Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.7, No.9, 2017

Evaluation of Four Color Sticky Traps for Monitoring Whitefly and Thrips on Okra Crops at Tando Jam, Pakistan

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Abstract
Okra, (*Abelmoschus esculentus* L.), is a warm-climate annual vegetable crop belonging to the family, Malvaceae. Whiteflies and thrips, because of their sucking actions, are the most destructive insect pests of this crop, and the most common means of controlling infestation is through the use of chemicals. A field experiment was designed to determine the attraction of whiteflies (*Bemisia tabaci* Genn.) to four different colors of sticky traps in okra crops during the late Rabi season in 2012. After 21 days of plant germination, empty 1.5 L Pepsi bottles covered with yellow, green, purple, and black sheets of sticky paper were randomly placed in the crop field, two meters between and 60 cms above the plants. Results showed that yellow sticky traps were the most effective for monitoring and managing whiteflies and thrips in okra crops at subtropical climate conditions. The other colors were less highly attractant. This study found that using yellow-colored sticky-traps as an alternative for okra crop protection is less expensive and less hazardous than using chemical pesticides.

Introduction

A Malvaceae family crop known as Okra, or lady finger, (*Abelmoschus esculentus* L.) is one of the most popular annual vegetable crops, originating in Africa and cultivated throughout the tropical regions worldwide (Padita *et al*., 2010; Naveed *et al.,* 2009;). The crop occupies a land area of 277,000 hectares with a production of 731,000 metric tons (FAO, 2006). The total crop area in Pakistan alone is estimated to be 2.21×10^5 hectares, yielding about 2.86×10^6 tons of green pods (Anwar *et al.,* 2011).

The vegetable parts of the plant are often plagued by a multitude of sucking and chewing insect pests, interfering with the farmers' ability to get their expected yield within the harvesting time frame. Pests are one of the most serious challenges facing crop production today, although there are many ways to reduce or kill pests (Owen, 2004). The most destructive insect pests are the whitefly, *Bemisia tabaci* (Genn.), thrip *Thrips tabaci* (Lind.) and jassid, *Amrasca devastans* (Dist.), aphid, *Aphis gossypii* (Glover), the American bollworm, *Helicoverpa armigera* (Hb.) and the spotted bollworm, *Earias spp.* (Shabozoi *et al*., 2011; Aziz *et al.,* 2011). Such pests are normally controlled by hazardous chemicals, which, when released into the environment, can have a negative global impact. Such concerns have created a need for analogous controls designed with safety in mind.

For pest monitoring and management, trapping provides the most convenient tools. Colored sticky-traps are a simple, low-cost method for determining the relative abundance of insects and are used to monitor flying insect species on many crops (Lessio and Alma, 2004; Raja and Arivudainambi, 2004). For instance, different colored cylindrical sticky traps placed at a height of 157.5cm are an effective means of controlling aphids. Keeping that in mind, a field experiment was conducted to determine which color of four different colored traps was the most attractive to whitefly adults and thrip adults and nymphs. It is hoped that the information from this study will be able to help in the monitoring and management of these pests, as well as enhance integrated pest management programs in Pakistan and other countries with similar ecological conditions. It is also hoped that a cheap, simple and easily attained method for control of these insect species will be introduced and prove useful for any crop attacked by whiteflies.

Material and Methods

The field experiment was carried out during the Rabi season Page: 12 (February-May) in 2012 to evaluate the attractive effects of different colors on insect pests at Tando Jam, Pakistan. The okra seeds cultivated were the *Rama Krishna* variety, sown on well-prepared soil on both sides of ridges, 15 February 2012. The distance between rows was 45 cms and from plant to plant, 4 to 5 cms.

Four different colors, yellow, green, purple and black, were used to trap the okra insect pests. After 21 days of plant germination, the researchers placed, at random, empty 1.5 L Pepsi bottles covered with yellow,

green, purple, and black sheets of sticky paper in the crop field, 2 meters between and 60 cms above the plants, with the help of bamboo stakes. No chemicals were used at any time for pest management throughout the research period.

Field studies

Traps were placed in the field between 10 am and 11 am and replaced after 24 hours. The adult whiteflies and thrip adults and nymphs were collected from each colored trap, then counted and recorded, repeating every four days; a total of 12 collections were recorded. The data obtained were subjected to statistical analyses using statistical computer software and figures were drawn on MS-excel.

Results

Whitefly Population Observed on Colored Sticky Traps

The yellow sticky trap was the strongest attractant of whitefly adults. The highest population of whitefly on yellow sticky cards was observed to be 61.13 per card from the eighth collection, while the lowest population was 8.62 per card from the first collection (Fig. 1).The green sticky trap was the second strongest attractant of whitefly. The highest population from the green sticky trap was 37.58 per card from the seventh collection, and the lowest population was 1.98 per card from the first collection (Fig. 1). Following the yellow and green traps, the purple card was observed to be favored by the whitefly, with the highest population of 24.81 from the eighth collection, and the lowest population of 1.27 from the first collection (Fig. 1). The black cards were found to be a poor attractant for whiteflies throughout the season, with the highest population of adult whiteflies recorded from the tenth collection, with 6.11 per card and the lowest population of 0.65 per card from the first collection (Fig.1).

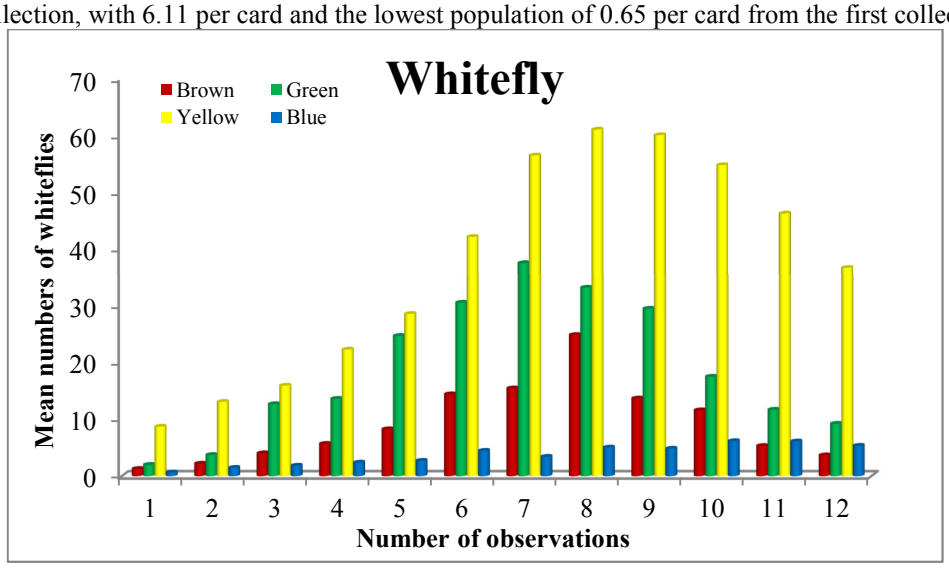

Fig. 1. Population of whiteflies on different colored sticky traps

Thrip Population Observed on Colored Sticky Traps

Thrips were observed to be more attracted to the yellow color trap, as well. At the time of eight collections, the highest adult population was 56.39 per card, and the lowest population 2.21 per card was recorded at the first collection (Fig. 2). Green was the second choice for thrips, with a maximum population of 47.95 per card recorded from the ninth collection, while the lowest population of 2.14 per card was recorded after the second collection (Fig. 2). Black cards were observed to be a better attractant for thrips, as compared to the whitefly. Thrips' peak population of 21.47 per black card was recorded on the tenth collection; the lowest population of 0.64 was recorded from the first observation (Fig. 2). The purple sticky cards were observed to be a poor attractant. The highest population from this color was 9.68 per card, recorded from the sixth collection; the lowest was 1.33 insects per card, recorded from the first collection (Fig 2).

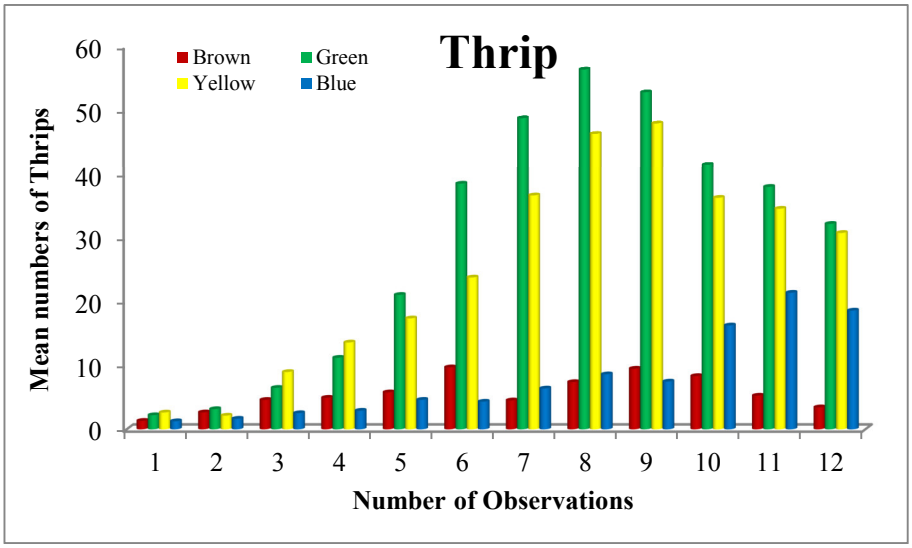

Fig. 2. Population of Thrips on different colored sticky traps

Discussion

The result of the present study show that yellow is the most effective attractant, followed by green, purple and black. Similar results were also reported by Prokopy & Owens (1983), who found that most foliage-eating insects have positive responses to the color yellow. The vertical yellow trap was the most attractive and efficient trap to use in monitoring the whitefly; however, Idris *et al*. (2012) found that yellow was the most attractive color to whiteflies, regardless of the trap design. A relatively small population was attracted by green, purple, and black traps when the populations peaked in crop infestations; therefore, it can be said that if the population is under control, the colors other than yellow will be useless.

Both adult and nymph thrips were attracted to yellow, followed by green, black and purple. A related study evaluating trap height and color was performed by Gharekhani, et. al. (2014), who found that yellow sticky traps at a height of 70 cm above the ground were the most suitable for adult thrips infesting garlic, onion and tomato crops. It was also observed that when the pest populations increased, they diverted to colors other than yellow.

Conclusions

The use of colored sticky traps shows good results for monitoring and managing okra's insect pests in subtropical climate conditions. Yellow is the most attractive color to the whitefly, followed by green, purple and black. For thrips monitoring and management, the color yellow was also observed to be a strong attractant, followed by green, black and purple. Furthermore, this study concluded that using different colored traps for okra crop protection was significantly less expensive and less hazardous than chemical insecticides.

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