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Trapping Efficiency of Various Colored Traps for Insects in Cucumber Crop under Greenhouse Conditions in Riyadh, Saudi Arabia

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Abstract: A greenhouse experiment was carried out to evaluate the insects trapping efficiency of various colored traps in cucumber (*Cucumis sativus* L.) crop in Riyadh, Saudi Arabia. The treatments involved were seven different sticky traps (green, fluorescent yellow, orange, pink, red, yellow and transparent (control)) placed at four different heights (0.5, 1.0, 1.5 and 2.0 m above the ground) and each treatment was replicated four times. The experiment was laid out in "Complete Randomized Block Design". The insect pests recorded were Thrips *Thrips tabaci* (Lindeman) and the leafminer *Liriomyze trifolii* (Burgess). Significantly more insect pests were trapped on fluorescent yellow as compared to other traps whereas pink, green and orange colored traps caught significantly lower number of insects and found statistically similar. However, there was no significant difference between mean number of various insects caught on sticky traps placed at different heights from ground level but more insects were trapped at maximum height (2 m).

Key words: Cucumber, *Cucumis sativus* L., greenhouse insect pests, sticky traps, thrips, leafminers, colored trap

INTRODUCTION

In natural ecosystems, phytophagous insects are coexisted in a complex relationship with plant communities that vary in phenology, abundance and association with other living organisms. Insects may be harmful to plants and even cause death. Greenhouse provides a more conducive environment, which facilitate their rapid multiplication. Cucumber (*Cucumis sativus* L.) is an important vegetable crop and is mostly grown in greenhouse where it is attacked by a number of greenhouse insect pests. Sticky cards for monitoring insect pest proved to be a successful method in greenhouse integrated pest management.

There are many ways of insect pest detection includes sticky traps and random foliage inspection. Whiteflies, leafminers and thrips are mostly attracted to Yellow sticky cards where as blue sticky cards are particularly attractive to thrips[1,2]. Prokopy and Owens[3] suggested that the role of vision in insect herbivores for the detection of potential host plants should be explored to utilize the mimics of appropriate shape, size and hue alone or in combination with olfactory stimuli to develop more effective insect pests monitoring technique. Herbivorous insects are highly discriminating while searching for food and oviposition sites utilizing visual or olfactory stimuli[4,5]. Greany *et al.*[6] found that Caribbean fruitflies *Anastrepha suspensa* (Loew) are attracted to orange and yellow colors of the fruit which they attack. Bremman and Weinbaum[7] found preference for yellow sticky traps while comparing psyllid response toward different colored (red, blue, green, white and clear) sticky traps.

Lapis and Borden[8] found that wavelength and intensity of reflected light influence response of *Heteropsylla cubana* to its host plant. In another experiment they proved the superiority of odor over color in host selection by *Heteropsylla cubana*. Vaishampayan *et al.*[9] showed that initial alightment of Greenhouse whitefly *Trialeurodes vaporariorum* (Westw.) predominantly elicited by color of the host plant rather than the suitability. They also depicted that insect landing is mainly elicited by yellow light (500-600 nm) a major component of the reflection from green leaves.

Position and orientation of sticky trap, also effects the trapping efficiency[10]. Gillespie and Vernon[11] noted that trap height and colors were important factors influencing thrips catches in commercial greenhouse

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cucumber crops. Yellow sticky traps showed a promising results when estimating the leafhopper density at potato under different cropping system[12,13].

The objective of this study was to evaluate trapping efficiency of different colored traps placed at various heights to attract various insect pests attacking cucumber crop grown in greenhouse.

MATERIALS AND METHODS

The experiment was conducted at Muzahmia research station, Natural Resources and Environment Research Institute, King Abdulaziz City for Science and Technology, Riyadh, Saudi Arabia. The experiment was carried out in the first season from September-October 2001 and in the second season from September-December 2002 to evaluate the trapping efficiency of various colored sticky traps in monitoring cucumber greenhouse insect pest's population density. Trap heights were also added as one of the factors affecting the insects trapping efficiency of sticky traps during 2nd cropping season.

Seven colored traps (fluorescent yellow, green, yellow, orange, pink, red and transparent (control)) were designed locally, from colored board covered with clear solofan cut into pieces of equivalent sizes of 14x14 cm and coated with adhesive tangle-trap. These traps were uniformly hanged at the top of the cucumber plant during first season but during second season the traps were placed at 0.5, 1.0, 1.5 and 2.0 m height above the ground to compare their relative insects trapping efficiency with respect of trap position.

The traps were collected weekly for counting and identification of trapped insects. The experiment was carried out using Completely Randomized Block Design with seven treatments and four replications. Data were transferred with the log and treatment means were compared using the least significant difference (LSD) method at 5% probability level using SAS[14].

RESULTS AND DISCUSSION

Results of present study revealed a significantly higher number of thrips catches on fluorescent yellow trap than green and orange traps that remained statistically at par with each other (Table 1). A significantly lower number of thrips were trapped on yellow, pink red and transparent traps (LSD 0.05=1.12). The results showed significantly more number of leafminers catches with fluorescent yellow and green traps, which were found statistically similar but different from orange and yellow traps where as pink, red and transparent presented significantly lower number of leafminer catches (LSD 0.05=0.07).

Table 1: Mean numbers of insects caught on sticky traps of various colors in greenhouse cucumber for two seasons 2001-2002

	Mean numbers of insects caught at various colored traps			
	Year (2001)		Year (2002)	
Trap colors	Thrips	Leafminers	Thrips	Leafminers
Fluorescent yellow	5.66a	0.30a	4.31a	0.14a
Green	3.73b	0.28a	1.74bc	0.10b
Orange	2.77bc	0.21b	2.74ab	0.08b
Yellow	1.71cd	0.20b	1.76bc	0.07b
Pink	1.56d	0.08c	4.27a	0.03b
Red	0.31e	0.06c	0.47c	0.05b
Transparen (Control)	0.67de	0.08c	0.25c	0.37a
LSD (0.05)	1.12	0.07	1.67	0.08

Table 2: Mean numbers of insects caught on sticky traps at different heights in cucumber crop in greenhouse during 2002

	Mean numbers of insects caught	
Trap heights (m)	Thrips	Leafminers
2.00	2.68a	0.13a
1.50	1.67a	0.12a
1.00	2.60a	0.10a
0.50	1.95a	0.14a
LSD (0.05)	1.26	0.06

Table 3: Mean numbers of insects caught on sticky traps of various colors in greenhouse cucumber crop during 2001-2

	Mean numbers of insects caught at traps	
Trap colors	Thrips	Leafminers
Fluorescent yellow	4.76a	0.20b
Green	2.40bc	0.16bc
Orange	2.75bc	0.13c
Yellow	1.75c	0.12cd
Pink	3.37b	0.05e
Red	0.43d	0.06de
Transparent (Control)	0.39d	0.27a
LSD (0.05)	1.18	0.06

Mean numbers of insects captured on sticky traps during 2002 exhibited a significantly higher thrips population trapped on fluorescent yellow and pink traps than on green, orange and yellow traps that were statistically at par with each other while a significantly lower number of thrips were trapped on red and transparent traps at (LSD 0.05 = 1.67) (Table 1). Non-significant few leafminer catches were recorded on fluorescent yellow, green, orange, yellow, pink and red traps where catches statistically remained higher on transparent traps (LSD 0.05=0.08).

There was no significant difference between mean number of catches for various insects on sticky traps positioned at different heights from the ground level (Table 2). However, the maximum catches were recorded from the traps placed at 2.00 m followed by 1.00, 0.5 and 1.5 m height, respectively.

Mean numbers of insects captured on sticky traps of different colors during 2001-2 showed a significantly higher number of thrips catches on fluorescent yellow trap than on green, orange and pink colored traps which were statistically at par with each other while a significantly lower number of thrips were trapped on yellow, red and transparent traps (LSD 0.05=1.18). The results presented significantly higher number of leafminers catches on transparent traps than the rest of the treatments while non-significant difference was found between fluorescent yellow and green colored traps (Table 3).

The result clearly indicated that fluorescent yellow traps caught significantly higher number of insects during both experiments, which showed insects preference toward fluorescent yellow traps over all other colors including regular yellow traps which may be attributed to more intense reflectance and wavelength of the fluorescent yellow sticky traps. The findings are in line with Lapis and Borden[8] who reported that fluorescent yellow trap having high reflective intensity when compared to the lower reflective intensities of less preferred yellow traps indicated that both wavelength and intensity of reflecting light affect insect response to its host. Mostly insects are attracted to spectral reflectance ranging from 350-650 nm whereas different colors varies in bandwidth such as ultraviolet 300-400 nm, blue 400-500 nm, green 500-560 nm, yellow 560-590 nm, orange 590-630 and red 650 nm[15]. A range of herbivorous insects respond positively to yellow color that establishes a supper-normal foliage type stimulus that gives out peak energy in similar bandwidth peak energy emitted by natural leaves detected by insects, but at higher reflective intensity[16,17]. Certain aphids species that feed on host plants having saturated leaves color are not attracted to unsaturated yellow surfaces which shows the insects preference for specific characteristics while searching potential host[18].

Pink, green and orange colored traps were statistically similar in attraction while red colored and transparent traps showed less attraction. Similarly, Vaishampayan *et al.*[9] indicated that yellow-green light (520-610 nm) had strong attraction for insects whereas blue and red lights were found strongly of moderately inhibitory. Some tephritid flies are also strongly attracted to green and yellow pigments that show strong resemblance to plant foliar color[19]. Mostly plant leaves give green or yellow-green shade with maximum reflection, ranging from 500-600 nm[20]. Caribbean fruitflies *Anastrepha suspensa* (Loew) are attracted to orange and yellow colors of the fruit which they attack[6]. The previous findings partly explain the insects' attraction toward yellow and green colors, which were also indicated by present study.

However, there was no significant difference between mean number of various insects caught on sticky traps placed at different heights from ground level but more insects were trapped at maximum height (2 m) may due to the presence of preferred new tender leaves at different heights. Aphids are attracted to high reflectance (yellow) from newly developing foliages than lower reflectance (green) from mature leaves of the same plant[5]. The findings are supported by Gillespie and Vernon[11] who reported maximum thrips catches on different colored traps at 2.4 and 1.8 m heights in greenhouse cucumber crop. Sticky traps placement at suitable height with respect to particular crop is very important for monitoring insect pests population[10]. Present results confirm that, insect pests monitoring placement of traps at optimum position and well awareness of the effect of background composition is imperative for desired results[21].

The present study presented less number of insect's catches with various color traps, which mostly remained statistically at par with each other except fluorescent yellow. It depicted that either colors were a week stimulus for insects attraction or the color traps used for this study were locally designed and could not achieved the results as with standard one. Some herbivorous insects feed on plants of various families termed as generalists whereas others restricted. Therefore, desired results can be achieved if the colored traps used for visual specialist insects[22]. However, more promising results can be obtained by thorough understanding the role of visual stimuli and incorporating it with plant olfactory attractants into traps for insect pests population monitoring.

In conclusion, more insects positively responded to fluorescent yellow colored traps having high reflective intensity. The use of this trap can improve the pest monitoring system. Sticky traps placement at suitable height with respect to particular crop is also very important as mostly insects are attracted to high reflectance (yellow) from newly developing leaves than lower reflectance (green) from mature leaves. More studies are necessary for understanding the role of visual stimuli to make unequivocal conclusions.

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