

Evaluation of Yellow Sticky Traps on Populations of Some Cotton Pests

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Abstract: Yellow sticky card were placed in horizontal and vertical position at two heights with two positions. The height of yellow sticky traps affected the populations. The largest population was captured at 25 cm above the plants for *Frankliniella* spp. In contrast, *Bemisia tabaci* and *Empoasca* spp. were highest at 30 cm above the ground level. Vertical position in each dimension captured more *Empoasca* and *Frankliniella* spp. than horizontal. However, there were not significant differences on *B. tabaci*. Directions also affected the pests. The largest population of *Empoasca* spp. was captured in north to south direction of dimension 2 whereas more *Frankliniella* spp. population captured in east to west direction. However, more *B. tabaci* captured in north to south direction in the dimension 1. This information is useful in the development of sampling techniques to aid the growers in making management decisions against the flying insects in cotton.

Key words: Cotton insects • yellow sticky trap • sampling

INTRODUCTION

Cotton is one of the important industrial plants with the production of 800, 000 ha in Turkey and Aydin province has one of the important places in Aegean Region where it has the second place in the cotton production with 267.000 ha in the country [1]. Insect pests have plagued the cotton growing industry over the years and they are a source of constant concern to growers. Insects such as flower thrip, whitefly and leafhopper cause serious destruction to the cotton plants resulting in a monetary loss to the cotton grower. Those insects are serious economic pests in the cotton fields of Turkey [2, 3] and the growers conduct management measures to control cotton insects.

Sticky traps have been widely used as flight traps to monitor flying insects in many agro-ecosystems and are the preferred more preferable method for some insects in the management systems. They have been used against some pests in ornamental plants [4], celery [5], tomato, potato [6] in both fields and greenhouses. The use of yellow sticky traps to monitor populations of flying pest have been widely used for monitoring whitefly [7], thrips [7, 8] and leafhopper [9].

Yellow color was proven to be the most effective color for attracting flying insects than other colors including yellow-green, orange, green and blue card [10]. Some research has showed that rather than color shape,

Height and size of traps were more important for the catching of some adult flying insects. Roa [11] compared sticky traps of different colors for monitoring population of *B. tabaci* on cotton in India. Uthamasamy *et al.* [12] and Nandihalli [13] found that 30 cm above the ground level attracted more adult of *B. tabaci* than traps placed at heights of 60, 90 and 120 cm a ground level on cotton in India. Mensah [9] also mentioned that yellow sticky trap for leafhopper should be placed at heights between 25 and 75 cm above ground level in cotton. For *Frankliniella* spp., Brodsgaard [14] mentioned that trap catches of *Frankliniella occidentalis* (Pergande) were affected by trap height, with the largest catches being obtained in traps placed just above the canopy on cucumber in glasshouse.

In this study I compared the effects of yellow sticky traps at various heights, positions, dimensions and directions for some cotton pests. The findings will be useful in the development of sampling techniques to aid the growers in making management decisions against flying insects in cotton.

MATERIALS AND METHODS

To determine the optimal trap height, position, dimension and direction for placing yellow sticky cards to monitor some cotton pests including flower thrips *Frankliniella occidentalis* Pergande and *F. Intonsa*

(Thysanoptera: Thripidae), whitefly *Bemisia tabaci* Germ. (Homoptera: Aleyrodidae) and leafhopper populations *Empoasca decipiens* Paoli and *Asymmetrasca decedens* Paoli (Homoptera: Cicadellidae), 10×15 cm and 15×10 cm sticky cards were placed at different heights, positions, dimensions and directions during the 2004 and 2005 cotton-growing seasons at the Agricultural Research Center of Adnan Menderes University, Aydin Province, Turkey. The Nazilli-84S local cotton variety was used and planted on 3 May 2004 and 12 May 2005 with north to south direction.

The study design was randomized complete block with three replicates of each trap height, position, dimension and direction. Trap heights were 30 cm above the ground level and 25 cm above the top of the cotton plant. Some researchers used this heights for some cotton pests. Yellow sticky card were placed horizontal and vertical position to the ground. Vertical position has two dimensions including 15×10 cm in length and height named as dimension 1 and 10×15 cm in length and height named as dimension 2 whereas horizontal position has dimension 1 (15×10 cm) at both heights. Traps in each dimension have also two directions with east to west and north to south direction. Each sticky trap was placed in each plot (30 rows×25 m long) and 10-m space was left to reduce edge effect. The traps used in the study were constructed from yellow plastic cards with >90% reflectance in visible wavelength spectrum of 540-600 nm and uniformly coated with a thin layer of an adhesive compound mixture of synthetic hydrocarbon polymers (Kapar Organik Tarim Sanayi, Ankara, Turkey) on both side. The traps were suspended on a wooden rod and the wooden frame held the sticky card in all heights, positions dimensions and directions; these could be easily moved up to the stake to keep them 25 cm above the plant canopy at sampling dates. However, traps were fixed on a wooden rod at 30 cm above the ground level. Trap height at 25 cm above the top of plant was adjusted once a week to ensure that the height was maintained at 25 cm above the plant.

Yellow sticky cards were collected each week and the number of flower thrips, whitefly and leafhopper populations per trap per week was determined. Yellow sticky cards were removed and transported back to the laboratory, where they were examined using dissecting microscope. Two species of flower thrips and leafhopper were counted together. Also, some natural enemies captured on the cards. However, they are not counted. The cards changed weekly throughout the entire growing season and finished by the picking of cotton. No

insecticides were used throughout the sampling period in both years and all cultural practices were also done.

The data were subjected to analysis of variance and means were separated by Duncan's multiple range test ($p < 0.05$). Data were transformed using $\log(x+1)$ before analysis of variance to correct for heterogeneity of variance. Comparisons of data the trap heights, positions, dimensions and directions were analyzed using SPSS [15] version 9.0.1. Data from each year were analyzed separately.

RESULTS

In 2004 seasonal mean number of *Empoasca* spp., *Frankliniella* spp. and *B. tabaci* on yellow sticky traps are presented in Table 1. As leafhopper *E. decipiens* and *A. decedens* were observed on the yellow sticky traps. Both species counted together and mentioned as *Empoasca* spp. in the Tables. The trap height affected the amount of *Empoasca* spp. on the yellow sticky card. The largest population was captured at 30 cm above the ground level compared to the 25 cm above the cotton plant level. At 30 cm height the largest population was captured in the dimension 2 of vertical position with north to south direction. Positions have also effect on the amount. Total amount of two directions in the dimension 1 and 2 of vertical position captured more *Empoasca* spp. was higher than that of horizontal one. Direction also affected the population in the dimension 1 of each position. East to west captured more population. However, in the dimension 2 of vertical position north to south direction was higher than east to west. At 25 cm above the cotton plant level the largest population was obtained in vertical position compared to the horizontal one (Table 1).

The trap height affected the flower thrips the population. The largest population of flower thrips was observed at 25 cm above the cotton plant level compared to the 30 cm above the ground level. The population was significantly different at 25 cm above the cotton plant level among the position, dimension and direction. Total amount of population in two dimensions of vertical position was higher than in horizontal one. The dimension also affected the amount. The largest population was captured with the dimension 1 and dimension 2 in vertical position. However, the lowest amount was observed in horizontal position. Direction also affected the population at the 25 cm above the plant level. East to west direction captured the largest population in dimension 1 and dimension 2 of vertical position and in horizontal position.

Table 1: Seasonal mean numbers (\pm SE) of some cotton pests at different heights, dimensions and directions on yellow sticky traps in cotton field, 2004

Heights (cm)	Position	Dimensions (cm)	Directions	<i>Empoasca</i> spp.	<i>Frankliniella</i> spp.	<i>Bemisia tabaci</i>	
30 cm above the ground							
	Vertical	15×10	EW	179.70±18.60ab	71.10±16.80bc	120.20±25.30bc	
			NS	170.60±17.70b	29.80±7.40c	155.50±28.40a	
		10×15	EW	168.50±15.90ab	56.60±14.30c	108.10±20.90c	
			NS	228.30±20.70a	28.00±5.90c	120.30±24.60bc	
		Horizontal	15×10	EW	169.30±15.80ab	28.40±6.00c	125.30±23.40bc
				NS	140.20±11.20bc	14.20±4.30c	145.10±26.30ab
25 cm above plants							
	Vertical	15×10	EW	144.60±14.00bc	172.60±33.30a	21.70±7.10d	
			NS	105.40±11.30c	81.60±13.30b	22.70±9.90d	
		10×15	EW	119.80±12.70c	146.00±25.70a	22.50±8.80d	
			NS	145.90±15.30bc	80.40±14.70b	17.90±6.10d	
		Horizontal	15×10	EW	70.10±7.40d	70.30±14.30bc	6.20±0.10d
				NS	75.30±8.20d	10.20±2.40c	8.10±1.20d

*Means followed by the same letter are not significantly different ($p < 0.05$). EW: east to west, NS: north to south direction

However, there were not significant differences between directions except dimension 1 in vertical position at 30 cm above the ground level (Table 1).

The trap height also affected the population *B. tabaci*. The largest population was captured at 30 cm above the ground level compared to the 25 cm above the cotton plant level. At 30 cm above the ground level the largest population was observed with dimension 1 in north to south of vertical position and the second one was observed with the same dimension in horizontal position. Total amount of population in two direction of dimension 1 was higher than total amount of dimension 2 in vertical position. However, there were not significant differences between dimension 1 in both positions. Direction affected the population at 30 cm above the ground level and statistical differences were observed. North to south direction in two positions and dimensions were higher than east to west. At 25 cm above the plant level there were not significant differences in positions, dimensions and directions. However, vertical position in two dimensions captured more whitefly populations than the horizontal position (Table 1).

In 2005 seasonal means number of *Empoasca* spp., *Frankliniella* spp. and *B. tabaci* on the yellow sticky traps are presented in Table 2. Trap height affected the amount of *Empoasca* spp. The largest population was captured at 30 cm above the ground level compared to 25 cm above the cotton plant level. At 30 cm the largest amount was obtained in north to south direction of vertical position in the dimension 2. Total amount of vertical position in each dimension captured more population than horizontal one. Direction also affected the amount. The largest population was captured with north to south direction of dimension 2. However, the population in east to west direction in the dimension 1 of vertical and horizontal position were higher than north to south direction. At 25 cm above the plant level the largest population was captured in the dimension 1 of vertical position and statistically different from the other dimensions. There were not statistically differences on the direction except east to west direction of dimension 1 in vertical position (Table 2).

Trap height affected the amount of flower thrips populations captured on the yellow sticky trap. The

Table 2: Seasonal mean numbers (\pm SE) of some cotton pests at different heights, dimensions and directions on yellow sticky traps in cotton field, 2005

Heights (cm)	Position	Dimensions (cm)	Directions	<i>Empoasca</i> spp.	<i>Frankliniella</i> spp.	<i>Bemisia tabaci</i>
30 cm above the ground						
	Vertical	15×10	EW	177.20±19.40ab	22.40±5.20c	161.20±17.00bc
			NS	157.30±17.20b	14.60±3.10c	234.90±26.40a
		10×15	EW	143.10±18.90b	12.90±2.90c	150.60±23.80c
			NS	212.70±25.90a	22.78±6.00c	162.90±16.20bc
	Horizontal	15×10				
			EW	164.40±14.50ab	31.70±5.40bc	184.20±30.90bc
			NS	132.10±11.80bc	16.11±3.70c	205.20±31.30ab
25 cm above plants						
	Vertical	15×10				
			EW	130.00±14.70bc	167.90±36.50a	10.20±3.20d
			NS	87.70±7.80c	79.20±15.40b	9.20±3.40d
		10×15				
	EW		93.60±9.90c	139.30±30.50a	16.70±4.90d	
		NS	93.70±11.50c	77.50±16.20b	12.10±4.30d	
	Horizontal	15×10				
			EW	79.10±8.50c	81.30±16.30b	5.90±0.90d
			NS	82.50±9.40c	16.10±3.70c	7.30±1.50d

*Means followed by the same letter are not significantly different ($p < 0.05$). EW: East to west and NS: north to south direction

largest populations were observed at 25 cm above the ground level compared to the 30 cm above the ground. Yellow sticky trap affected the amount of population and statistical differences were observed at 25 cm above the cotton plant. Total amounts of population were captured in vertical than horizontal position in total. Direction in all position and dimension also affected the population and east to west direction captured more flower thrips population compared to the north to south. The largest populations were obtained in dimension 1 with east to west direction and dimension 2 and with east to west direction in vertical position. However, at 30 cm above the ground level there were not significant differences among the positions, direction and dimensions except horizontal's east to west direction (Table 2).

Trap height also affected the amount of *B. tabaci* in 2005. The largest population was captured at 30 cm above the ground level compared to the 25 cm above the cotton plant level. At 30 cm above the ground level there were significant differences on dimensions and directions. In the total amount of vertical and horizontal position there were not significant differences between total amount including both directions of vertical and horizontal position. The dimensions have effect on the population. The largest amount was obtained and in dimension 1 of

the 2 position with north to south and they were higher than dimension 2. At 25 cm above the cotton plant level, statistical differences were not observed among the position, dimension and directions. However, vertical position captured more whiteflies on the traps.

DISCUSSION

It was found the vertical position captured more *Empoasca* spp. than the horizontal position in both years. Differences were also obtained in two dimensions of vertical position and the largest populations were obtained in the dimension 1 (15×10 cm). Dimension and height did differ at 25 cm above the plant. Direction of dimension also affected the population level. The largest population was observed in north to south direction of horizontal and vertical position at 30 cm above the ground whereas it was not seen at 25 cm above the plant level. The result showed that the differences were observed mainly on the high population captured on the yellow sticky trap. Atakan and Canhilal [16] reported that leafhopper catch was significantly higher at 60 cm. Mensah [9] said that yellow sticky trap for leafhopper should be placed at heights between 25 and 75 cm above ground level in cotton. The study showed that the largest

population was captured at 30 cm above the ground level and the same result was obtained with some experiments. However, it was concluded that direction affected the population captured on the yellow sticky trap. It was not found any study on the direction that affected the population. Therefore, it was difficult to compare the result of directions and dimensions. I thought that sunlight reflect more light on north to south direction, thus, attracted more leafhopper population than east to west direction.

The height of yellow sticky trap significantly affected the amount of seasonal population of *Frankliniella* spp. The largest number of flower thrips population captured at 25 cm above the cotton plant compared to that of 30 cm above the ground level in both years. The research showed that yellow sticky traps affected the capture of flower thrips between vertical and horizontal position and the largest population captured in vertical position and higher than horizontal one. There were significant differences between two dimensions in vertical position. Dimension 1 captured more population. Also, direction affected the population at 25 cm above the cotton plant level and statistical differences were also observed among the dimensions of trap in vertical position and vertical position's east to west direction was about two times more than north to south. However, there were not significant differences among the position's north to south in two dimensions placed vertically at 30 cm above the ground level. The same result also obtained at 30 cm above the ground level. However, it did not differ statistically. Atakan and Canhilal [16] reported that most flights of flower thrips occurred above the plant canopy. Pearsall [17] also reported that numbers of flower thrips in flight decreased with height of sticky trap from the ground in nectarine orchards. This study showed that the yellow sticky trap at 25 cm above the plant captured more flower thrips in cotton like the other crops. It was concluded that sticky traps should be placed vertical position with east to west direction for flower thrips in cotton at 25 cm above the cotton plant level.

B. tabaci population were affected from the height, position, dimension and direction of yellow sticky trap in both years at 30 cm above the ground level. The largest population was significantly captured at 30 cm above the ground level compared to the 25 cm above the cotton plant in both years. At 30 cm above the ground level there were statistical differences observed between dimensions and the directions of yellow sticky trap at 30 cm above the ground level. It was found that there were not significant differences between total amounts of dimension one of vertical and horizontal position in both years. However,

differences were observed in two dimensions of vertical position and the largest populations were obtained in the dimension 1. Dimension and height did differ at 25 cm above the cotton plant. Direction of the dimension affected the population amount. The largest population was obtained with north to south in vertical and horizontal position at 30 cm to ground level. The study showed that the same result was obtained with some experiments. Atakan and Canhilal [16] found that numbers of whiteflies were highest at 60 cm in cotton field. It was concluded that yellow sticky trap should be placed in the dimension 1 of vertical position and with north to south direction for *B. tabaci*.

In conclusion, yellow sticky trap in vertical position placed at 30 cm above the ground level and 25 cm above the plant canopy level will provide a practical method for monitoring the whitefly, flower thrips and leafhopper populations during the growing season. However, the position and height were not enough only. Dimension and direction also play an important role in catching flying insects. This information will be useful in the development of sampling techniques to aid growers in making management decisions against flying insects in cotton.

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