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EGG AND LARVAL ABUNDANCES OF *HELICOVERPA* HARDWICK (LEPIDOPTERA: NOCTUIDAE) ON CHRISTMAS BELLS

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Abstract

A population of the native monocot Christmas bells was examined for eggs and larvae of *Helicoverpa* spp. throughout the 1989-1990 flowering season. *H. armigera* (Hübner), but no *H. punctigera* (Wallengren), were found. Eggs were found only on floral buds or recently-opened flowers. On plants with eggs, individual buds carried only a single egg. On such plants the mean number of eggs was 1.2 ± 0.6, although plants had 6.5 ± 2.0 buds. During peak flowering 21% of plants carried eggs. Larvae were found on plants with buds, flowers and/or fruits. Late instar larvae that fed predominately on buds and flowers of Christmas bells produced fertile offspring, suggesting that this plant was suitable as a host. Egg and larval abundances were both correlated positively with the numbers of plants with buds. Abundance of larvae, but not eggs, was also correlated positively with the numbers of plants with flowers. During peak flowering, egg and larval abundances were estimated at 1.5 and 0.5 million per 100 ha respectively.

Introduction

Helicoverpa (= *Heliothis*) spp. are major pests of many crops in Australia, causing millions of dollars of damage each year (Zalucki *et al.* 1986; Fitt 1989). Because of these economic consequences, information about local populations outside agricultural areas is valuable as it may provide insight into the population dynamics on a regional scale. Few quantitive studies have investigated the importance of Australian native plants as host species (Zalucki *et al.* 1986). When suitable crop hosts are unavailable, small *Helicoverpa* Hardwick populations on native plants may be important in maintaining populations (Fitt 1989). However, the importance of populations of native plant species as hosts will depend upon whether larval development can be completed on the plants and whether suitable conditions are available for pupation.

The native plant Christmas bells (*Blandfordia grandiflora*, Liliaceae) occurs in wet heathland and sedgeland habitats of coastal, near coastal and some tableland areas of north-eastern New South Wales and south-eastern Queensland (Henderson 1987). Christmas bells often occur in high densities and may exceed 10 plants/m^2 (M. Ramsey, unpublished data). Plants flower during the summer and are particularly conspicuous after fires have occurred. *Helicoverpa* eggs and larvae have been observed on flowering plants and may provide potential habitats for larval development.

In this study we assessed the abundances of eggs and larvae of *Helicoverpa* spp. in a population of flowering Christmas bells. In addition, we assessed the suitability of these plants as hosts and speculate on the likelihood of populations of Christmas bells providing suitable host "patches".

Methods

Christmas bells are perennial monocots with basal leaves and a single flowering stalk with a terminal inflorescence of 3 to 10 flowers. Flowering stalks are up to 1.8 m tall and inflorescences are generally located above the co-occurring vegetation. Buds and flowers are glaborous (Henderson 1987).

The study was conducted within Yuraygir National Park (29°51 'S, 153°16 'E) on the coast in north-eastern N.S.W. during the summer of 1989-1990. In response to a fire of the previous year, Christmas bells flowered en masse at the study site, a swampy area of about 100 ha. Other plants found at the study site are included in Williams (1985).

Throughout the study 27 eggs and 103 medium to large larvae were collected from buds or flowers of Christmas bells from different areas of the swamp. These were returned to the laboratory and reared to adults to determine if they were *H. punctigera* (Wallengren) or *H. armigera* (Hübner). Larvae were placed in 125 mL plastic containers with artificial diet (Shorey and Hale 1965). As the eggs hatched, each larvae was placed in a 28 mL rearing cup with artificial diet. At second or third instar, larvae were transferred to 125 mL plastic containers with artificial diet. Larval cuticle patterns and wing patterns of newly-emerged adults were examined for species identification.

The numbers of plants with floral buds and/or flowers were counted in 2-25 m × 2 m transects within the swamp at 2 week intervals from November to March. Within these transects the numbers of *Helicoverpa* larvae on plants were counted. The numbers of *Helicoverpa* eggs on plants were estimated during these sampling periods by examining 100 different plants with floral buds. The associations between flowering and egg and larval abundances were assessed with Pearson correlations. During peak flowering, 200 plants with buds only and 100 plants with either flowers or fruits were examined for eggs to determine oviposition preference.

Sweep-netting was used to determine if *Helicoverpa* larvae occurred in the vegetation of areas adjacent to the swamp. In these areas during the study myrtaceous and proteaceous species were the predominant flowering plants. Sweeps of 1 m (net diameter 46 cm) at 5 m intervals along several transects through the area were completed. Sweeps were done at the top of the heath vegetation. In addition to sweep-netting, flowering plants within these areas were examined for eggs and larvae. Similarly, within the swamp flowering plants other than Christmas bells were examined for eggs and larvae throughout the summer.

To assess the suitability of Christmas bells as host plants, 25 final-instar larvae of *H. armigera* were collected from plants at the study site. Larvae were placed in separate 125 mL plastic containers with artificial diet and returned to the laboratory. Larvae pupated within 24-36 h after they were collected. Larval and adult characteristics described above were used for species identification. Adults were mated amongst themselves and the resulting eggs were hatched and development on artificial diet was monitored.

Results

Christmas bell flowering commenced during late November, peaked during January, and was mostly finished by the end of March (Fig. 1a). Differences between the numbers of plants with buds and plants with flowers were due largely to the consumption of buds by *Helicoverpa* larvae.

The 27 eggs and 103 larvae that were collected from Christmas bells and reared in the laboratory developed into adults. No *H. punctigera* were found; all specimens were *H. armigera* as shown by a saddle marking on the dorsal surface of the first abdominal segment on larger larvae and a pale patch close to the posterior margin of the hind wing of adults (Common 1985; Zalucki *et al.* 1986, and references within).

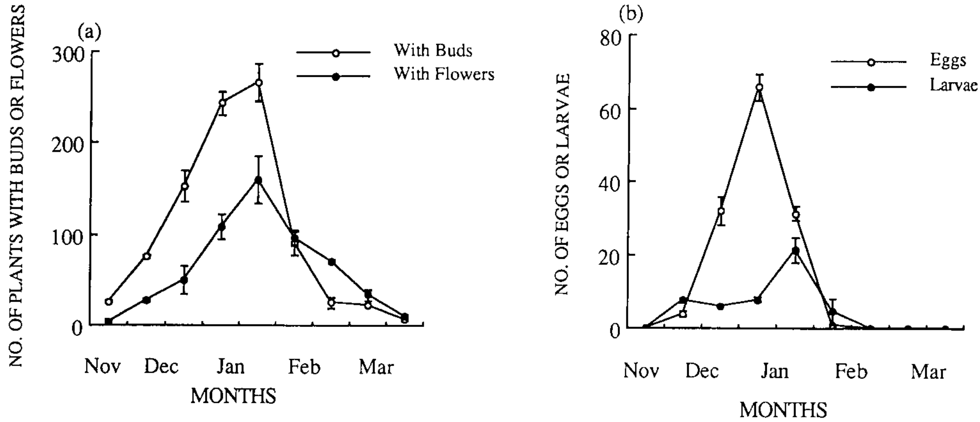

FIG. 1—Abundances of (a) Christmas bells with buds and flowers, and (b) eggs and larvae of *Helicoverpa armigera*. Values are means (±S.D.) of two 50 m² transects.

The abundance of eggs (Fig. 1b) was positively correlated with the numbers of plants with floral buds (r_p = 0.88, $t_{(7)}$ = 4.83, $P<0.01$) but not with the number of plants with flowers (r_p = 0.58, $t_{(7)}$ = 1.88, $P>0.05$). The decrease in egg numbers in late January coincided with heavy rains just prior to the sampling period. During peak flowering, 21% of the plants with buds (n = 200) carried eggs. In contrast, no eggs were found on plants without buds (n = 100). When all sampling periods were pooled the mean ± S.D. number of eggs on plants carrying eggs (n = 66) was 1.2 ± 0.6, although individual buds carried only a single egg. The mean number of buds per plant was 6.5 ± 2.0 (n = 965).

Larval abundances (Fig. 1b) were correlated with both the number of plants with buds (r_p = 0.85, $t_{(6)}$ = 3.88, $P<0.02$) and the number of plants with flowers (r_p = 0.83, $t_{(6)}$ = 3.58, $P<0.02$). Larvae were found on plants with buds, flowers or fruits. They consumed both anthers and gynoecia of buds and flowers. Immature fruits were destroyed by larval feeding, whereas larger, more mature fruits were only partially eaten.

At peak flowering the density of flowering plants within the 100 ha study area was estimated at 5.3 million. During this period the abundance of eggs and larvae were estimated at 1.5 and 0.5 million, respectively. Estimating from the egg abundances of each sampling period (Fig. 1b), approximately 2.6 million eggs were laid over the entire flowering season.

Sweep-netting of the surrounding vegetation of the swamp yielded no *Helicoverpa* larvae. Similarly, no eggs or larvae were found when the flowering plants of these areas were examined. *Helicoverpa* eggs and larvae were found only within the swamp on flowering Christmas bells. Other flowering plants within the swamp carried neither eggs nor larvae.

All of the 25 final instar larvae that were collected to determine host plant suitability pupated and emerged. When mated amongst themselves, the adults produced fertile eggs. Subsequent development of the larvae proceeded normally; the resulting adults when mated together, produced fertile eggs.

Discussion

Of the eggs and larvae collected from Christmas bells at the study site and reared for species identification all were *H. armigera*; no *H. punctigera* were found. In addition, the field identification of larger larvae also indicated the presence of *H. armigera* only. It is possible, however, that *H. punctigera* eggs were present but in low abundance. Eggs of *H. punctigera* may have been laid on buds but Christmas bells, which are monocots, may not have been a suitable host for larval development. Fitt (1989) reported that *H. punctigera* appear to be restricted to dicotyledonous hosts within Australia, although larvae are found in low numbers on some monocotyledonous crops (Wardhaugh *et al.* 1980). In contrast, *H. armigera* occurs on both dicots and monocots (Fitt 1989).

Christmas bells were the only plants used for egg laying and larval feeding by *H. armigera*. The abundances of both eggs and larvae were positively correlated with the flowering of Christmas bells. Although similar relationships have been reported for crops (e.g. Roome 1975), data for non-cultivated hosts such as native plants are rare. However, the presence of eggs and larvae on a plant species does not necessarily indicate that the plant is a suitable host (Kitching and Zalucki 1983; Zalucki *et al.* 1986).

Christmas bells appeared to be a suitable host plant for *H. armigera*. Fertile offspring were produced by larvae that had fed substantially on buds and/or flowers of these plants. All of the larvae pupated shortly after collection from Christmas bells, indicating that most of their development was completed on these plants. However, the effects of the artificial diet during the final stages of larval development on adult fertility and fecundity are not known.

The potential importance of Christmas bells as hosts for *H. armigera* was indicated by the estimated abundances per 100 ha of eggs (1.5 million) and larvae (0.5 million) at peak flowering. Overall, however, the importance of Christmas bells to the population biology of *H. armigera* depends on whether pupation occurs in the wet heath and sedgeland habitats where these plants occur. At the study site, and most other areas where Christmas bells occur, over 44% of the annual rainfall occurs during December to March (Bureau of Meteorology, unpublished rainfall records). This rainfall coincides with flowering, peak periods of egg and larval abundances, and pupation. During this period, the poorly drained soils of Christmas bell habitats are waterlogged. Because of these conditions, free standing water is often present after rainfalls in the early summer. In the late summer during this study, free standing water was persistent from late January to early winter. Murray and Zalucki (1990a) showed that submersion in water for periods greater than 48 h killed *H. armigera* pupae. Further, they demonstrated that although pupal survival was similar in dry and wet soils, rainfall reduced survival because emergence tunnels were disrupted (Murray and Zalucki 1990b). Because of the waterlogged soil and frequent inundation of the Christmas bell habitat during our study, it is likely few pupae survived. As Christmas bells typically occur in swamps their importance in harbouring *H. armigera* populations may be minimal.

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