PRELIMINARY ASSESSMENT OF MARK/RECAPTURE METHODS AND STICKY CARD COLOR CONSIDERATIONS FOR THRIPS IN MISSISSIPPI

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Abstract

Thrips are a major pest of cotton in the United States due to the declining efficacy of neonicotinoid seed treatments. Transgenic *Bt* cotton has potential to be a tool for managing thrips in the future; however, the potential for thrips populations to become resistant to *Bt* must be evaluated. Research utilizing sticky card and beat pan sampling along with mark/capture methods is currently being conducted to study thrips movement in a cotton agroecosystem. The preliminary results of this research shows that the attractiveness of thrips to specific sticky cards colors may be dependent upon several factors. Also, beat pan sampling may be a more effective way to collect thrips for mark/capture research. This paper discusses in more detail the findings of preliminary experiments in regards to monitoring thrips movement with sticky cards, beat pans, and mark/capture techniques.

Introduction

Thrips (Thysanoptera) are a major pest of cotton in the United States. Insecticides for thrips management were used on approximately 70% of the cotton acreage in the United States during 2014 and cost United States cotton growers approximately 10.9 million dollars for management and more than 150 thousand bales of cotton in lost yield (Williams 2014). The primary management strategy for thrips has been neonicotinoid seed treatments; however, neonicotinoid insecticide resistance has developed in thrips population in recent years (Darnell et al. 2015, Harrell et al. 2015, Plummer et al. 2015). Transgenic *Bt* cotton varieties are under development that are genetically engineered to express *Bacillus thuringiensis* proteins effective against thrips. Research evaluating the movement of thrips in the landscape is being conducted to determine any risk of *Bt* resistance occurring in thrips populations.

Monitoring for thrips is often done by beating plant tissue over a substrate such as a white tub and counting the dislodged thrips, visually counting thrips on plants, cutting plant tissue and washing thrips from the tissue to be counted on a substrate such as filter paper in a petri dish, or capturing thrips on sticky cards. A method of monitoring insect movement is marking plant tissue with a protein such as egg white albumin or milk casein and capturing insects in a designated area around the marked area and using ELISA to detect the presence of the protein. Marking plants with protein allows the investigator to know if thrips moved from or through the marked area to another area of a landscape. This method has been successful for monitoring movement of *Lygus*, thrips, and other insects (Fernandes and de Sena Fernandes 2015, Hagler et al. 2014, Hagler and Jones 2010, Jones et al. 2006)

Initial trials (June 2015) utilizing blue sticky cards to monitor thrips movement revealed a less than satisfactory number of tobacco thrips (*Frankliniella fusca*) collected, thus experiments were undertaken during 2015 to determine if a better color choice existed and if the effectiveness of colors was affected by the plant species in the sampling area and the thrips species targeted. Additionally, a mark/capture trial was conducted to monitor thrips movement. This paper discusses ongoing, preliminary work of testing sticky card color and mark/capture techniques to monitor thrips movement in a cotton agroecosystem.

Materials and Methods

Sticky card trials

Two trials were conducted in a field on the Mississippi State University R.R. Foil Plant Science Research Farm that is used for small plot research and teaching. Four colors (blue, fluorescent, white, and yellow; Figure 1) of sticky cards were used in both trials. The first trial was initiated on 4 August and cards were placed in the field in triplicate in plots of six crops at varying stages of growth (crop/stage). The crop/stages studied were vegetative soybean (*Glycine max*), reproductive soybean, peanut (*Arachis hypogaea*), vegetative cotton (*Gossypium hirsutum*), reproductive cotton, and at the interface of reproductive corn (*Zea mays*) and sorghum (*Sorghum bicolor*). Cards were placed on bicycle flags at approximately 15 cm above the plant canopy and collected six days later. The second trial was initiated on 2 Oct

and repeated on 12 Oct in a plot of seedling cotton and seedling volunteer corn. The second trial was part of the mark/capture trial that is discussed below. Cards were placed in transects across the rows and each color replicated nine times on each date. Cards were removed seven days after being placed in the field. Tobacco thrips (*Frankliniella fusca*) and flower thrips (predominantly *Frankliniella occidentalis*) were counted on the cards under magnification. Data were log-transformed and analyzed in Proc Glimmix (SAS Institute, Cary, NC).

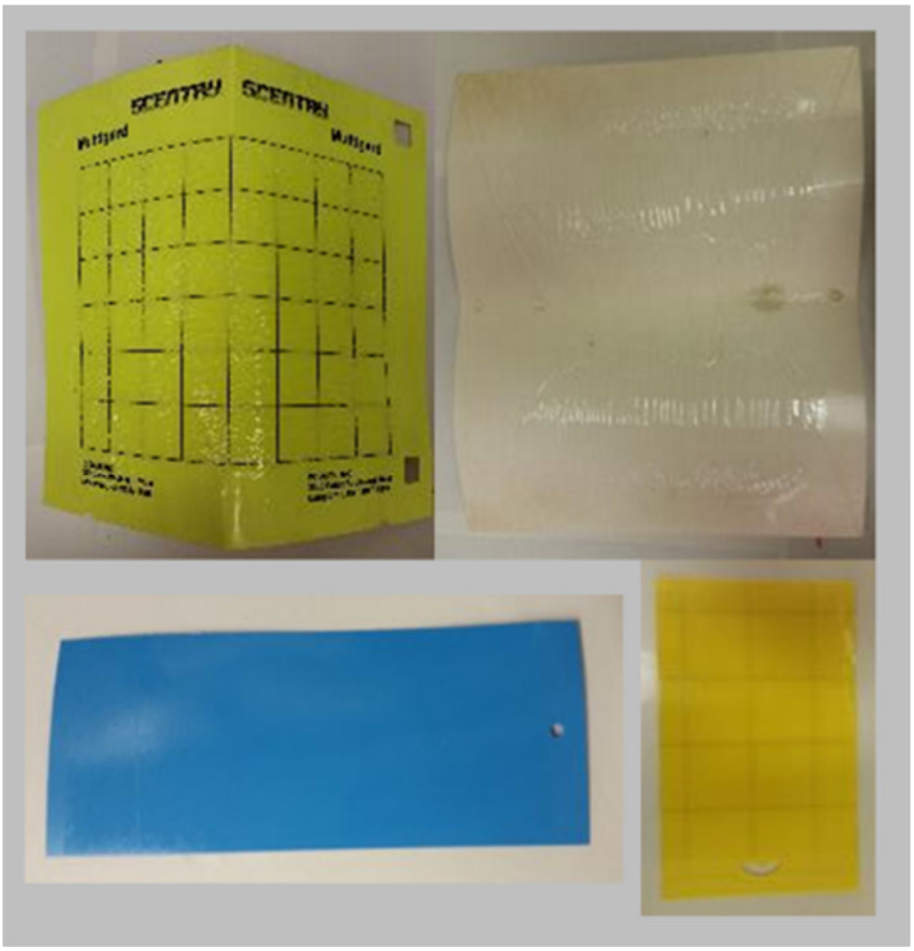

Figure 1. Sticky cards used in the trials. Colors (clockwise from top left): fluorescent, white, yellow, blue.

Mark/capture trial

As mentioned above, a trial comparing mark and capture techniques for thrips was conducted as part of the second sticky card trial (October). On the second date of the trial (12 Oct), a 10 % egg white albumin protein solution was sprayed on two middle rows of the plots. Four transects were established perpendicular to the sprayed rows. Thrips were collected from the cards used in the aforementioned trial by removing the thrips from the card with a toothpick and placing the thrips with the toothpick individually into 1.5 ml microcentrifuge tubes. As many as five thrips were removed per card. Beat pan samples were also taken in a similar manner to the layout of the sticky cards. Ten plants (five cotton and five corn) were beaten over a white pan and individual thrips aspirated into 1.5 ml microcentrifuge tubes. Tubes were placed in a -20°C freezer for storage until ELISA was conducted. ELISA was performed based on the methods of Hagler et al. 2014. Data were analyzed in Proc Glimmix (SAS Institute, Cary, NC). Transects were considered replicates.

Results

Sticky card trials

There was a significant interaction of crop/stage and color in the first sticky card trial for tobacco thrips (df= 15, 36; F= 3.70; p= 0.0007) and flower thrips (df= 15, 47; F= 2.93; p= 0.0025). Differences between colors within a crop/stage

were observed for all crop/stages (Figures 2 and 3) in regards to both thrips species. Significant differences were also observed between like colors and crop/stages for both thrips species (Figures 2 and 3). Overall, fluorescent and blue were the most attractive colors for tobacco and flower thrips (Figure 4) in the first experiment. In the second experiment, there was a significant effect of color for tobacco thrips (df= 3, 49.9; F= 76.87; p<0.0001) and flower thrips (df= 3, 47.96; F= 100.75; p<0.0001). Yellow was the most attractive color for tobacco thrips, while blue was the most attractive color for flower thrips (Figure 5).

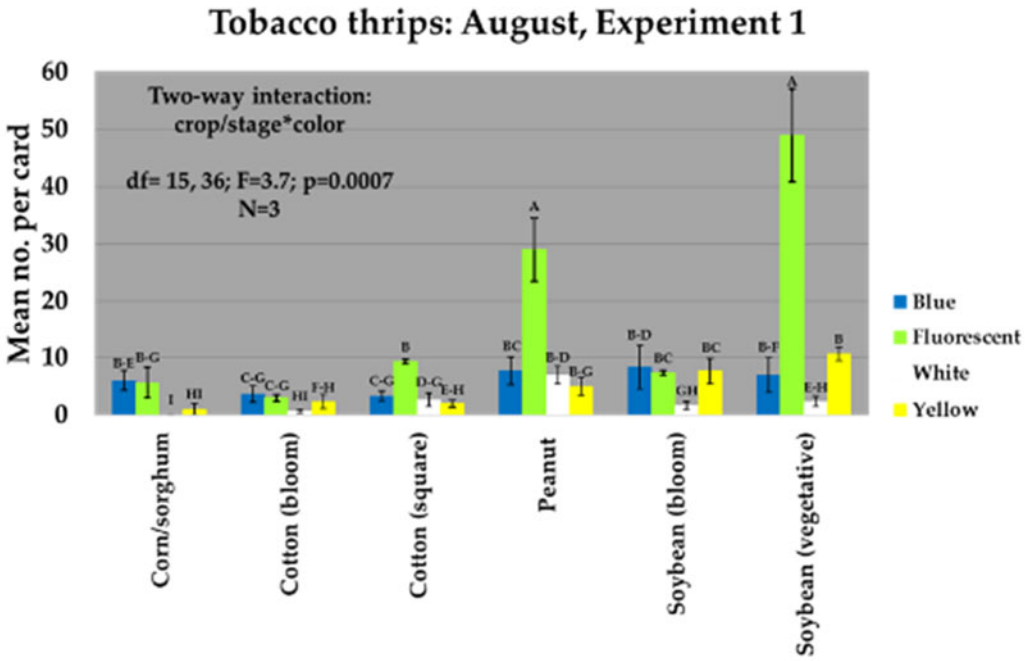

Figure 2. Mean +/- SE of the number of tobacco thrips on sticky cards in August experiment.

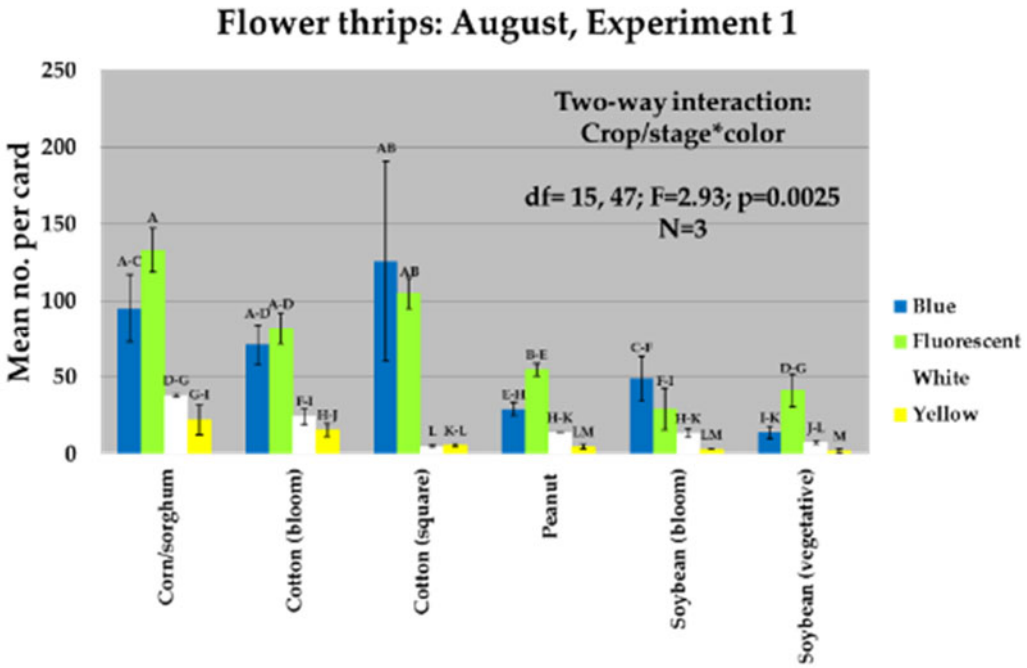

Figure 3. Mean +/- SE of the number of flower thrips on sticky cards in August experiment.

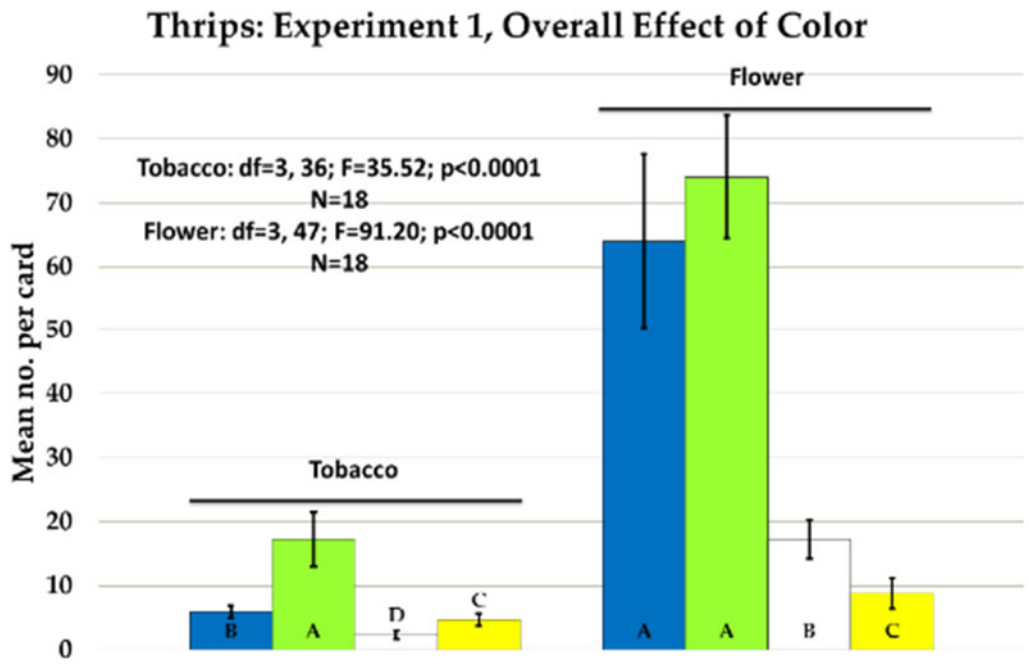

Figure 4. Mean +/- SE of the number of tobacco and flower thrips on sticky cards across all crop/stages in the August experiment.

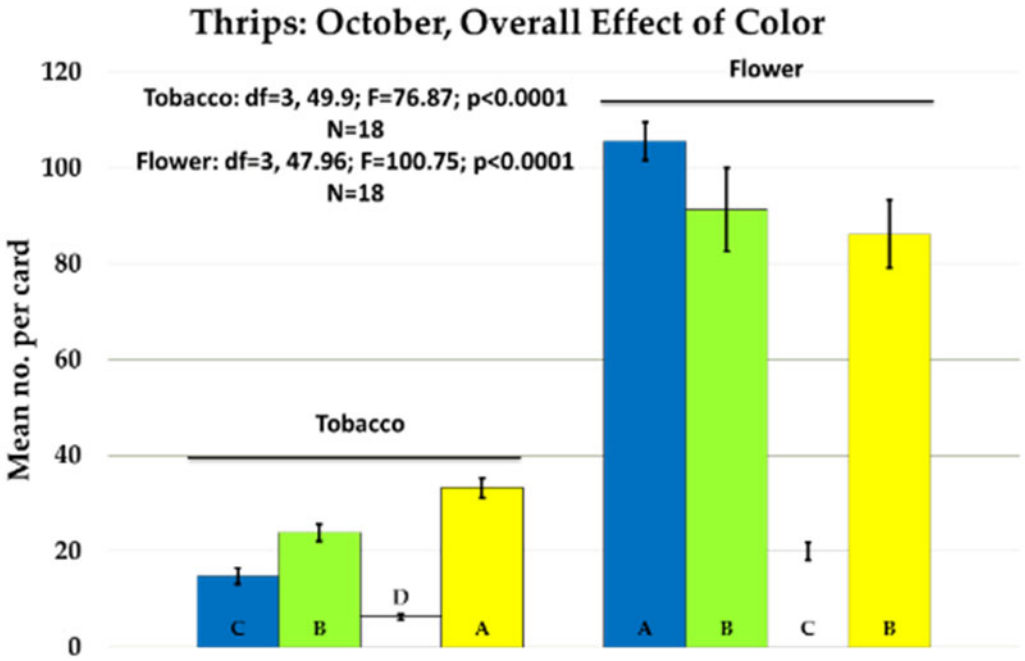

Figure 5. Mean +/- SE of the number of tobacco and flower thrips on sticky cards in the October experiment.

Mark/capture trial

Three hundred and eighty-seven thrips were collected by beat pan and two hundred and thirty-nine thrips were collected from sticky cards. Approximately 14.5% of thrips collected by beat pan were positively marked with egg white albumin and approximately 2.4% of thrips collected from sticky cards were positively marked with egg white albumin. Further analysis of sticky card samples was not performed due to insufficient quantity of marked thrips collected. The number of days after the rows were marked and the side of the marked rows (direction from marked

rows: north or south) the samples were taken from did not significantly affect the number of marked thrips collected by beat pan. The number of marked thrips in the marked area was significantly more (approximately ten-fold) than any of the unmarked rows ($df= 4, 100$; $F= 21.1$; $p<0.01$) (Table 1).

Table 1. Mean (SE) of the number of marked thrips collected by bean pan and sticky card in the mark/capture experiment.
*Rows followed by a different letter are significantly different ($\alpha=0.05$)

Capture method	Rows from marked area	Mean no. marked (SE)*
Beat pan	0	2.41 (0.36) A
	1	0.29 (0.11) B
	3	0.13 (0.07) B
	5	0.33 (0.21) B
	9	0.29 (0.14) B
Sticky cards	0	0.16 (0.11)
	1	0.04 (0.04)
	3	0.04 (0.04)
	5	0.04 (0.04)
	9	0 (0)

Discussion

The results of the sticky card experiments revealed that differences in attractiveness of card colors may vary by thrips species, crop species, crop growth stage, and time of year. These data reveal that there may not be one best color choice for collecting thrips and that to effectively collect thrips an array of color choices may need to be available in an agroecosystem. The cards used in these experiments represent only a few color options. Many more colors and variations on colors are available. More research is needed to determine the best times for specific color, host, growth stage, and thrips species combinations.

The number of positively marked thrips was much lower on sticky cards than those collected from beat pans. This may be due to a large number of thrips from outside the experimental area being attracted to the cards, thus having no exposure to the marked area. Egg protein may be a suitable marker for thrips movement experiments. More research is needed to optimize the materials and methods. In summary, sticky cards, beat pan sampling, and protein markers have good potential to serve as methods for monitoring thrips populations and movement.

Acknowledgements

We thank Monsanto and Mississippi State University for partial funding of this project

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