

**SUMMARY**

Heliothis punctigera Wallengren and H.armigera (Hübner) are two serious pests of field crops in Australia. They are highly polyphagous and attack a wide range of food, fibre, oil and fodder crops as well as many horticultural and ornamental plants. Control of Heliothis outbreaks has a heavy reliance on insecticides, but insecticides are not a long-term solution to Heliothis management. Alternative tactics and strategies will ultimately be forced upon pest managers. An understanding of the basic ecology of the species provides a sound basis for the assessment of future pest management options.

The objectives of this study were:

- (i) To study the population dynamics of Heliothis on the Darling Downs and to quantify the significance of the major controlling influences (predators, parasites, pathogens, weather and host plant quality) on population changes within the species, and,
- (ii) To assess the potential for an area-wide management approach to the suppression of Heliothis populations through the identification of ecological bottlenecks and the practical manipulation of the controlling factors.

The seasonal abundance of Heliothis spp. and local variation in densities of their immature stages on different crops were studied by

routine sampling of medium to large larvae on major crops on the Darling Downs. Chickpeas were confirmed as an early season "nursery" crop for the first (Spring) generation of Heliothis. Second generation larval densities peaked in reproductive maize and sunflower, and a third generation peaked in soybean, sorghum and late sunflower. Generally, the proportion of H.armigera within collected larvae increased as the season progressed. Natural enemies were detected in most crops but were low in numbers in early season (September to mid October).

Factors affecting survival of eggs and larvae were studied through both field and laboratory studies. In the field, marked individuals were continually observed as they developed on plants up to the time that they pupated in the soil. The observed mortality of individuals was divided into five broad categories, namely that due to parasitism, predation, disease, weather and host plant effects. The dislodgement of eggs from plants and the disappearance of first instar larvae accounted for the major decrease in Heliothis numbers. Hence the major mortality factors responsible were not knowable from direct observation.

While parasitism, predation and diseases each had measurable effects on Heliothis mortality in most of the crops studied, none of these components were related to the Heliothis densities on which they acted. This placed emphasis on the roles played by weather and host plant effects in causing mortality.

Average moth emergence (= pupal survival) of natural pupal populations under crops was 37%. Parasitism accounted for 37% pupal mortality but was highly variable. Mortality from predators and disease was generally low.

Under field cages, in the absence of cultivation, and with predators and parasites excluded, survival of pupae (mostly over-wintering) was high (>80%). These studies demonstrated that pupae could successfully over-winter and reinfest crops in the spring. However, substantial spring flights of moths occurred before local emergence from over-wintering pupae.

The importance of migration in local population dynamics and the source(s) of immigrants are critically important in determining our management strategy and relevant control tactics. As immigration is important in early season before the emergence of local moths, the possible effectiveness of any Wide-Area Management is decreased. Therefore, control may be restricted to finding ways to increase local mortality rates. Later in the season, Heliothis are generated locally

and immigration is probably less important. It is then that interference with source populations may limit the size of successive generations.

Highly variable pupal development, especially in H.punctigera, and diverse diapause strategies, highlight how well these species are adapted to the Australian environment. The pathway towards improved Heliothis management will not be straightforward.