PHEROMONE TRAPPING AS A MONITORING TOOL OF BROWN STINK BUG, *EUSCHISTUS SERVUS* MOVEMENT WITHIN COTTON FIELDS

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Abstract

As plants senesce or are harvested, numbers of Brown stink bug, *Euschistus servus* migrate from crops that act as host plants, such as; shrubs, many broadleaf weeds, corn, soybean, sorghum, millet, snap beans, into nearby susceptible crops (ie. Cotton). The presence of host crops in close proximity to susceptible crops increases the difficulty of managing Brown stink bugs in cotton. When pheromone trapping was used, greater numbers of *E. servus* (n -= 89) over a shorter sampling period were recovered when compared to sweep sampling. Pheromone trapping revealed that there did not appear to be a significant aggregation of *E. servus* along cotton field perimeters, although there is a general trend of reducing populations as you penetrate deeper into cotton fields from the field perimeter. Associated damage done to cotton bolls caused by *E. servus* feeding and the resultant cotton boll rot was not found significantly damaging in this trial. This suggests that the presence of cotton boll rotting pathogens plays a significant role in cotton yield loss. However low the presence of cotton boll rot, there is the same general trend of reducing incidence of cotton boll rot as you move away from the cotton field perimeter. Low incidence of cotton boll rotting bacteria suggests that damage done by *E. servus* in California is limited to direct damage by the insect feeding itself. This is similarly reflected in the lack of significant differences of HVI color classing between the sampling locations as you away from the cotton field perimeter.

Introduction

As plants senesce or are harvested, numbers of Brown stink bug, *Euschistus servus* will migrate from crops that act as host plants, such as; shrubs, many broadleaf weeds, legumes, corn, soybean, sorghum, okra, millet, snap beans, into nearby susceptible crops (ie. Cotton). The presence of host crops in close proximity to susceptible crops increases the difficulty of managing Brown stink bugs in cotton. Repeated insecticide applications, necessitated by migration from host crops, are not only costly, but increase the possibility of secondary pest outbreaks. Brown stink bugs can be found across all of southern Canada, much of North America and often throughout the year in parts of the southern U.S. *Euschistus servus* occurs throughout North America with two subspecies. *Euschistus s. servus* (Say) occurs throughout the southeastern U.S. from Florida through Louisiana to California, *E. s. euschistoides* (Voltenhoven) occurs across Canada and the northern U.S.

In 2013, damage to cotton from *E. servus* resulted in a 25-30% yield reduction which required repeated pesticide applications. Typical cotton insecticide applications in Southern California range from 3 – 4 applications. However, in 2013, infestations of cotton by the Sweetpotato Whitefly Biotype B, *Bemisia tabaci* (Gennadius) and *E. servus* resulted in ≈ 11 combined applications. To better implement an area-wide integrated pest management (IPM) program for *E. servus*, more information is needed concerning the influence that host crops have on *E. servus* populations. Insects are known to have directed movement towards preferred host plants. In order to manage *E. servus* from a pest management perspective, it is essential to understand *E. servus* dispersal capability so that we can manage the pest with minimal use of pesticides in cotton. Stink bugs will often leave a host within 24 hours after the field is harvested or senesces. Harvest of nearby crops creates this condition.

Materials and Methods

Three commercial cotton fields planted with cv. 'Phytogen 375 WRF' round-up ready cotton which were selected with alfalfa fields adjacent on at least two sides prior to establishment of experimental plots. Field margins were mapped and then a grid was overlaid so that perimeter sampling locations could be located approximate to the edge of field(s) (Fig. 2). At each sampling location, a 1.22-m high 4-vane pyramid trap constructed of yellow (international yellow) corrugated plastic for strength and anchored into place with a 3-m yellow fiberglass pole (Fig. 3). To each of the pyramid traps was affixed an aluminum screen funnel trap top which were baited with *E. servus* aggregation pheromone, methyl (2E,4Z)-decadienoate (1 mg/d release rate) replaced every 14 d and a ¼ piece of insecticide impregnated animal ear tag (containing 10% lambda-cyhalothrin and 13% piperonyl butoxide) for improved stink bug retention. Sampling consisted of tallying of *E. servus* taken per trap location every 7d to minimize stink bug escape.

Individual trap samples were immediately transferred into individual 3.8 L plastic bags and their contents hand sorted in the laboratory to identify stink bug to species. Damage by *E. servus* done to cotton bolls were assessed every 7d by sampling 10 cotton bolls (22.9 – 27.9 mm in size) per trap location. Cotton bolls (from each trap location were immediately transferred into individual 3.8 L plastic bags and placed in a cooled ice chest. Samples were destructively processed afterwards to determine cotton boll damage caused by *E. servus*; external feeding punctures, internal feeding punctures, stained cotton lint and boll rot. A nearby cotton field was divided into 3 replicated 0.65m areas which were sampled every 7d with 50 sweeps per area for *E. servus* for comparison. Sweep net contents were immediately transferred into individual 3.8 L plastic bags and placed in a cooled ice chest. Samples were then processed afterwards by first freezing the bags and their contents and hand sorted in the laboratory to identify stink bug to species. Data was analyzed using a mixed model with $P < 0.05$ level of significance to analyze potential differences in mean abundance of *E. servus* at the various trap location along field perimeter(s).

Results

Use of weep sampling recovered few *E. servus* which ranged from 0.33 ± 0.33 - 2.0 ± 0.58/50 sweeps over the course of the sampling period (Fig. 5). Pheromone trapping yielded greater numbers of *E. servus* (n -= 89) over a shorter sampling period (Fig. 4a). *Euschistus servus* pheromone traps monitored over the course of the season revealed no significant difference in captures of *E. servus* found among trap lines (df = 3, $P = 0.11$). Position of pheromone traps as they penetrated deeper into cotton fields from the field perimeter revealed a general trend of reducing populations of *E. servus* but was not found significant among sampling locations (df = 3, $P = 0.81$) (Fig. 5). Cotton boll damage used to indirectly asses for presence of *E. servus* (Fig. 1b & 1c) revealed that the presence of cotton boll warts from feeding by *E. servus* was not found significantly different as you move deeper into cotton fields from the field perimeter (df = 9, $P = 0.21$) (Fig. 6a). Cotton boll rot which is often associated with presence of cotton boll warts (warts X boll rot) was not found significant (df = 14, $P = 0.89$) (Fig. 6a). Cotton boll rot was also not found to be significantly different among the sample locations deeper into cotton fields (df = 3, $P = 0.51$). However, there is a general trend of greater presence of cotton bolls with rot nearest the field perimeter (Fig. 6b). Correlation analysis was done to further elucidate the relationship between presence of cotton boll rot and presence of cotton boll warts (Fig. 7a, 7b & 7c). No significant relationship was found between presence of cotton boll warts and boll rot by date ($R^2 = 0.23$) or when the sampling date variable was removed ($R^2 = 0.02$). No significant relationship was found also between presence of cotton boll warts and cotton lint staining ($R^2 = 0.02$) (Fig. 4b). Preliminary evidence of *E. servus* carrying cotton boll rot bacteria was investigated. All of the *E. servus* collected during this project along with 100 cotton bolls exhibiting *E. servus* external feeding punctures were sent to the Insect Control & Cotton Disease Research Unit (USDA-ARS) for analysis (Fig. 4a). Little to no presence of cotton boll rot was found. Impact of cotton boll rot and cotton lint staining on cotton quality was assessed. No significant difference was found among the HVI color classes was found among the among the sample locations deeper into cotton fields (df = 7, $P = 0.20$) (Fig. 9).

Discussion

The work presented here demonstrated that the use of pheromone trapping yielded greater numbers of *E. servus* compared to sweep sampling for monitoring populations of *E. servus*. Using pheromone trapping revealed that there does not appear to be a significant aggregation of *E. servus* along cotton field perimeters, although there is a general trend of reducing populations as you penetrate deeper into cotton fields from the field perimeter. This is consistent with populations of *E. servus* infesting cotton fields in the South-eastern US. Associated cotton boll warts caused by *E. servus* feeding and the resultant cotton boll rot, which is prevalent in the South-eastern US was not significantly damaging in this trial (Fig. 7a, 7b & 7c). However low the presence of cotton boll rot, there is the same general trend of reducing incidence of boll rot as you move away from the cotton field perimeter. That along with the preliminary evidence of low incidence of cotton boll rotting bacteria suggests that damage done by *E. servus* in Southern California is limited to direct damage by the insect feeding itself. This is similarly reflected in the lack of significant differences of HVI color classing between the sampling locations as you away from the cotton field perimeter (Fig. 9).

Fig. 1 Brown stink bug feeding damage in cotton; a, *Euschistus servus*, b, Damaged cotton bolls showing internal feeding punctures and "warts" c, Damaged cotton bolls showing boll rot and stained seeds

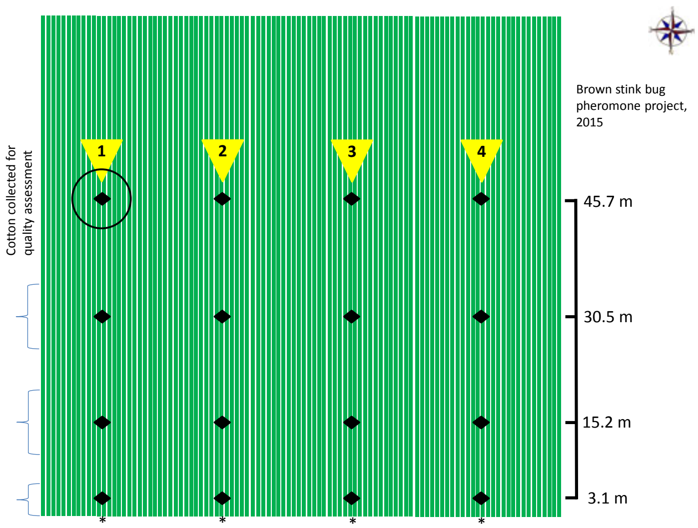

Fig. 2 Plot map showing pheromone trap locations starting from the edge of the cotton field(s)

Fig. 3 Pyramid Brown stink bug trap topped with a aluminum wire screen funnel trap

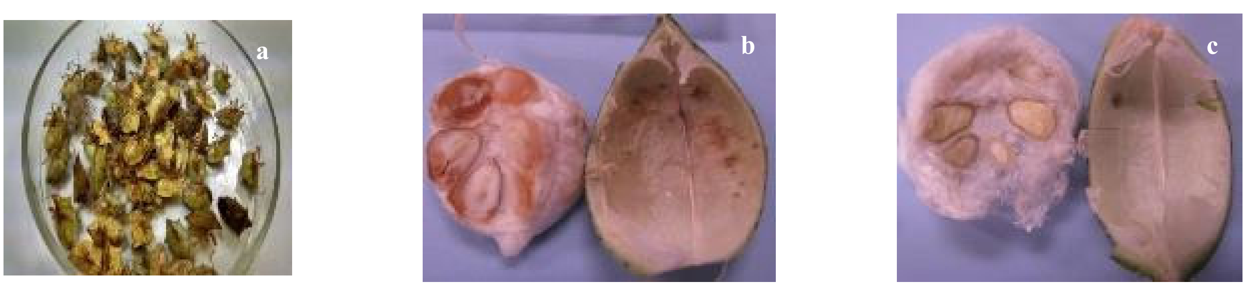

Fig. 4 Brown stink bug feeding damage in cotton; a, *Euschistus servus* collected from sweep sampling, b, Damaged cotton bolls showing stained cotton lint surrounding seeds c, Damaged cotton bolls showing undamaged cotton lint and seeds

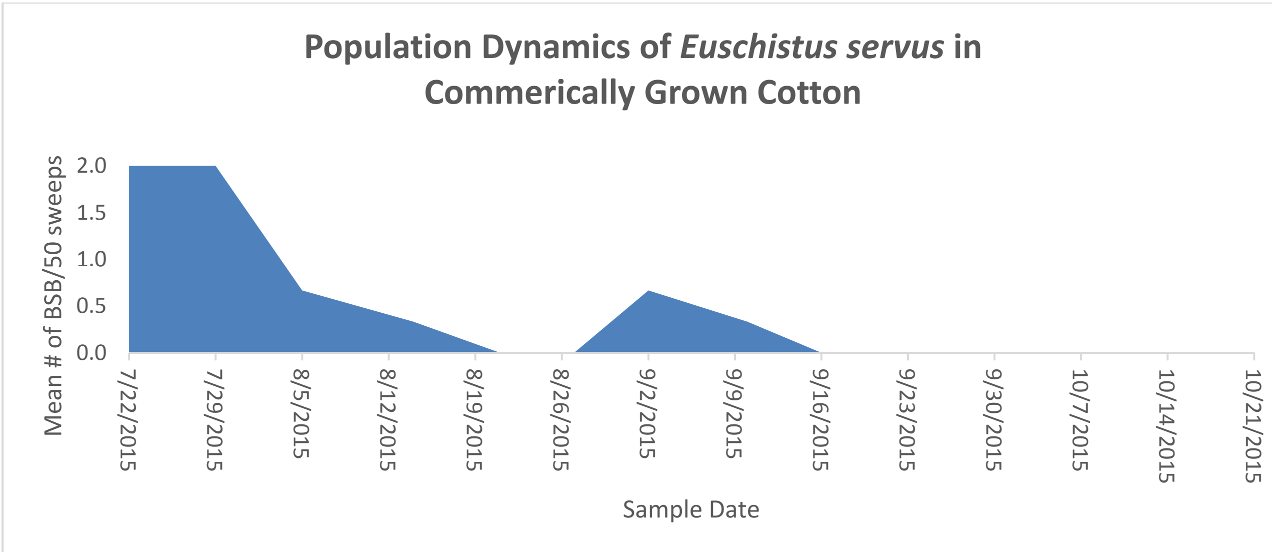

Fig. 5 Population

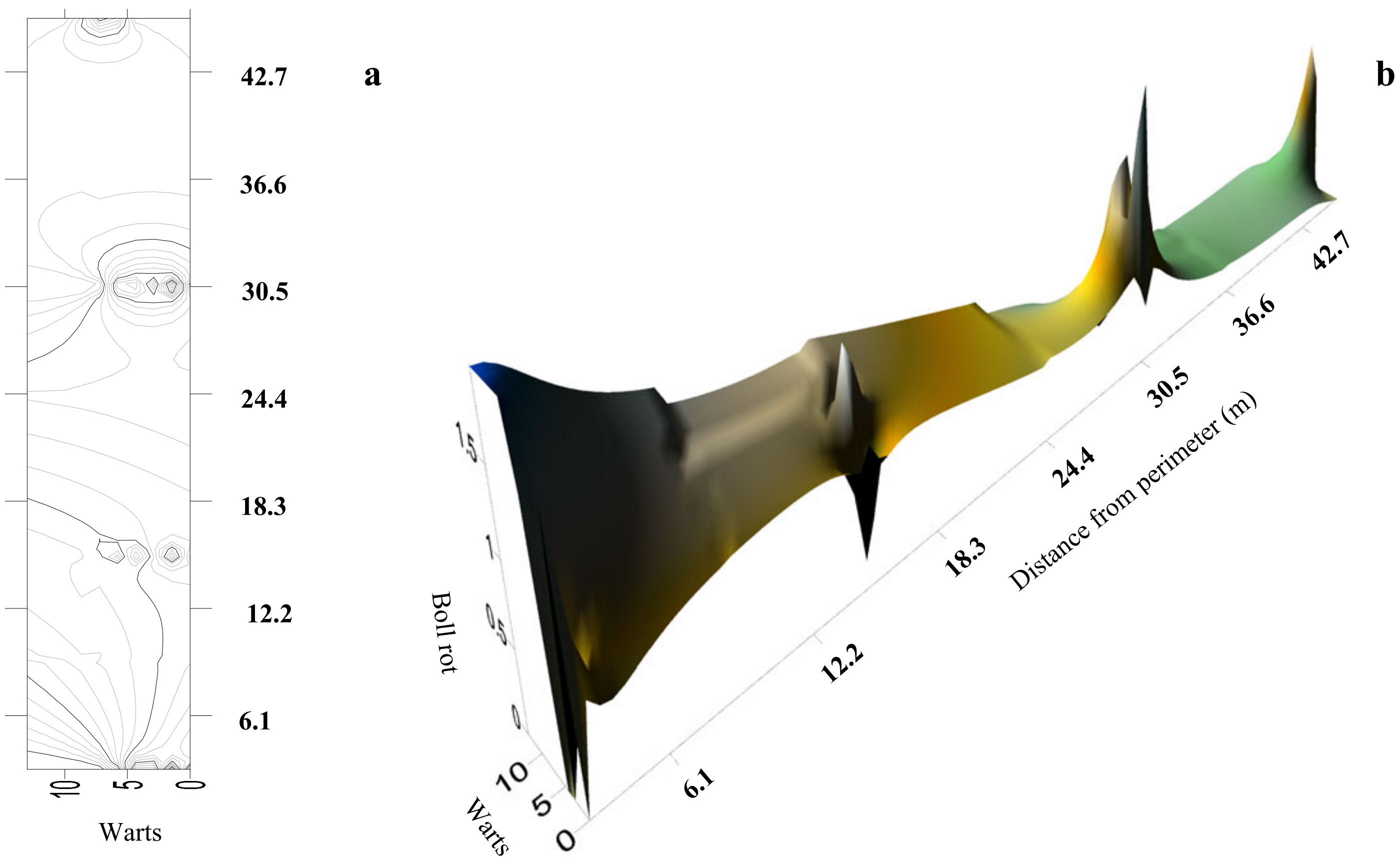

Fig. 6 Brown stink bug feeding damage in cotton bolls; a, Presence of cotton boll "warts" from edge of cotton field. b, presence of cotton boll "warts" and cotton boll rot from edge of cotton field

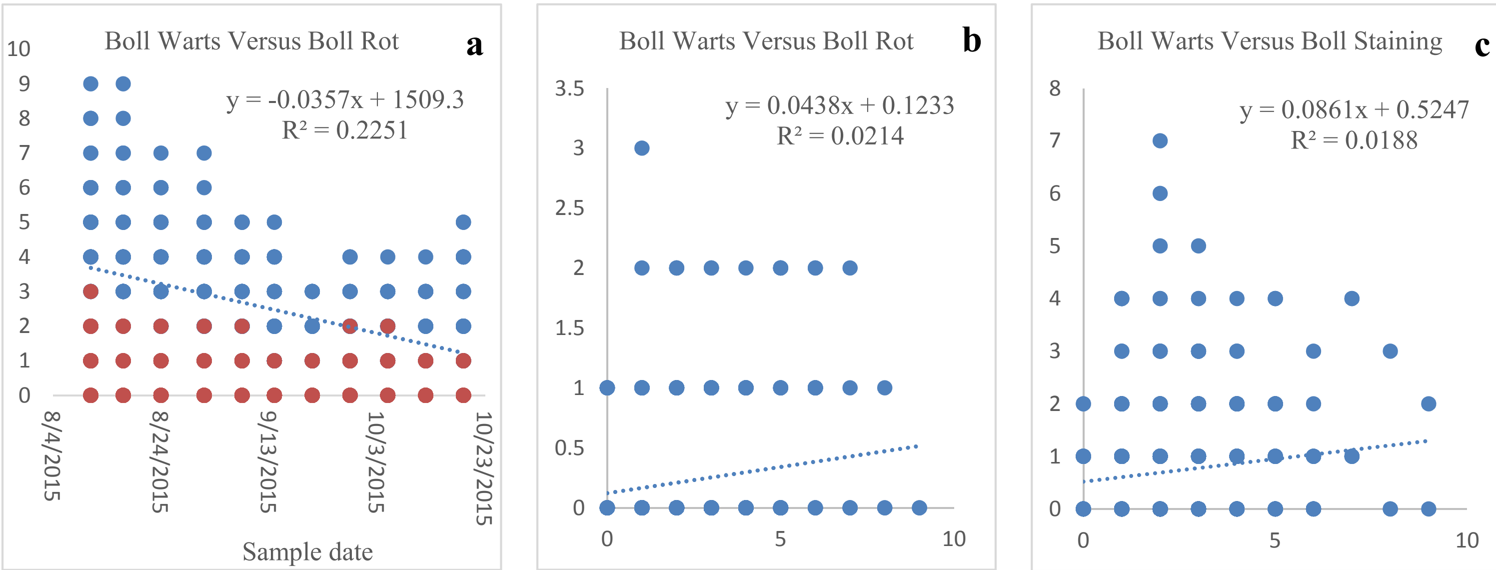

Fig. 7 Brown stink bug feeding damage in cotton bolls; a, Presence of cotton boll "warts" versus cotton boll rot by sample date, b, Presence of cotton boll "warts" versus cotton boll rot, c, Presence of cotton boll "warts" versus cotton boll lint staining

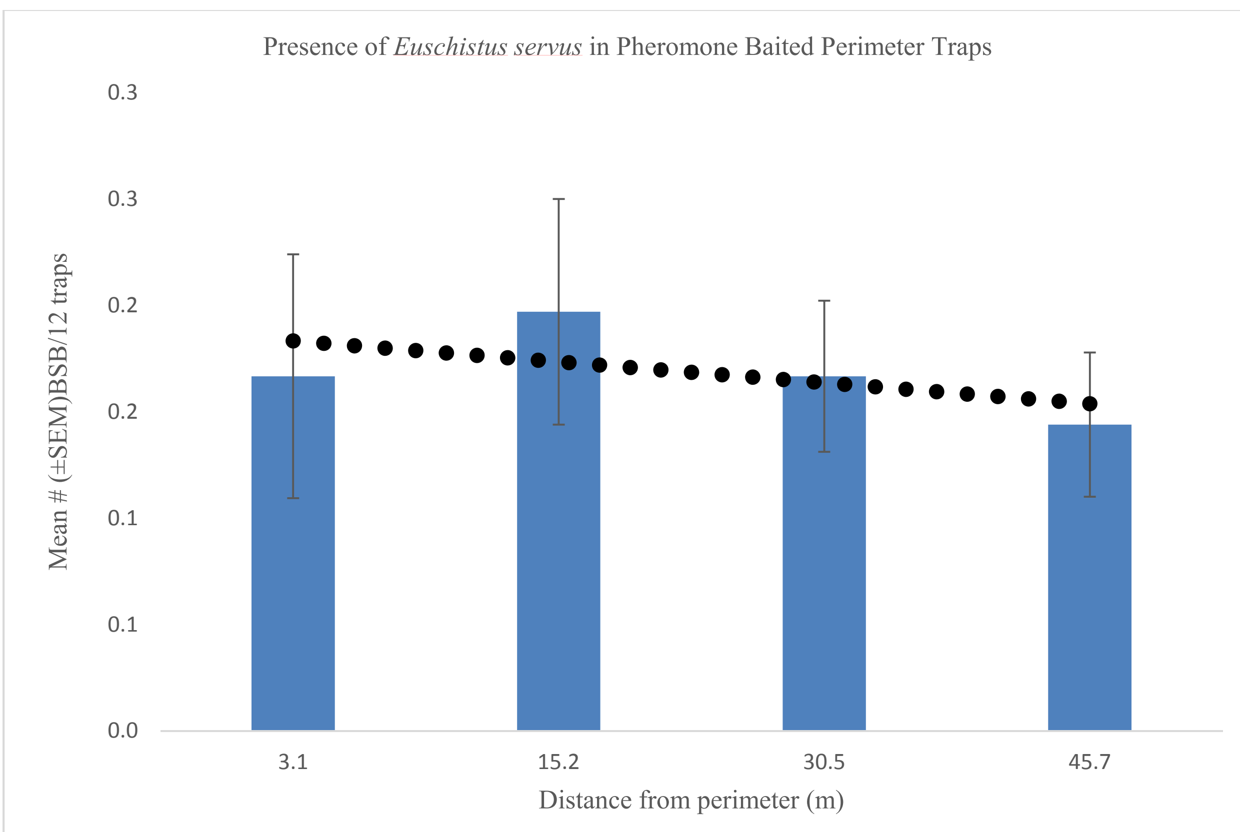

Fig. 8 Captures of *E. servus* in pheromone baited traps located along the perimeter of cotton fields

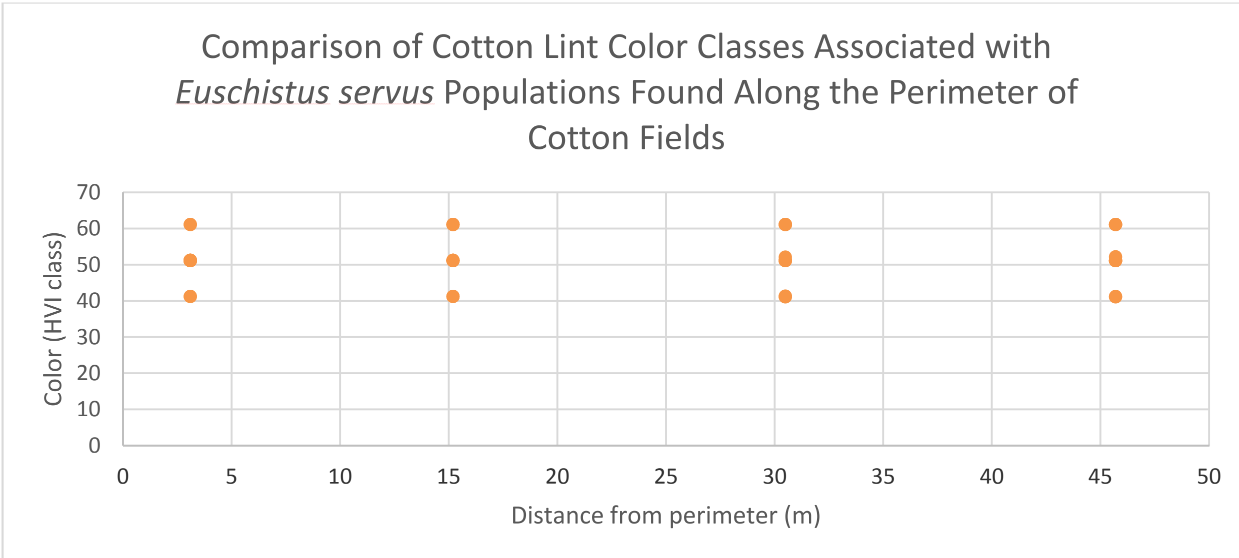

Fig. 9 Comparison of cotton lint color (HVI) classes located along the perimeter of cotton fields