A Summary of Silverleaf Whitefly population dynamics in central Queensland: 2001 – 2004

Alison Shields[1], Jennifer Blacklock[1], Andrew Moore[1], Richard Sequeira[1] & Paul De Barro[2]
[1]Queensland Department of Primary Industries & Fisheries, Locked Mail Bag 6, Emerald, QLD 4720
[2]CSIRO Entomology, 120 Meiers Road, Indooroopilly, QLD 4720
[1,2]Australian Cotton Cooperative Research Centre, Narrabri NSW

Introduction

The Silverleaf whitefly (SLW), *Bemisia tabaci* Biotype B is a major production constraint in many parts of the world including the USA, Israel and other parts of the Middle East. Legumes, particularly soybean, have been virtually eliminated from many production systems in Texas and Arizona where SLW is now endemic. Cotton growers in the USA (Arizona) are faced with potential losses of up to $500 million annually, directly and indirectly from SLW.

SLW was first discovered in Australia in 1994 by Dr. Robin Gunning (NSW Department of Agriculture). Research by CSIRO scientists has since shown that it has spread throughout much of the east coast of Queensland and is now the dominant whitefly on both cultivated and wild host plants in the northern half of Australia. SLW has since become a troublesome pest of horticulture with frequent outbreaks in the Bowen/Burdekin region and other coastal regions of Queensland and New South Wales.

The spread of SLW into the central Queensland (CQ) cropping areas of Emerald and the Callide and Dawson valleys presents a serious and imminent threat to field crops including sunflower, peanut, grain legumes and cotton in these areas and other cropping regions further south.

SLW was discovered in very low numbers in the Emerald Irrigation Area in 1998. However, it was not until the 2001-02 growing season that CQ experienced its first serious whitefly outbreak. Broad-acre crops including sunflower, soybean, navybean, mungbean, peanut and cotton were affected to varying degrees. Soybean was among the worst affected of the legumes with total crop loss reported in most instances. Cotton crops were also heavily infested with many requiring chemical control.

SLW is a sap-sucking insect that not only has a very high reproductive capacity and a wide host range, but also rapidly develops resistance to conventional chemistry thus making it very difficult to manage. Feeding adults excrete honeydew and the resulting stickiness of lint is the main threat to the cotton industry. Sticky lint is usually downgraded and attracts financial penalties at gins and processing plants.

The CQ response to the SLW outbreak

In response to the SLW outbreak in the 2001-02 cotton season and the ensuing threat to the industry, the DPI&F, in collaboration with CSIRO, local growers and consultants, set out

to monitor the build-up and movement of SLW populations throughout the district as part of an area-wide approach to SLW management.

As a first step, a regional research and field control plan was developed. A prime objective of this plan was to quantify the spatial and temporal abundance of SLW in the area. In order to achieve this, it was necessary to identify key components of the CQ cropping system that are affected by and/or contributed to the SLW problem and to target those for sampling purposes. There is an almost continual availability of suitable hosts for SLW in CQ. With cotton, horticulture, grain legumes and sunflower grown throughout the district and the presence of various weed species, there is a steady supply of suitable host material right throughout the year. Of these crop types however, the key components identified as being the most important in relation to the SLW population were Weeds, Cotton and Horticulture.

Sampling methods

The sampling protocol used to monitor SLW on cotton was adopted from Arizona (USA) and involves sampling SLW on the fifth node leaf on the main-stem leaf, counting down from the terminal. Nymphs were counted in a $4cm^2$ disc placed on the underside of the leaf. Adults were counted across the whole leaf.

This protocol was modified and adapted for sampling weeds and horticultural crops. Adult SLW were sampled from one of the top three leaves. Nymphs were sampled on the lower portion of the plant using a $4cm^2$ disc, based on a visual assessment of where nymphs were located (this differs with each crop type and growth stage of plants).

Preferred weed hosts of SLW, such as thistle and bladder ketmia were specifically targeted for sampling. Off-farm weeds are particularly important in estimating levels of parasitism across the district as they are generally available throughout the year and less likely to be affected by insecticide usage. Parasitism of SLW was also monitored on cotton, horticulture and grain crops by assessing 4th instar nymphs.

For sampling purposes, the Emerald cropping area was divided into seven main sectors with areas of significance being those directly surrounding the township. The sampling sectors were NW, NE, SW, SE, Foley Rd, Comet and Springsure/Gindi. Area-wide surveys were conducted fortnightly throughout the cotton season, and on a monthly basis for the remainder of the year. Data was mapped using GIS to identify any population trends that were occurring within the system.

After the outbreak

After the initial SLW outbreak in 2001-02, it was not known whether the situation was a 'one-off' event or if SLW would be an ongoing issue in CQ. In the early months of the 2002-03 cotton season there was a high infestation of SLW on cotton seedlings and it was feared that SLW could be an even bigger problem than seen in the previous year. However, this did not eventuate (Figure 1), but increasing numbers of SLW during the season

resulted in many farms throughout the district applying an Insect Growth Regulator to control SLW.

The third cotton season after the outbreak saw very low numbers of SLW on cotton and it appeared that SLW might no longer be an issue in CQ. However, high pressure of mirids and heliothis early in the season resulted in "hard" chemistry being used for their control. This had the adverse effect of flaring the SLW population. The resulting increase in the population may also have been influenced by mortality of SLW parasitoids as a result of the chemicals used. Although SLW numbers increased dramatically at the end of this season, the population did not reach the high levels experienced in the initial outbreak of 2001- 02.

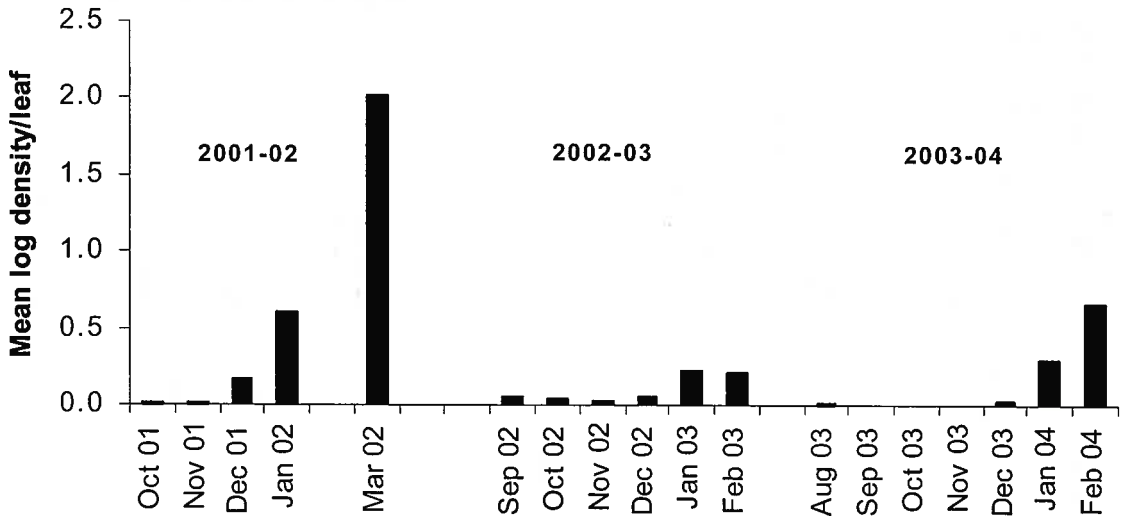

Figure 1. SLW adults on cotton over three consecutive seasons

Base population of SLW

The overwintering population of SLW is critical as this is the base level of insects leading into the following season. Sampling on weeds indicated that there was a much higher base population in August 2002 and 2003 compared with the same period in 2001 (Figure 2). Further sampling is required in the coming season to see if this base population will stabilise at the level seen in August 2002 and 2003, and if so, could it be said that the system is in equilibrium?

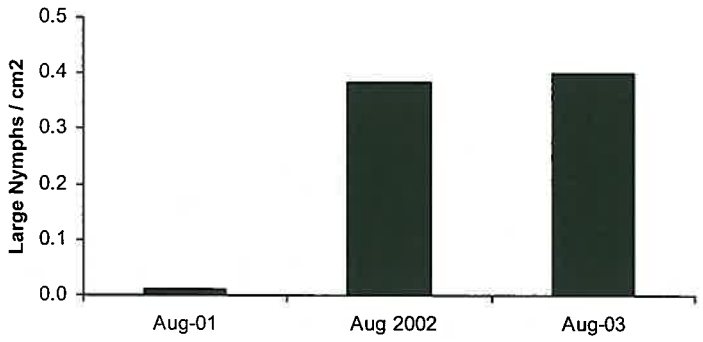

Figure 2. Base populations of SLW on weeds.

The key to regulating SLW is to limit this overwintering

population by predation or parasitism. This could have huge implications for the CQ cropping industry as a whole, as the lower the base population of SLW, the slower the build-up of the insect within the system.

Population trends

The population increase and dispersal patterns of both the SLW and its native parasitoids were monitored and mapped using GIS to identify any trends that were occurring. There is an almost continuous availability of hosts for SLW in the CQ cropping system, with SLW overwintering primarily on weeds and horticultural crops. The population of SLW moves onto young cotton in early spring and this increase in numbers on cotton coincides with the

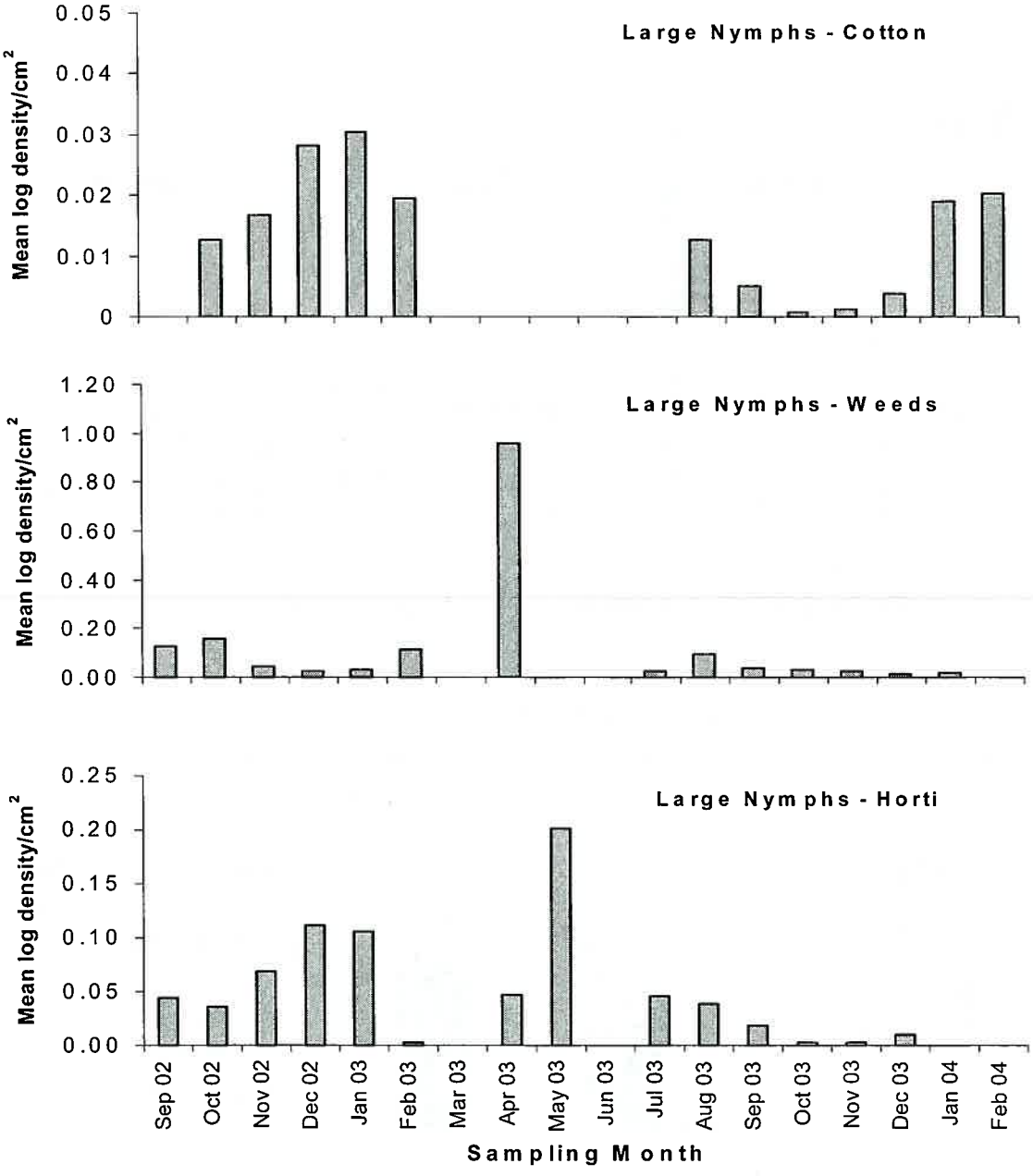

Figure 3. Dispersal trends of SLW within the cropping system

decrease in SLW on weeds and horticulture (Figure 3). Conversely, at the end of the cotton season, the decrease in SLW on cotton coincides with a sharp increase in numbers on horticulture, weeds and grain crops including sunflower and soybean. This pattern of dispersal is cyclical and is repeated in subsequent seasons.

The main interaction in the cropping system occurs mainly between cotton and weeds. Weeds are widespread throughout the district and provide a refuge for SLW that enables successful dispersal from weeds to cotton crops. Horticulture however, is grown on a relatively small scale and is limited to the SE and NE sectors. Whilst horticultual crops are very attractive to SLW, the interaction between horticulture and cotton appears to be restricted to where the two crop types are actually grown in close proximity.

Parasitism

Two genera of native whitefly parasitoids were identified during the area-wide monitoring of SLW. These are the Aphelinid wasps *Eretmocerus* and *Encarsia.* In the 2001-02 cotton

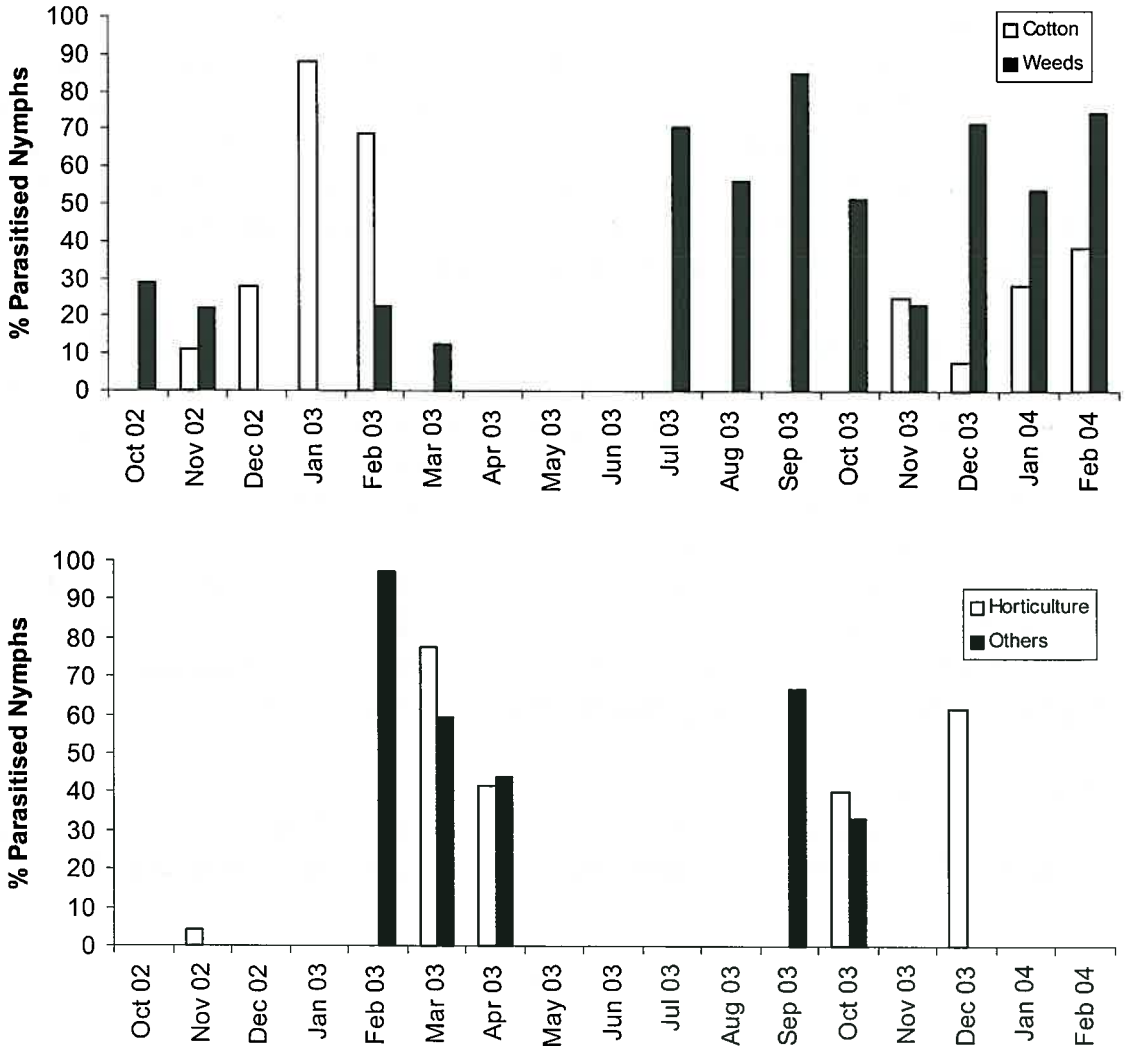

Figure 4. Dispersal trends of parasitoids within the cropping system

season there was no significant parasitism. In contrast, parasitoids played a major role in the management of SLW over the next two seasons (Figure 4); not discounting the role of Area-Wide Management grower groups.

Literature indicates that the parasitoids present in CQ are very effective in controlling low populations of SLW; hence the assumption is that these particular parasitoids may be unable to lower the base population of SLW any further than the present level.

The dispersal pattern of the SLW parasitoids is essentially identical to the movement of SLW (Figure 3). Although there is a slight lag phase as the parasitoids track the migration of SLW, the patterns are essentially the same with parasitoids overwintering on weeds, moving to cotton and then as the cotton season finishes, migrating to other available hosts. These include weeds, horticulture, grain and sunflower crops; and as the availability and quality of these crops declines, the parasitoid tracks the SLW back onto weeds and then onto cotton at the start of the next cotton season. As with SLW, this trend is cyclical.

Conclusion

The key components identified as being the most important in terms of SLW populations in CQ are weeds, cotton and horticulture. Of these three components, the main interaction occurs between weeds and cotton with over-wintering SLW dispersing from weeds to cotton, then again moving back to weeds at the end of the season in a cyclical pattern. Whilst horticultural crops are preferred hosts of SLW, they appear to be of consequence only when grown in close proximity to cotton crops.

Off-farm weeds were found to be of particular importance as they not only provide a refuge for SLW but they also provide a host and nursery for the native parasitoids *Eretmocerus* and *Encarsia*. Even though these parasitoids play a major role in managing the population of SLW, they appear limited in their ability to lower the overwintering population of SLW any further than the levels seen over the past 2 seasons. Further research is required into the factors limiting the size of over-wintering populations of SLW. The lower the population of SLW entering the system at the start of the cotton season, the greater the chance of a lower population dispersing from cotton to other crops at the end of the season. If this base population could be reduced from its current level, the implications for the CQ cropping industry as a whole is immense.

Acknowledgements

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