Cotton–chickpea mixtures for early season Helicoverpa control

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Integrated pest management (IPM) in cotton continues to be hampered by a lack of non-chemical control options during the season. It is only in recent years that trap crops, biopesticides and other alternative tools have been added to the repertoire of IPM tactics for cotton crops. The workings of these new tools and appropriate use patterns are by no means fully understood, and research is currently in progress to address this.

Over the past three seasons, entomological research conducted by QDPI in Emerald has been focused on a number of issues related to trap crops. In particular, we have been working on identifying crop plants that are highly attractive to key cotton pests and the most effective ways of using trap crops for pest relief within the season.

Trap cropping works on the basic principle that pests have distinct host plant preferences. Some plant species are more attractive to certain insect pests than other plants. One plant species that stands out for attractiveness to Helicoverpa is chickpea (Cicer arietinum). This feature has resulted in the growing use of chickpea to trap and destroy early spring populations of Helicoverpa.

In this article, we report on trials during the 2000–01 and 2001–02 seasons on commercial farms using chickpea to manipulate the pattern of Helicoverpa egg laying activity within early season cotton crops. Mixtures of cotton and chickpea seed were planted to determine if:

• Helicoverpa egg pressure could be diverted away from cotton and on to chickpea; and,

• Egg laying activity could be concentrated into particular rows, so taking the pressure off adjacent rows.

TRIAL SETUP AND RESULTS

2000–01 season

FIGURE 1: Mean Helicoverpa egg density per plant on chickpea and cotton in the seed-mixed rows (R–0), adjacent (R–1) and 4th (R–4) cotton-only rows, 2000–01season

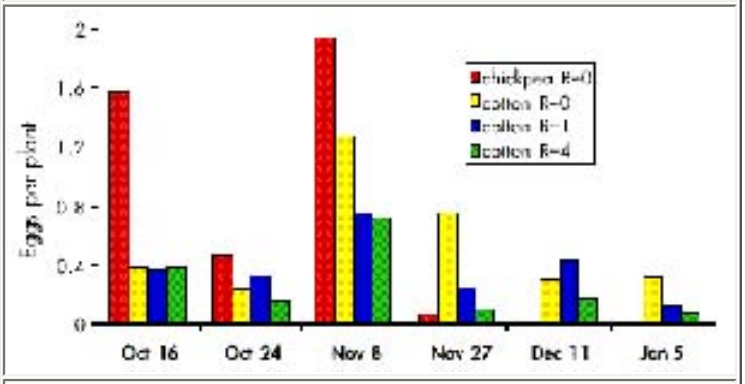


FIGURE 2: Comparison of mean Helicoverpa egg density per metre in seed-mixed (R-0) and cotton-only rows (R–1 and R–4), 2000–01season

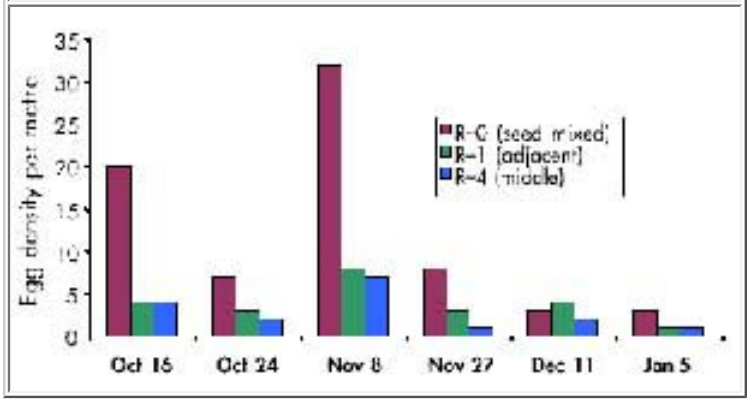


FIGURE 3: Mean height of chickpea and cotton in the seed-mixed rows (R–0), adjacent cotton-only rows (R–1) and 4th cotton-only rows (2000–01)

On one 45 hectare paddock, a mixture of cotton and chickpea seed (five kg cotton plus five kg chickpea per hectare) was planted in one of every eight rows by placing the seed mix in the fourth box of an eight row planter. Cotton only, at the normal rate (10–12 kg per hectare), was planted in all the other rows. The trial was planted on September 24.

Sampling for Helicoverpa eggs and larvae was done at regular intervals in the first half of the season. At every sampling, 30 plants each of cotton and chickpea from the seed-mixed row (R-0), 30 cotton plants from the adjacent row (R-1) and 30 cotton plants from the fourth row (R-4) were selected at random and examined for eggs and larvae. The height of chickpea and cotton plants was also recorded.

Chickpea is more attractive than cotton

Figure 1 shows mean Helicoverpa egg densities per plant during the first half of the season. The attractiveness of chickpea to the moths was apparent as early as one week after plant emergence. A strong preference for chickpea plants in the seed-mixed rows was evident at the first sample roughly three weeks after planting.

One week later, at the time of the second sample (October 24), the chickpea plants were largely defoliated and partially or completely eaten out by Helicoverpa larvae, which might explain the lower egg densities recorded at this sampling. The chickpea plants then recovered somewhat, allowing further egg laying in early November. A clear preference for chickpea plants within the seed-mixed rows was again evident at the third sample (November 8).

Helicoverpa egg laying activity was clearly concentrated in the seed-mixed rows for approximately the first eight weeks after planting (Figure 2). During this period, egg density in the seed-mixed rows was generally two to three times greater than in the cotton-only rows.

The higher attractiveness of the seed-mixed rows compared to cotton-only rows was still evident in late November. After November the chickpea plants were no longer attractive to Helicoverpa, partly because of excessive acid production in response to increasing temperatures, and partly as a result of being shaded out by cotton that was by then substantially taller (Figure 3).

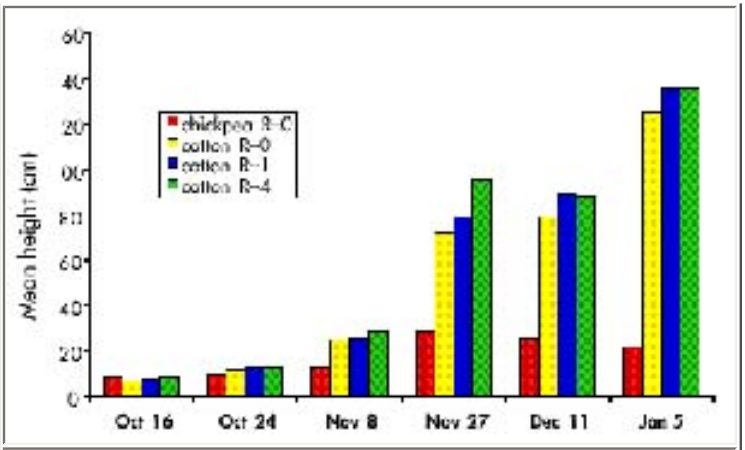
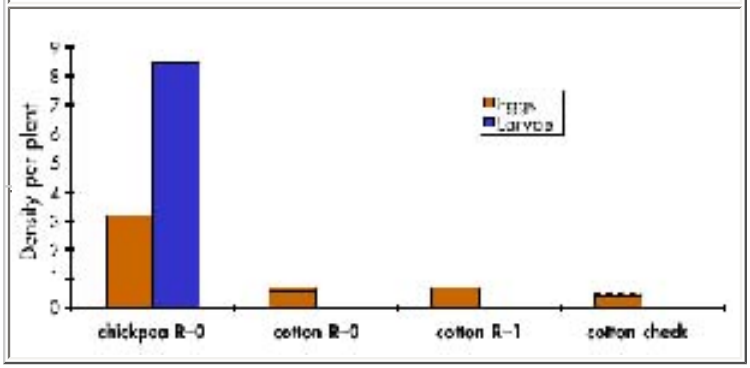


FIGURE 4: Mean Helicoverpa egg and larval density per plant on chickpea and cotton in seed-mixed rows (R–0), adjacent cotton-only rows (R–1) and in the cotton only check area (2001–02)



The Helicoverpa pulling power of chickpea is clearly evident.

In the first four samples, larval densities ranged from 0.5 to 1.5 larvae per plant on chickpea and negligible numbers on cotton. The majority of larvae were first and second instars. Over the whole sampling period (October–January) 78 per cent of all larvae counted were found on chickpea plants, 14 per cent on cotton plants in the seed-mixed rows and the remainder on the cotton-only rows. Some larvae migrated from chickpea to cotton within the seed-mixed rows but only after the chickpea plants had been largely defoliated or destroyed by feeding.

2001–02 season

The protocol adopted in the previous season was modified to accommodate higher egg pressure and larval damage to chickpea plants. One half of a paddock was planted to the cotton–chickpea seed mixture (five kg cotton plus five kg chickpea per hectare) in two of every eight rows, through the third and sixth boxes of an eight row planter. Cotton only, at the normal rate (10–12 kg per hectare), was planted in all the other rows. The second half of the paddock was planted to cotton only, as a commercial check.

The trial was planted on September 18. Random plant sampling for Helicoverpa eggs and larvae was done on 30 plants each of cotton and chickpea from the seed-mix row (R-0), 30 cotton plants from the adjacent row (R-1), and 30 cotton plants from the middle of the check area in the other half of the paddock, approximately 100 metres away from the seed-mix treatment.

The results of the first sampling 23 days after planting (October 10) are shown in Figure 4. Egg laying was again heavily concentrated in the seed-mixed rows. There was little activity in the adjacent rows or in the check area. Within the seed-mixed rows, individual chickpea plants were estimated to be carrying on average more than three eggs and around nine mostly first and some second-instar larvae.

By comparison, less than one egg and no larvae were recorded per plant on cotton in the same row (R-0), in the adjacent row (R-1) or in the check area. At the time of the second sample three weeks later (October 30), the chickpea plants were found to have been completely destroyed by larval feeding, so further sampling was pointless.

AGRONOMIC AND MANAGEMENT ISSUES

Mixing another plant species with cotton raises many issues including agronomy, management, weediness, diseases and impacts on yield. Due to the preliminary nature of the trials, most of these issues have not been thoroughly addressed and will need to be researched prior to widespread adoption.

But observations over the past two seasons point to minimal, if any, impact on cotton production. Chickpea was able to germinate and emerge successfully within the commercial pre-emergent herbicide regimes used on both farms.

In both trials the seed-mixed rows could not be distinguished from the cotton-only rows with regard to cotton plant density at the end of Stage II (early January). Chickpea plants at the bottom of the seed-mixed rows did not exceed 30 cm in height at any time (Figure 3) and were not apparent later in the season, having either been destroyed earlier by larval feeding or shaded out by the cotton canopy.

So weediness resulting from seed mixing chickpea and cotton does not appear to be a significant concern based on the trial work to date.

While the pulling power of chickpea mixed with cotton on Helicoverpa moths is clearly evident from our results, the useful life of the chickpea plants is short as a result of intense larval feeding damage. Failure to control the larval population on chickpea or non-intervention by choice would result in some level of damage to cotton plants in the seed-mixed rows due to some migration of larvae.

If larval control is not undertaken, the damage would be restricted to the seed-mixed rows as larval migration to adjacent or more distant rows has not been observed and is not very likely. Alternatively, band application of biopesticides (virus and Bt formulations) to the seed-mixed rows for larval control may be a viable option.

Band application of ovicidal products such as Amitraz to seed-mixed rows in heavy egg pressure situations may be another option. While the need for insecticide application for Helicoverpa larval control may be viewed as a drawback of the tactic, concentration of the pest in one or two of every eight rows immediately cuts down the spray area by more than 75 per cent.

FUTURE RESEARCH

Further testing of the technique is planned. Future research will address larval management and other issues related to cotton–chickpea mixtures. The scope for integrating this tactic with other cultural control measures for Helicoverpa and sucking pest control will also be examined.

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