to flowering. In contrast, eggs were observed on chickpea plants prior to flowering.

Impact of host choice on survival

A large number of the tagged eggs disappeared from the plants, particularly in the field pea treatment. The eggs or resultant neonates that disappeared from the plants could not be accounted for either as dead larvae or by the appearance of other individuals. The percentage of eggs unaccounted for and therefore presumed dead in the field peas was significantly greater than in chickpeas in both assessments (Fig 7).

On-farm evaluation of trap crops

When planted as a trap crop under commercial conditions field pea attracted significantly higher numbers (P<0.01) of *Helicoverpa* spp. eggs compared with chickpeas during the 2002 and 2003 seasons (Fig 5 & 6). *Helicoverpa* spp. oviposition in the field pea plots was observed primarily after the onset of flowering. Field peas were also observed to host various ladybird and lacewing species and *Microplitus* parasitoids unlike chickpeas which did not host any beneficial insect species.

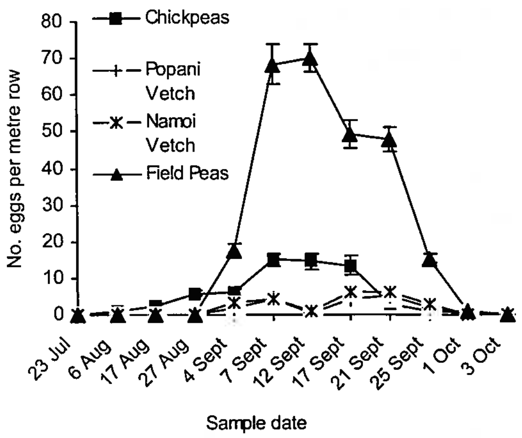

Fig 1. Helicoverpa eggs per m^{-1} of crop foliage in the treatment plots of chickpea, popani vetch, namoi vetch and field pea in the 2001 legume assessment. Error bars denote s.e.m

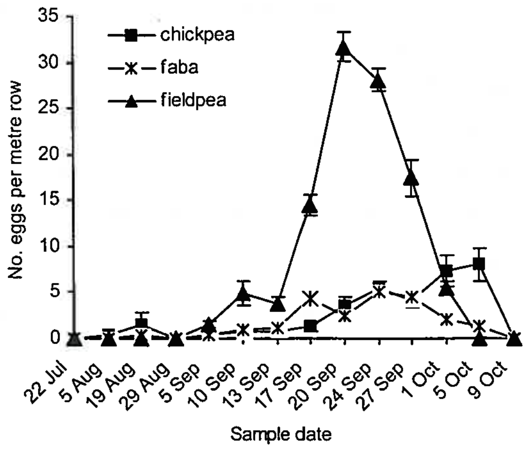

Fig 3. Helicoverpa eggs per m^{-1} of crop foliage in the treatment plots of chickpea, faba bean and field pea for the 2002 legume assessment. Error bars denote s.e.m.

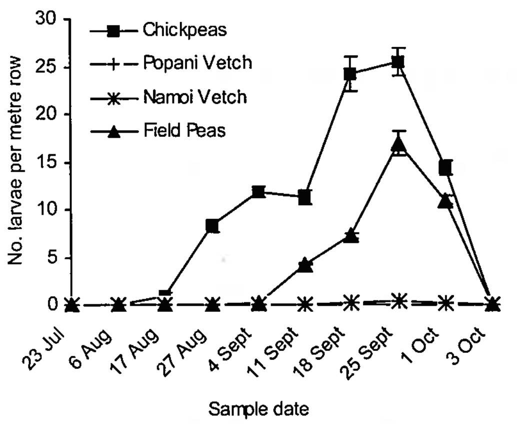

Fig 2. Helicoverpa larvae per m^{-1} of crop foliage in the treatment plots of chickpea, popani vetch, namoi vetch and field pea for the 2001 legume assessment. Error bars denote s.e.m.

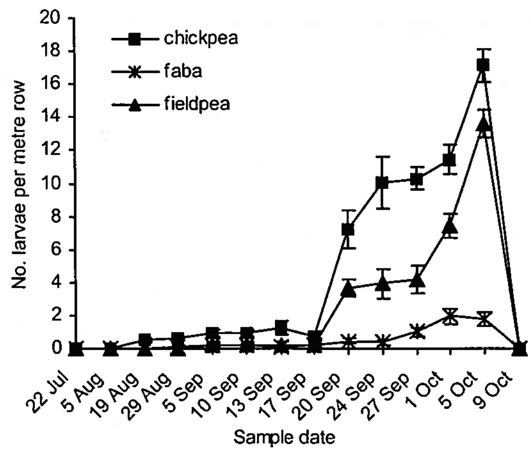

Fig 4. Helicoverpa larvae per m^{-1} of crop foliage in the treatment plots of chickpea, faba bean and field pea for the 2002 legume assessment. Error bars denote s.e.m.

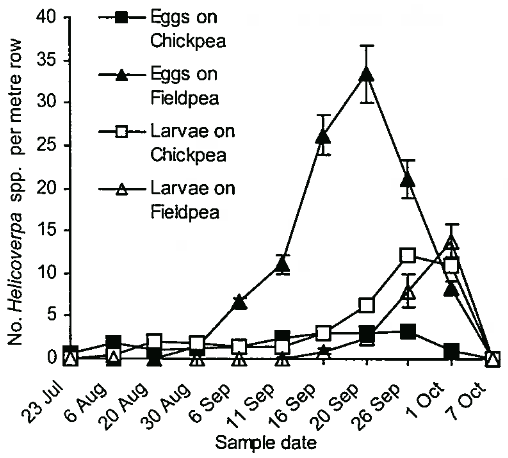

Fig 5. Helicoverpa eggs and larvae per m^{-1} of crop foliage in the chickpea and field pea trap crop fields at Theodore 2002. Error bars denote s.e.m.

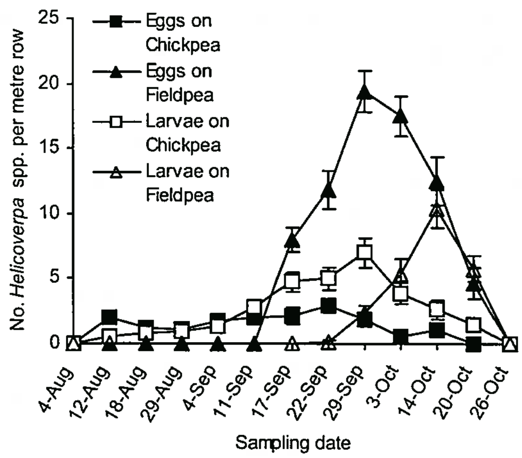

Fig 6. Helicoverpa eggs and larvae per m^{-1} of crop foliage chickpea and field pea trap crop fields at Theodore 2002. Error bars denote s.e.m.

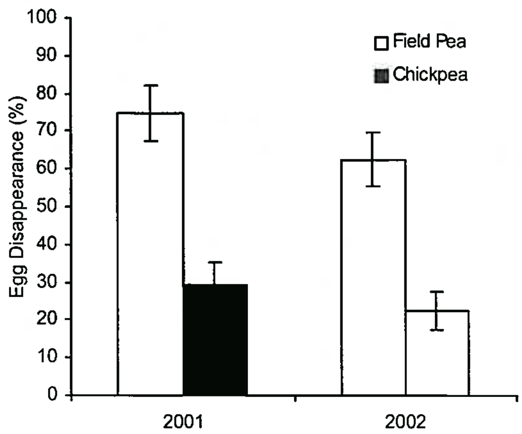

Fig 7. Disappearance (presumed mortality) of marked *Helicoverpa* eggs from the chickpea and field pea plots during the 2001 and 2002 legume assessments. Error bars denote s.e.m.

Conclusions

In each field test scenario, field peas were shown to attract high levels of egg laying *Helicoverpa* spp.. It could be expected that in having the highest densities of eggs that field peas would have also had the highest larvae numbers. However, the fate of eggs laid on the two trap crops suggested that less than a third of the eggs laid on field peas survived to hatching as opposed to over two thirds egg survival on chickpeas (Fig 7). The loss of eggs from field pea may be largely due to the waxy nature of the leaves. During the collection and handling of field pea foliage for egg sampling, many of the *Helicoverpa* spp. eggs were observed to readily dislodge, something that was not observed in chickpeas. The observed losses may have also been due in part to predation by ladybirds and lacewings that were abundant in the field pea treatments.

As a trap crop is intended to attract and divert egg laying *Helicoverpa* spp. moths, the field peas outperformed chickpeas in these experiments by attracting more eggs. The substitution of field pea for chickpea as a spring trap crop in central Queensland is advantageous in that it circumvents potential problems with leaf blight caused by *A. rabiei* that continues to threaten the disease-free status of central Queensland's commercial chickpea industry. Field peas are also advantageous compared to chickpea that can frequently serve as a *Helicoverpa* spp. nursery by hosting substantial populations during the early vegetative stages under central Queensland conditions. These early populations in chickpeas often require chemical control to prevent dispersal.

Our results show that field pea is highly attractive to *Helicoverpa* spp. moths in spring after the onset of flowering. Unlike chickpea, many of the eggs laid on field pea perish which in part makes it a self-sustaining trap crop during the first weeks of becoming attractive to *Helicoverpa* spp.. Field pea was also observed to host various predatory arthropods, which could potentially disperse into surrounding cotton crops upon trap crop destruction. Silver leaf whitefly was not observed to host in the field peas during either season.

Agronomically, field pea establishes as well as chickpea. However, field pea was not as drought tolerant as chickpea and required at least one irrigation or rainfall event between sowing on an initial full soil moisture profile and flowering to achieve luxuriant growth and extended flowering.

The use of field pea in southern regions for spring trap cropping may also have merit and deserves investigation. If successful under cooler conditions, the use of field pea would also ease the management of trap crops in these regions by eliminating the current need to apply several fungicides for the control of chickpea ascochyta blight.

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