ALTERNATIVE CROPS FOR PRODUCING NATURAL ENEMIES OF COTTON PESTS

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INTRODUCTION

Integrated pest management systems for cotton are now being developed that place a greater emphasis on beneficial insects (Mensah and Harris 1994, Murray *et al.* 1994). The development of food sprays and the planting of lucerne strips has shown that effective populations of beneficial insects can be maintained within cotton crops (Mensah and Harris 1995). Reductions in pesticide use associated with the introduction of transgenic cotton should also increase the abundance of beneficial insects (at least those not dependent on *Helicoverpa*) and improve natural control (Dick 1994, Fitt 1994). However, there is considerable scope within the cotton agroecosystem to use other crops as nurseries and/or refuges for beneficial species, and/or as trap crops for *Helicoverpa* and other pests. Such nursery crops or refuges could be sown in strips through cotton fields, in a similar way to that proposed for lucerne, to attract beneficial species and/or trap pest species. The advantages and disadvantages of various crops in such a system have not been fully investigated. The nursery crop approach relies on there being sufficient beneficial insects within the wider cropping system to colonize the nursery crops in the first place and perhaps recolonize it during the season if pesticide application or drift eliminate populations in the nursery crop. However, we understand very little about the origin and dynamics of beneficial insect populations outside the cotton crop. Where do beneficial species originate and what happens to their populations when the cotton crops disappear? Which natural habitats or crops generate most

beneficials? In order to answer these questions we initiated a three year project in the 1995/96 season with two main objectives. Firstly, moving beyond the cotton crop we will quantify the seasonal phenology and abundance of key beneficial species in other parts of the cotton cropping system, including uncultivated habitats. This part of the work is being conducted in the Namoi Valley cotton agroecosystem. Secondly, we will evaluate a range of potential nursery crops some of which may also be effective trap crops for *Helicoverpa*, perhaps used in conjunction with envirofeast food sprays. In this paper we present the preliminary results from two small plot experiments, established at the Australian Cotton Research Institute (ACRI), Narrabri, and at Dalby Agricultural College, to evaluate a range of potential nursery crops. Also presented are the partial results from a survey conducted to determine the seasonal dynamics of beneficials in cropping and non-cropping habitats in the Namoi Valley.

MATERIALS AND METHODS

Nursery crops for producing natural enemies of cotton pests

1. ACRI plots: Two sowings of nursery crops were established on the Leitch block, near ACRI, to examine the effect of planting date on numbers of beneficials. The early sowing consisted of three replicate plots (27m x 36m) of sunflower, sorghum, safflower and niger seed. All crops were sown on 16 October 1995 except safflower which was sown on 3 August 1995. The second sowing consisted of three replicate plots (30m x 36m) of sunflower, sorghum, pigeon pea and adzucki bean sown on 14 December 1995. Both plots were flanked by large areas of unsprayed cotton, sown at the same time as the early plant crops. Beneficials were sampled using a suction sampler on a weekly or fortnightly basis. Two 10 m long suction samples were taken in each plot (giving 6 replicate samples per crop type) until each crop type senesced. The early plant plots were sampled on six occasions between 20 December 1995 and 8 March 1996, while the late plant plots were sampled on eight occasions between 11 January and 12 April 1996. However,

for comparison reasons, only data from the first six sampling dates for late plant crops are used in this paper. All samples were stored in alcohol until being sorted for key beneficial species (as listed in Table 1) using a microscope.

2. Dalby plots: Two replicate plots (10m x 55m) of buckwheat, lucerne, mung bean, pigeon pea, sorghum and sunflower were sown on 14 November 1995 with the exception of lucerne which was sown on 26 September 1995. Each plot was flanked by unsprayed cotton sown on 14 November 1995. Beneficials were sampled using a suction sampler, taking 2 x 10m long samples in each plot (giving 4 replicate samples per crop type). Sampling was conducted on 12 occasions, at approximately weekly intervals, between 5 December 1995 and 26 March 1996. Half of each lucerne plot was cut every two weeks and samples were taken from the most mature half. All samples were processed and sorted as described for the ACRI plots.

Beneficials on alternative crops in the Namoi Valley: The presence/absence of key cotton beneficials on other crops in the Namoi Valley was assessed by taking three 10m long suction samples in each crop type. All samples were processed and sorted as described above. Fields were chosen at random to represent a full range of the crop types present in the Namoi Valley between December 1995 and April 1996.

RESULTS

Nursery crops for producing natural enemies of cotton pests

1. ACRI plots: When sampling of the early plant crops was started in late December, the safflower plots had already senesced. Therefore this crop was not sampled and is excluded from analysis. Similarly, the sunflower plots senesced much early than the remaining crops and sampling of these plots ceased at the end of January. More beneficials were present in early plant crops than in late plant crops with the majority being caught in sorghum (Figs. 1A-C and 2A-C). Higher numbers of predatory bugs were present in sorghum (Figs. 1A and 2A) mainly due

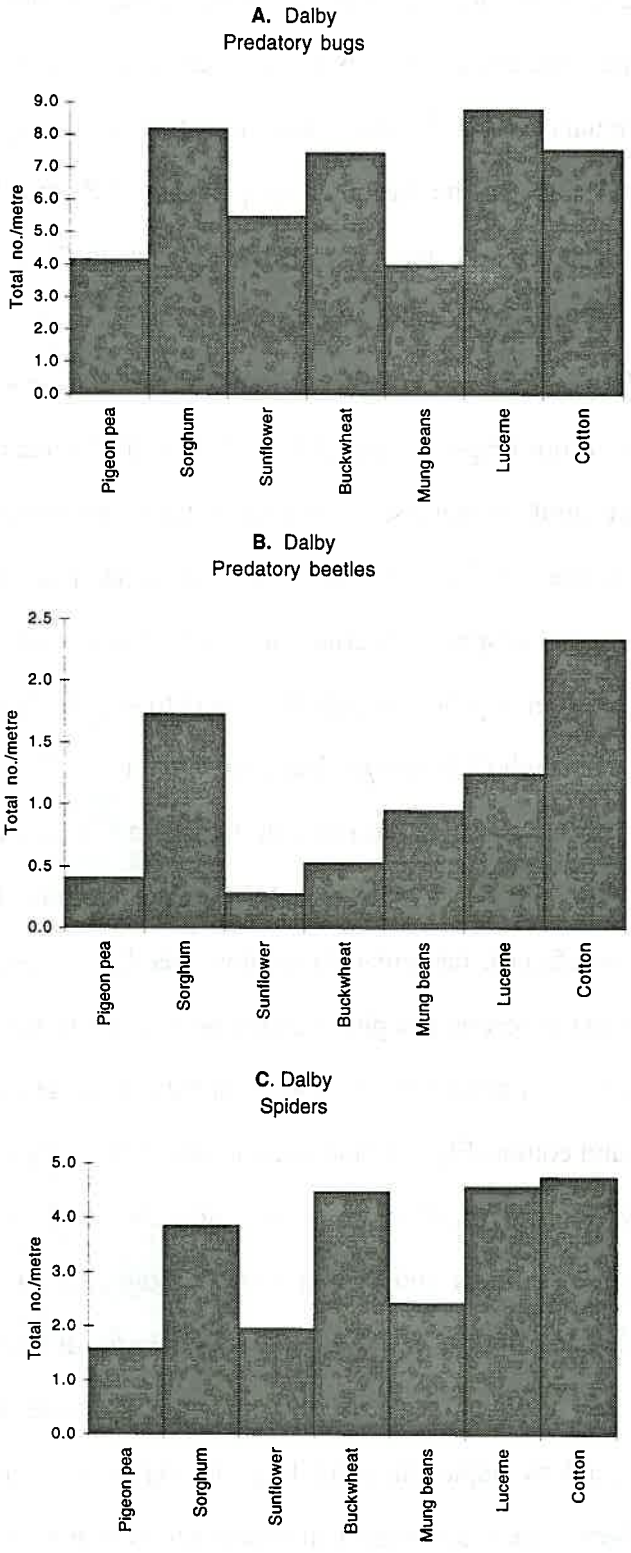

Fig. 3. Total number of (A) predatory bugs, (B) predatory beetles and (C) spiders caught in plots at Dalby Agricultural College on 12 sampling occasions between December 1995 and March 1996.

Spider numbers were highest in cotton, lucerne, buckwheat and sorghum with very few being caught in pigeon pea and sunflowers (Fig. 3C). In all crops except lucerne, spider numbers were low early in the season but increased sharply at the end of the season, particularly in sorghum, buckwheat and cotton.

Beneficials in alternative crops in the Namoi Valley: The presence/absence of key cotton predators on eight crop types in the Namoi Valley is shown in Table 1. Lucerne had the greatest diversity of beneficials (19 out of 20 the types of predators considered), followed by sunflowers (13 out of 20) and peanuts (12 out of 20).

DISCUSSION

The preliminary results presented in this paper confirm that lucerne is a very good nursery crop for a diverse range of cotton beneficials (Figs. 3A-3C and Table 1). However, sorghum was also shown to support a diverse and often numerically dominant population of beneficials. Incorporation of sorghum into cotton crops may be more favourable than lucerne, particularly in dryland farming systems. However, much more research is needed to fully compare the advantages and disadvantages of using either crop as a nursery for beneficials. The species composition of beneficials present in each nursery crop and their relative importance in controlling cotton pests must be considered alongside the dynamics of their populations and movement into cotton. While other legume crops tested (mung beans, adzucki beans and pigeons peas) appear to be the least favourable for producing beneficials, despite developing high *Helicoverpa* populations, these crops need to be further tested over a number of growing seasons before being discounted. Such crops may have a place in a farming system by acting as trap crops for *Helicoverpa* in conjunction with other nursery crops that are more favourable for producing beneficials. Although sunflowers were a good source of beneficials during flowering, the short growing period of this crop negates its usefulness as a nursery crop for beneficials of cotton. Over the next two seasons,

Table 1. Presence/absence of cotton predators on alternative crops in the Namoi Valley between December 1995 and April 1996: X = species present, O = species absent.

Crop type/ predator	Lucerne	Maize	Mung beans	Peanuts	Potatoes	Grain sorghum	Forage sorghum	Sunflower
Apple dimpling bug *Campylomma liebknechti*	X	O	O	X	X	O	O	X
Predatory shield bug *Oechalia schellenbergii*	X	O	O	O	O	O	O	X
Big eyed bug *Geocoris lubra*	X	O	O	X	X	O	O	X
Pirate bug *Orius* spp.	X	X	O	X	X	X	X	X
Glossy shield bug *Cermatulus nasalis*	X	O	O	O	O	O	O	O
Brown smudge bug *Deraeocoris signatus*	X	X	O	X	X	X	O	X
Damsel bug *Nabis kinbergii*	X	X	O	X	O	X	X	X
Red and blue beetle *Dicranolaius bellulus*	X	X	X	X	X	O	X	X
Transverse ladybird *Coccinella transversalis*	X	O	X	X	O	X	X	X
Three banded ladybird *Harmonia octomaculata*	X	X	O	O	X	X	O	O
Striped ladybird *Micraspis frenata*	X	O	O	O	O	O	O	O
Two spotted ladybird *Diomus notescens*	X	O	O	O	X	X	X	X
Mite-eating ladybirds *Stethorus* spp.	O	X	O	X	X	X	O	O
Anthicus beetle *Anthicus* spp.	X	O	O	O	X	O	X	O
Rove beetles Staphylinidae	X	O	O	O	O	O	O	O
Green lacewing *Mallada* spp.	X	X	O	X	O	X	O	X
Brown Lacewing *Micromus tasmaniae*	X	X	O	X	X	X	O	X
Hover fly Syrphidae	X	O	O	O	O	X	O	O
Spiders Arachnids	X	X	X	X	X	X	X	X
Ants Formicidae	X	O	X	X	O	O	O	X
TOTAL PRESENT	19	9	4	12	11	11	7	13

trials with potential nursery crops will be repeated and refined. Sampling of alternative crops and non-cropping areas of the Namoi Valley will continue to determine the relative importance of these habitats to the establishment and maintenance of beneficials within cotton crops.

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