

Abstract

Helicoverpa spp., in particular *H. armigera* and *H. punctigera*, are considered to be some of the most damaging agricultural pests in Australia (Fitt & Cotter 2005, Jallow *et al.* 2004, Zalucki *et al.* 1986) and are a serious pest of cotton (*Gossypium* spp.). In the past, pest management has relied heavily on the use of insecticides. Finding economic and environmentally sustainable alternative management tools for this highly polyphagous and fecund pest is imperative.

The subject of this thesis “*The effect of cereal stubble on Helicoverpa armigera* (Hübner) (Lepidoptera; Noctuidae) activity in early season cotton (*Gossypium* spp.)” is a direct result of consultation with the Cotton Research and Development Corporation (CRDC), Queensland Department of Natural Resources and Mines (DNR&M) and Australian cotton growers. These stakeholders sought a scientific explanation for the observed reduction in the use of disruptive insecticides in cotton when it was sown into cereal stubble. Lower pest activity had been observed when cotton was sown into wheat (*Triticum* spp.) stubble compared to conventionally planted cotton. This is significant because it provides a possible low-cost, environmentally friendly method of controlling pests in early season cotton without the use of disruptive insecticides.

Previous studies investigating this phenomenon were limited to anecdotal accounts, but suggested that such a planting strategy reduced the need to use insecticides to control pests. This project was designed to evaluate and quantify the effect of stubble on pests and natural enemies, and identify factors responsible for the reported lower pest activity in early season cotton.

There is no explanation in the literature for why lower numbers of *Helicoverpa* spp eggs have been found in cotton sown into cereal stubble. It is possible that *Helicoverpa* moths behave differently in the presence of stubble, showing reduced entry into crops or reduced oviposition in the presence of stubble. Alternatively there may be more natural enemies in cotton sown into cereal stubble that remove eggs and larvae at a greater rate than in conventionally sown cotton.

Field and laboratory investigations were performed to determine if sowing cotton into cereal stubble could affect *H. armigera* and natural enemy activity in early season cotton. Stubble type, height, density, architecture, colour and odour failed to significantly reduce ($P < 0.05$) the number of eggs oviposited by *Helicoverpa* on cotton plants. However, stubble significantly influenced the oviposition placement in some cases where this was studied; resulting in greater placement on terminals of plants or upper surface of leaves. Stubble presence was linked with reduction of another pest species. The presence of sorghum (*Sorghum* sp.) stubble in cotton significantly reduced ($P < 0.05$) cotton aphid (*Aphis gossypii* Glover) infestation and showed a greater percentage of parasitism compared to cotton sown into wheat stubble and cotton with no stubble.

Infrared video recordings were used to observe the effect of wheat stubble on *Helicoverpa* behaviour, and determine if wheat stubble reduced or inhibited *Helicoverpa* movement or searching behaviour by acting as a physical barrier and/or by providing camouflage for cotton plants. Under the conditions of the experiment, it did not. The difference in oviposition behaviour and time spent searching for cotton plants growing in amongst the wheat stubble were not significantly different from cotton plants without stubble.

As well as parasitoids, predators are an important part of Integrated Pest Management (IPM). Cotton sown into stubble was found to provide a suitable environment for organisms such as green lacewings (*Mallada signatus* Schneider), white collared ladybirds (*Hippodamia variegata* Goeze), transverse ladybirds (*Coccinella transversalis* F.) and spiders. Wheat stubble significantly increased ($P < 0.05$) predation of aphids on cotton plants by lacewing larvae and significantly increased ($P < 0.05$) predation of *Helicoverpa* eggs on cotton plants by night stalker spiders (*Cheiracanthium* spp.). In the glasshouse the presence of wheat stubble did not appear to affect oviposition by green lacewings, white collared ladybirds or transverse ladybirds (*C. transversalis*). This may be different in the field however, due to availability of alternative food sources and extended period of habitation.

The presence of stubble in a cotton field appears to be advantageous in building the natural enemy profile by providing an alternative habitat and shelter from environmental factors. It does not however, influence *H. armigera* oviposition behaviour *per se*. The

recommendation is made that a stubble regime be used in conjunction with transgenic cotton varieties to provide a mechanism to maintain pest numbers below economically damaging levels in cotton IPM.