Reduced Whitefly Infestations in Cotton Using a Melon Trap Crop

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Abstract

A second year of field experiments was completed in 1999 at MAC that explored the potential of using a melon trap crop to reduce whitefly infestations in cotton. The experimental design was altered from 1998 to gain isolation among treatment blocks by using 4 separate fields that helped to avoid the influence of one treatment upon the other. A consistent response of significantly fewer whiteflies in cotton planted within a surrounding melon trap crop, relative to the same area of cotton without the trap crop, was observed throughout the July-September sampling period. Better chemical management of whiteflies in the melons during the second season helped to reduce the large differential in whitefly densities between melons and cotton observed the previous year, but preferentially contributed to a greater differential observed between melon-protected cotton and unprotected cotton. Although the infestation buildup was delayed and the season-long densities of whiteflies in the melon-protected cotton were reduced, the action thresholds for treatment with IGRs were ultimately attained and exceeded. In the present management environment of perhaps only 1 IGR treatment per season, it is unlikely that the melon trap crop approach would provide acceptable control unless a grower was willing to tolerate late-season whitefly densities higher than the current IPM recommendations.

Introduction

Trap cropping involves the manipulation of crop stands in time and space with the objective of concentrating a pest species within the trap crop rather than the main crop (Hokkanen, 1991). This can be achieved by using a trap crop that is the same species or cultivar as the main crop, but which is grown asynchronously to the main crop in order to concentrate either early or late pest invaders. Alternatively, a trap crop that is contemporaneously grown with the main crop will probably involve a different plant species that is more attractive to the target pest than the main crop. Assuming that either approach is effective at concentrating the target pest, then the real challenge begins with managing the pest in the trap crop effectively so that the trap crop does not become a source of the pest rather than a sink.

Whiteflies are amenable to trap crop management for a number of reasons. Foremost is that whiteflies are highly polyphagous, utilizing many different crop, ornamental and wild hosts, but also are differentially attracted to their various plant hosts. Basic differences among plant species in food quality and as reproductive hosts probably determine why certain plant species accumulate and generate more whiteflies than other species. Whatever the mechanism(s), years of observation and data collection in the field have amply demonstrated that much higher numbers of whiteflies are found on melon plants than on other crop plants. In addition to putative superior host characteristics for silverleaf whiteflies, the use of melons as a trap crop is advantageous in that cultivation and pest management practices are well determined. Thus, there is greater certainty to manipulating an agronomically-proven trap crop for the intention of minimizing the impact of whiteflies on the cotton main crop than would be true for a typically non-crop trap host.

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Another reason that whiteflies are good candidates for trap crop management is that their seasonal population development shows a regular and predictable pattern in accordance with crop succession and calendar time. For example, in central Arizona, significant dispersal of whiteflies does not really begin until July, more often than not during the second half of the month. This dispersal may be linked to spring-grown vegetable crops that have reached maturity and/or senescing wild hosts, and may vary with annual weather deviations, but overall is a predictable event. It is therefore possible to anticipate when the cotton crop will be vulnerable to immigrating whiteflies so that a protective trap crop can be in place and sufficiently developed in anticipation.

Finally, the availability of superior insecticides for combating whiteflies and providing long-term control in the melon trap crop rather than the cotton main crop makes possible the trap-crop concept for managing whiteflies. To be effective, the trap crop must be capable of trapping whiteflies throughout the July through September period when whitefly infestations are most problematic for cotton production. Moreover, good management of whiteflies as they concentrate within the trap crop is essential to controlling whiteflies in the trap crop and preventing them from spilling over into the cotton main crop. This is currently possible due to the long residual activity provided by the insecticides Admire® and Applaud®. Also crucial to the chemical management scenario is the availability of effective adult-whitefly knockdown compounds such as endosulfan and chlorpyrifos.

Materials and Methods

Four replicate fields in isolation of one another were prepared at MAC and planted with cotton in mid-April, 1999. Each field consisted of 3 subplots 140' long and planted i) 24 rows wide with DP-5415, ii) 24 rows wide with DP-33B, or iii) 20 rows wide with DP-5415 and 2 rows on either side planted with melons. The subplots were separated from each other by 20 ft with the DP-33B in between both DP-5415 subplots. The planting of melons was divided into an early and late planting to insure a robust cover of melons from the period of early July through late September. To achieve this goal, the early planting was sown in mid-May and the late planting was sown 5-6 weeks later in the second half of June. Only a single row of melons was sown each for the early and late plantings on either side of the 20-row subplot of DP-5415. In addition, a 10' area at the head and tail of each 20 row subplot of DP-5415 were planted with a single melon plant in every other row. Treatment of the first planting of melons with the systemic insecticide Admire® was delayed until late June when the first few adult whiteflies began to appear on the melons. The melon plants at this point were in the 4-6 true leaf stage. By holding back treatment with Admire®, the effective period of treatment could be extended into late July-early August. In contrast, Admire® application to the late melon planting was made in the cotyledon to first true leaf stage because of the heavier presence of whiteflies that demanded immeditate protection.

Treatment with Admire® was followed by an application of Applaud®+Thiodan® (0.35 lb ai/a and 1.0 lb ai/a, respectively) when whiteflies began to reach a density of approximately 10-15 small nymphs per melon leaf. The inclusion of Thiodan® with Applaud® was to prevent adult whiteflies from scattering into the cotton main crop following the spray treatment. The same adult knockdown strategy was employed a few weeks later (Thiodan® only) when the early melon planting was disked and the late planted melons assumed sole responsibility for trapping immigrating whiteflies.

Evaluations of whitefly infestations in the melon-surrounded subplot of DP-5415 and the DP-5415 subplot not surrounded by melons were made on a weekly basis beginning the first week of July through the third week of September. Each subplot was subdivided into 5 strata of 4 rows each. Leaf disks from the 5th mainstem node leaf down from the terminal were collected from 24 plants within each stratum each week. The number of eggs, small nymphs and large nymphs on each disk were counted.

Results

Whitefly densities in the melon-surrounded subplots of DP-5415 were consistently lower than the unprotected DP-5415 subplots (Fig. 1). On 7 consecutive dates between 2 August and 13 September, the density of eggs in the melon-protected subplots was significantly lower than that in the unprotected subplots (Fig. 1a). Similarly during this same time span, the density of small and large whitefly nymphs was significantly lower in the melon-protected

plots on 6 of 7 dates (Fig. 1b). The magnitude of the differences in densities between subplots was often 2-3 fold. However, despite the consistently lower densities in the melon-protected cotton, nymphal densities eventually exceeded currently practiced action thresholds for treatments with IGRs (Ellsworth et al., 1996).

Distributions of whiteflies within the DP-5415 subplots varied somewhat depending on whether melons surrounded the cotton or not. A cross-sectional look across the unprotected cotton subplots on 16 and 23 August revealed little difference in whitefly densities from one edge of the field to the other (Fig. 2). In contrast, some evidence of a trend toward higher whitefly densities in the middle of the melon-surrounded cotton subplots than on the edges was apparent on both dates, but better defined on 23 August (Feb. 2b).

Discussion

Although the melon-protected cotton had consistently lower densities of whiteflies throughout the July-September period compared to the unprotected cotton, the densities in the melon-protected cotton still exceeded the IPM guidelines that govern when treatment with the IGRs Applaud® and Knack® should commence against whiteflies in cotton. If the IPM guidelines had been strictly adhered to in this study, then the melon trap crop would have been effective only in delaying the timing of the first spray treatment by about 2 weeks. Considering the awkwardness involved with the additional agronomic and pest management inputs required for growing a trap crop peripheral to the cotton main crop, the melon trap crop approach would probably have limited appeal if the same treatments with IGRs are eventually required. Moreover, a peripheral trap crop planting consumes a substantial amount of land that pragmatically is justifiable only by monetary returns that cover the lost cotton production. The trend of higher whitefly densities observed in the middle of the melon-protected subplots (Fig. 2) suggests that an increasing plot size and distance from the center of a cotton field to the melon-protected edge of the field may result in poorer control of whiteflies.

Acknowledgements

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References

Ellsworth, P.C., J.W. Diehl & S.E. Naranjo. 1996. Sampling sweetpotato whitefly nymphs in Cotton. IPM Series No. 6. The University of Arizona, Cooperative Extension Publication #196006. Tucson, AZ. 2pp.

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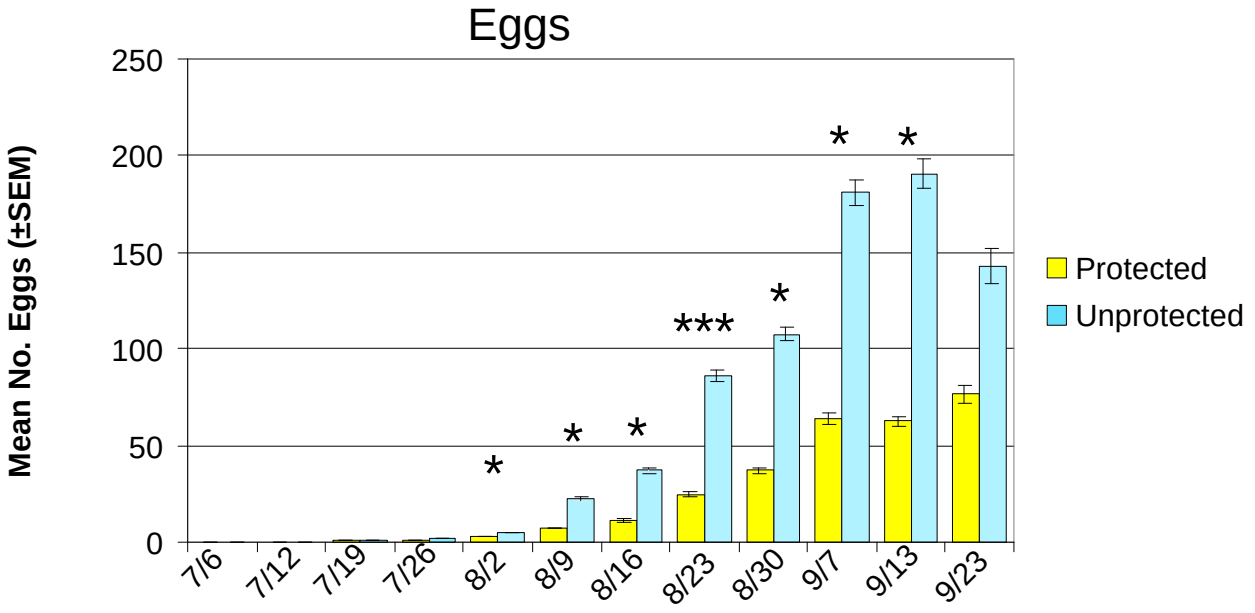
Fig. 1. Contrast in densities of whitefly eggs (a) and nymphs (b) in cotton surrounded by a peripheral melon trap crop (protected) or without a peripheral trap crop (unprotected). Asterisks above pairs of bars indicate statistical significance (* P<0.05, *** P<0.001) by ANOVA.

(a)



(b)

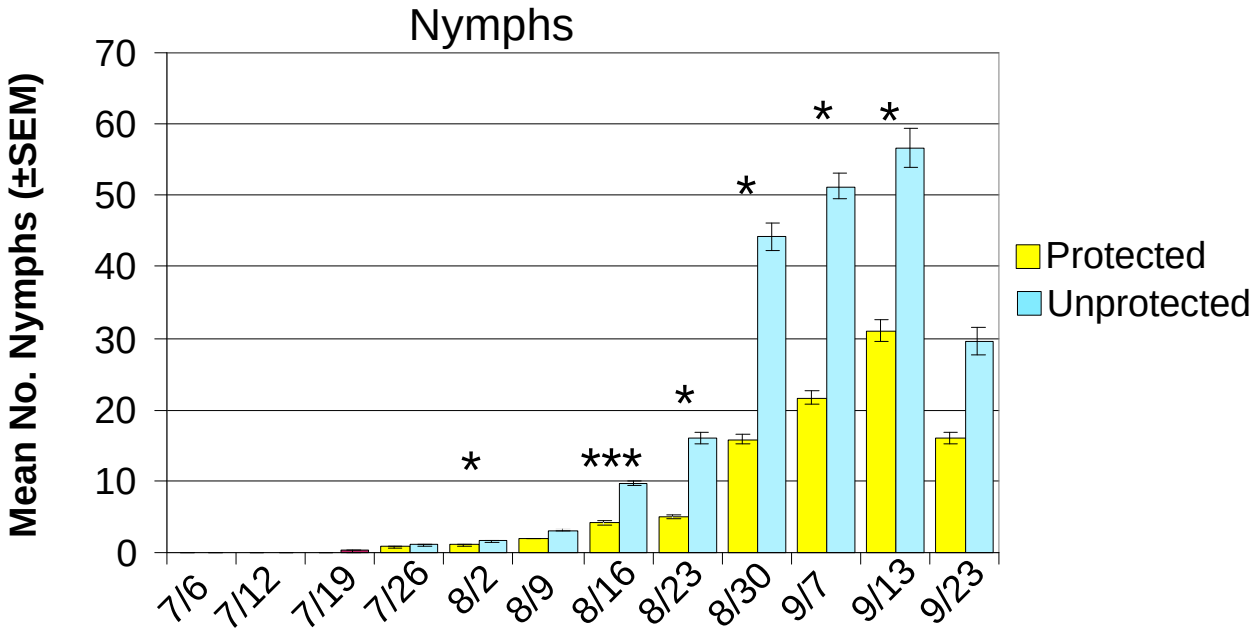
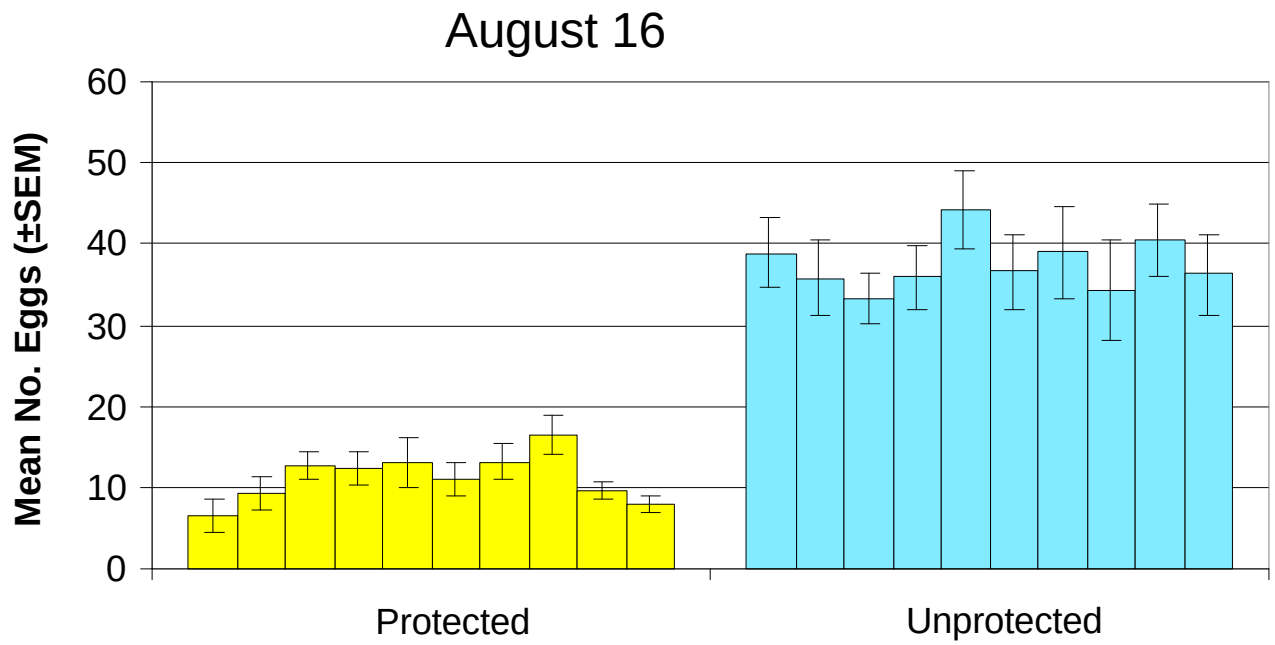


Fig. 2. Distribution of whitefly eggs across melon-protected and unprotected cotton subplots on 16 (a) and 23 (b) August, 1999. Each grouping of bars represents a cross-section across a subplot with middle bars representing samples from the middle of subplots and edge bars representing the edges of subplots. Note the trend towards a center hump in the melon protected subplots as well as the differences in whitefly egg densities between melon-protected and unprotected cotton plots.

(a)



(b)