

DEVELOPMENT OF THE SILVERLEAF WHITEFLY ON KEY PLANT HOSTS IN THE COTTON AGROECOSYSTEM.

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Introduction

The silverleaf whitefly (SLW) *Bemisia tabaci* B-biotype is a major problem to cotton growers overseas and is a threat to the cotton industry in Australia. It is currently established in plant nurseries in most states and is a pest of various horticultural crops in the field in North Queensland.

The genetically modified INGARD^R cotton contains a Bt gene which codes for an endotoxin that is active against major lepidopteran pests such as *Helicoverpa* spp. Bt cotton has been trialed in Australia over the last few years with some positive results (D. Murray *pers. comm.*). However, the key to the success of transgenic cotton will be to integrate it with other management strategies, such as crop refuges, in an effort to slow resistance development (Fitt 1996). Pigeon pea is highly preferred by *Helicoverpa* spp. and is being used as a refuge or trap crop (Walker *et al.* 1998). Lucerne is also being investigated as a refuge or breeding ground for beneficial insects (Mensah & Singleton 1998; Walker *et al.* 1998), such as predators or parasites of *Helicoverpa* spp. Sowthistle, a common weed in cotton agroecosystems, may also act as a refuge for beneficial insects or for the pests themselves. Cotton and lucerne are both hosts of the SLW overseas. These and other plants in the cotton agroecosystem may become important hosts in Australia. This project assessed the suitability of these key hosts to SLW development.

Materials and Methods

Fecundity, immature survival, development time and fecundity of the first generation (F1 fecundity) SLW was assessed on conventional cotton, Bt cotton, pigeon pea, lucerne and sowthistle. All trials were conducted in glasshouses at the QDPI in Toowoomba.

Fecundity was measured by caging freshly emerged, mated females on young leaves in small plastic clip-on cages. Females were recaged on fresh leaves every two days and eggs were counted.

Survival of the crawler, nymph and pupal stage and development time from egg to adult emergence, was recorded.

Fecundity of the F1 progeny from the different host plants was assessed by caging females on eggplant, a novel host for all cohorts, using the same clip-on cages and techniques as for the original population.

The parameters of fecundity, immature survival and development time were entered into a population development simulation package (DYMEX) to give an indication of the potential size of the adult SLW population on each host after 4 - 5 generations (155 days).

Results

Daily fecundity was consistently higher on sowthistle and lucerne than on all other hosts (Figures 1a and 1b). Total fecundity was significantly ($P < 0.05$) higher on sowthistle than on conventional cotton, Bt cotton and pigeon pea (Table 1). There was no significant ($P > 0.05$) difference between conventional cotton and Bt cotton. Total fecundity on pigeon pea was significantly ($P < 0.05$) lower than on Bt cotton, lucerne and sowthistle.

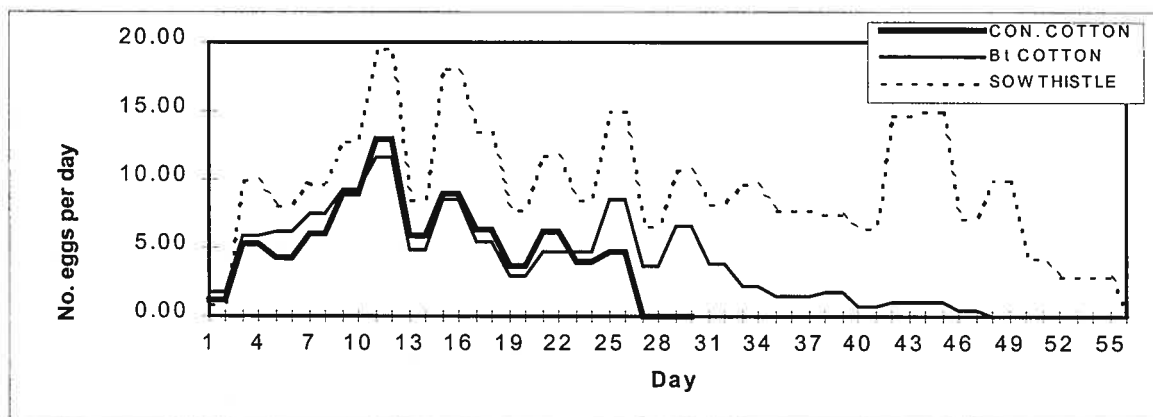


Figure 1a. The number of eggs laid per female per day on sowthistle, conventional cotton and Bt cotton.

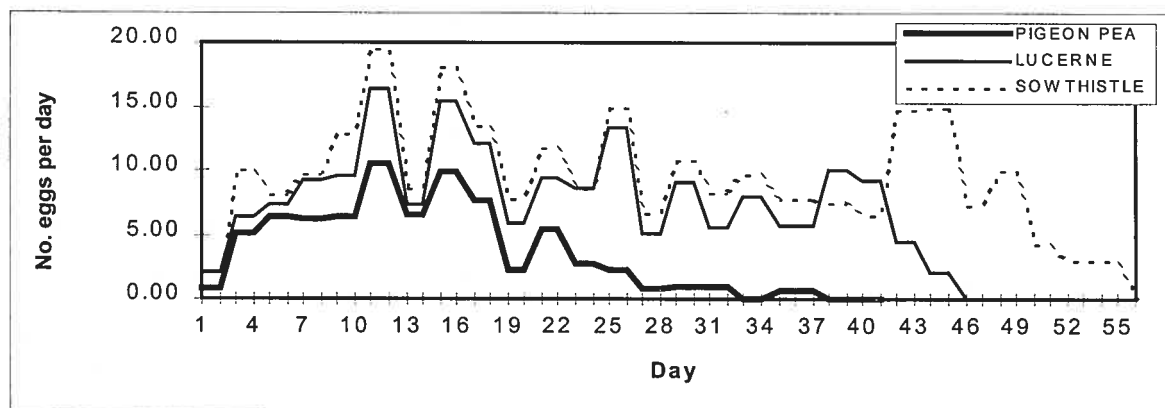


Figure 1b. The number of eggs laid per female per day on sowthistle, lucerne and pigeon pea.

The survival of the immature stages was calculated as a percentage of the starting population (Figure 2). Counts of numbers in each stage were made when all individuals had reached that stage of development. Sowthistle was the most suitable host for immature survival with 86% of the starting population surviving to the adult stage. There was relatively little difference in survival between conventional cotton and Bt cotton. Pigeon pea was the poorest host for immature survival with only 23% of the starting population surviving to the adult stage.

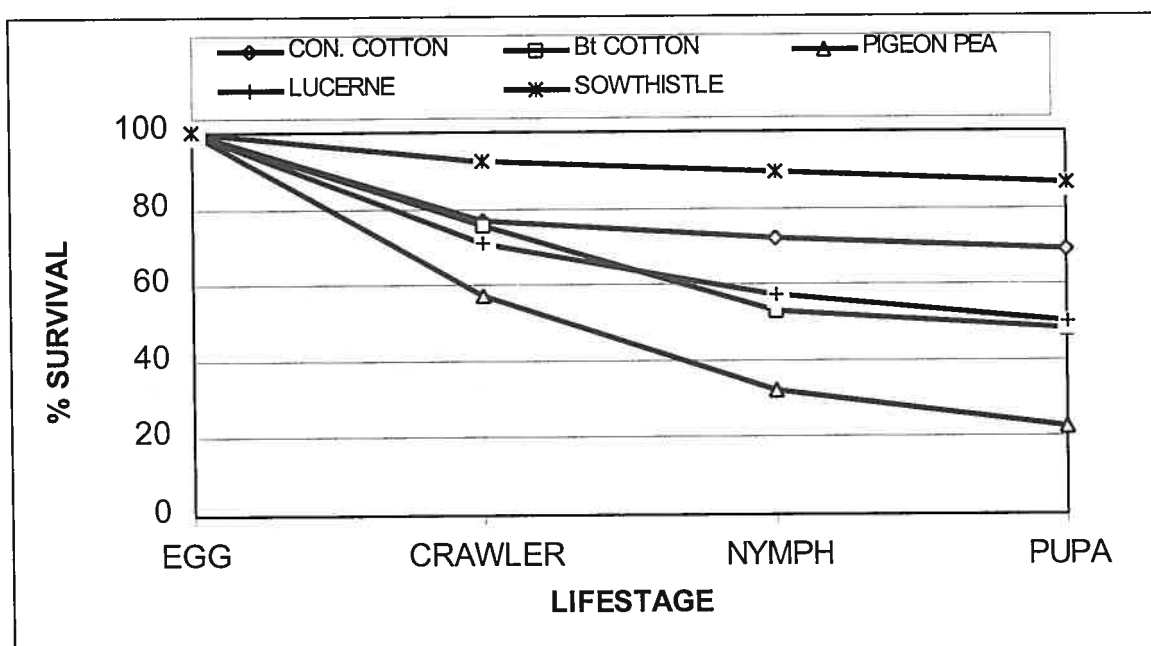


Figure 2. The percentage survival of the immature stages.

Crawler survival was significantly ($P < 0.05$) higher on sowthistle than on all other hosts (Table 1). There was significantly ($P < 0.05$) lower survival of the nymphal stage on pigeon pea and Bt cotton than on sowthistle and conventional cotton. Pupal survival was significantly ($P < 0.05$) lower on pigeon pea than on all other hosts.

Total development time from egg to adult was significantly faster ($P < 0.05$) on sowthistle than on conventional cotton, Bt cotton and pigeon pea (Table 1). Development time was slowest on pigeon pea.

There was no significant ($P > 0.05$) difference in F1 fecundity of the SLW reared on different hosts. All females laid 200 - 300 eggs on eggplant. Rearing host had no effect on the fitness of the female F1 generation.

TABLE 1. Total fecundity, percent survival[†] of the immature stages and development time.

Host plant	Total fecundity	% Survival			Development time (days)
		Crawler	Nymph	Pupa	
Conventional cotton	138.50ab*	79.49bc	93.78b	94.96b	31.79bc
Bt cotton	183.75bc	77.44bc	74.22a	93.69b	32.23bc
Pigeon pea	123.00a	62.74c	59.53a	41.67a	32.95c
Lucerne	304.80cd	73.51bc	79.84ab	89.58b	31.66abc
Sowthistle	408.40d	95.00a	96.69b	97.20b	30.38a

*Means within a column followed by the same letter are not significantly different ($P > 0.05$; ANOVA and LSD).

[†]The number of immatures surviving each stage was calculated as a percentage of the number in the previous stage.

Using DYMEX, the size of the adult SLW population on each host was predicted over 155 days starting with a population of 20 eggs and was plotted on a log scale (Figure 3). The population on sowthistle was the largest reaching over 30 million adults. The population on pigeon pea reached only 360. The size of the populations on lucerne, conventional cotton and Bt cotton were very similar; all were below 1 million.

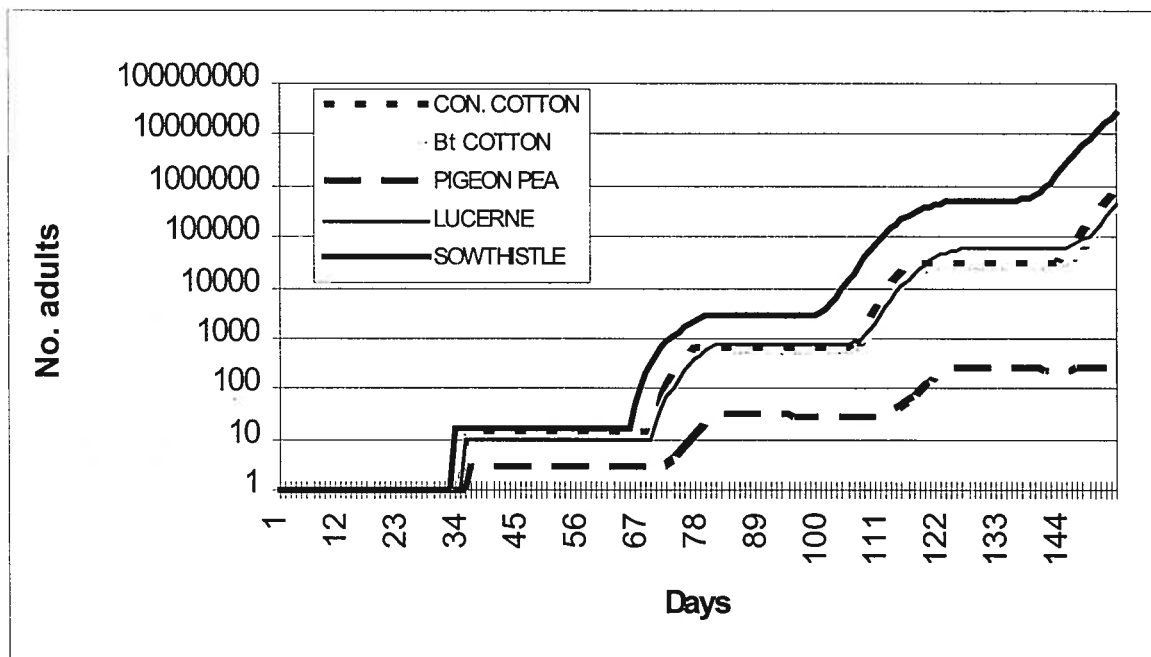


Figure 3. Simulated population development of adults (Log scale) over 155 days using DYMEX.

Discussion and conclusions

Sowthistle was a very good host of the SLW and this may be the case for other weed species common to cotton cropping areas. Sowthistle and lucerne are prevalent over winter when other hosts may not be available. This may provide a breeding ground for the SLW and allow substantial populations to survive between cropping seasons. These refugia of the pest over non-cropping seasons may be of benefit in sustaining populations of natural enemies of the SLW.

There was no overall difference in the suitability of conventional cotton or Bt cotton so the use of Bt cotton would not generate SLW problems to any greater extent than conventional cotton.

The performance of the SLW on pigeon pea was very poor. The use of pigeon pea by cotton growers for *Helicoverpa* spp. management would not lead to SLW problems.

Lucerne may contribute to a SLW problem in the cotton agroecosystem. However, lucerne is a good breeding ground for parasites and predators of pests and this may compensate by providing a refuge for SLW natural enemies. Lucerne may act as a pool for parasites and predators of *Helicoverpa* spp., the SLW and other pests.

Literature cited

- Fitt, G.P. 1996. Refuges - a key element in transgenic cotton management. *Proceedings of The Eighth Australian Cotton Conference*, Broadbeach, pp.69-76.
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