

Research Article

Comparison of different mechanical traps to screening and control of whitefly (Aleyrodidea: Hemiptera) population in tomato crop

Hamid Rehman¹, Aslam Bukero¹, Abdul Ghani Lanjar¹, Lubna Bashir¹, Zainab Lanjar² and Shahzad Ali Nahiyoon^{1*}

1. Department of Entomology, Sindh Agriculture University, Tandojam, 70060-Pakistan

2. Department of Pharmacy, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, 70060-Pakistan

*Corresponding author's email: Shezi_129@yahoo.com

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Hamid Rehman, Aslam Bukero, Abdul Ghani Lanjar, Lubna Bashir, Zainab Lanjar and Shahzad Ali Nahiyoon.

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Abstract

A significant issue is associated with the pest management control system and insect preferences for the tomato plants, Whiteflies masticate on the lower epidermis of the tomato plant leaves and eradicate tomato plants by diminishing the trim quality due to removal of the plant phloem, sucking out the sap, transmitting plant infections, and by discharging honeydew, which can increase leaf sheaths. Therefore, obstructing light absorption that results in less photosynthesis activity, causes the development of sooty mold. The adequacy of various sticky traps with various kinds of colors and cup traps against whitefly were assessed in tomato crops. The yellow sticky traps got whitefly adult an average of 374.2 ± 48.65 during 24-h and 823.6 ± 49.32 during 48h test periods per card. The wheat (fluorescent) sticky cards caught adult whitefly average of $391.4 \pm$ during and $569.4 \pm$ per card during a similar period. The Cup traps just got an average of 4.64 ± 1.23 adult (*Bemisia tabaci*) over a 24-h and 7.28 ± 1.12 in 48 h periods. Staying sticky traps got whitefly, sky blue or cyan (fluorescent) 299.4 ± 49.08 and 488.9 ± 87.34 , somewhat bluish-green (fluorescent) 59 ± 5.98 and 94.36 ± 8.68 , blue (fluorescent) 99.28 ± 7.133 and 206.5 ± 21.09 and red (fluorescent) 101 ± 6.73 and 192.7 ± 18.48 , in 24h and 48h time frame individually. All traps caught other insects too. These outcomes exhibited those sticky traps with fluorescent colors more attractive and valuable to control whitefly (*Bemisia tabaci*) at other hand cup traps were helpful for monitoring. RGB (red, green, blue) and HSB (hue, saturation, brightness) value also estimate to check the correlation of color with whitefly. Both values showed a positive and in same negative correlation as well.

Keywords: Sticky trap; Cup trap; Fluorescent; Mechanical; *Bemisia tabaci*; Whitefly

Introduction

The sweet potato whitefly is an important pest of cotton [1] and transfers various types of virus such as TLCV of tomato [2]. Whitefly is a major pest of many vegetables and other cash crops in china and elsewhere

[3-6]. Since 1990s whitefly was considered a major pest of many crops [5-7]. In China, a lot of pesticides used to control whitefly, which adversely developed resistance in whitefly against pesticides[8]. In contrary, biological control methods increased to

control whitefly [8, 9]. Similarly reported in China [10, 11].

Yellow sticky traps, considered major attractive traps for whitefly, aphid and leaf miners as well [1, 3, 11-13]. Vernon [14], Capture of the western blossom thrips, *Frankliniella occidentalis* (Pergande), on yellow or violet traps of four unique shapes, when set before plywood outlines painted violet, blue, green, or yellow as foundation hues were contemplated in a cucumber nursery in 1988. Among traps with cubic, round, rectangular crystal, or tube-shaped states of roughly a similar surface zones, just yellow barrel-shaped traps before a violet foundation were essentially more appealing than alternate shapes.

During 1996, 1997 and 1999, think about were led in cotton, sugar beets, horse feed, yard long bean and shelled nut fields to look at adult gets in CC traps furnished with various trap base colors, found yellow color most appealing trap base against *Bemisia argentifolii* Bellows, Perring and leafhopper, *Empoasca* spp. Adult [15]. The different colors sticky traps such as blue, white, yellow, red and green were used to screening the development of thrips and quantity of thrips catches at various development phases of cotton. Aftereffects of two field trials affirmed that yellow sticky trap pulled in more number of thrips contrasted with different hues. Yellow sticky trap recorded most extreme mean thrips get of 124.00 and 102.47 Nos. /trap in the first and second trial, separately. Blue and white shading traps are the following best favoured by thrips in the cotton biological community. Low population density of thrips was recorded in red and green traps in both the trials. Thrips gets were likewise high amid the vegetative and beginning blooming stages (45 to 90 DAS) of cotton trim [16]. The sticky yellow traps 60, 80, 100, and 120 cm over the ground level were evaluated in different formative phases of cotton for their relative skill in catching the accompanying pest in the

Cukurova area of Turkey in 2001 and 2002 [17].

Used yellow sticky card against Poinsettia (*Euphorbia pulcherrima*) in the greenhouse, traps might decrease bug populace in nurseries [18]. Yellow, white, and blue colors traps were used against *Scirtothrips perseae*, *Frankliniella occidentalis* and *Frankliniella orizabensis*. The Yellow was most attractive to *S. perseae* and white cards caught generally *F. orizabensis* and *F. occidentalis* [19]. The Yellow sticky traps are broadly used for observing and administration of whiteflies in cotton (*Gossypium hirsutum* L.) to contrast their engaging quality with *Eretrrwcerus eremicus* and *Bemisia argentifolii* and *Bemisia tabaci* that is indigenous to U.S. deserts. The cup traps got a normal of 264 adult whiteflies, at contrary 523 adult whiteflies catches by yellow sticky traps [20].

The whitefly (*Trialeurodes vaporariorum*) is a pest of an extensive variety of vegetable around the globe. The yellow sticky traps are exceedingly attracting to adult of many flies of many crops [20]. The Different shading sticky traps are ordinarily used against sucking complex pest, for example; thrips, whiteflies, leaf digger adult and aphids. They have additionally been utilized to screen the characteristic adversaries related with the sucking pests. By and by, the screening of the occurrence of sucking vermin in pomegranate utilizing sticky traps needs [21]. A field trial was led to assess the efficiency of seven color sticky traps against sucking pests. Results showed that the greatest number of sucking pests such as *Bemisia tabaci* was caught by a yellow sticky card [22].

Materials and methods

Evaluated the Impact of mechanical traps against whitefly population by using the materials listed: A. cup trap, B. Color sticky card traps, Yellow (fluorescent), Sky blue (fluorescent), Wheat (fluorescent), Bluish Green (fluorescent), Blue (fluorescent), Red

(fluorescent). All traps were installed adjacent to another in the same direction. The traps installation replicated five times.

Observation

The observation was taken on daily bases. The crop was growing in 2acre. For this experiment, the Randomized Complete Block Design was used. The Cup traps were hanging from a wire arm in field and separated by 10m²/trap. Various color sticky traps such as Yellow (fluorescent), Sky blue (fluorescent), Wheat (fluorescent), Bluish-Green (fluorescent), Blue (fluorescent), Red (fluorescent) was attached with wire clips vertically. All traps were installed during cropping season of tomatoes in 2017 and retrieved after 48h.

The traps were installed in tomato field for 24h & 48h in randomized complete block design (RCBD). During retrieval from the field, each trap was placed into a clear plastic bag to protect the contents during transport to the laboratory and counting. Whiteflies were visually counted and if required a magnifying glass was used.

Data analysis

For the calculating values of HSB and RGB, one sticky card of each color was selected and photographed using a digital camera. The parameters of the camera were set as follows; screen speed: 1/125, aperture: F14; ISO: 200, AF mode and physically focused. Both the values of RGB (Red, Green, and Blue) and HSB (Hue, Saturation, and Brightness) were calculated with the help of Adobe Photoshop 7.0.

Results

This test was performed in tomato crops to assess the fascination and checking of whitefly to various mechanical snares of different hues just as cup traps. This experiment was conducted in tomato crops for assessing the efficiency of various mechanical traps against whitefly.

For example; cup trap, yellow sticky trap, sky blue or cyan (fluorescent), wheat (fluorescent), bluish-green (fluorescent), blue (fluorescent) and red (fluorescent) (Fig. 1).



Figure 1. Different color traps used in experiment For example; A. Cup trap, B. Yellow sticky trap, C. Sky blue or Cyan (fluorescent), D. Wheat (fluorescent), E. Bluish-green (fluorescent), F. Blue (fluorescent) and G. Red (fluorescent)

Whitefly numbers are high throughout the experiments as compared to thrips and aphid. Whitefly are substantially attracted to the yellow sticky card traps, (374±48.7 - 824±49.3), (299±49.1 - 489±87.3), (391±54.4 - 569±44.5), (59±5.99- 94.4±8.69), (99.3±7.13 - 207±21.1), (101±6.74 - 193±18.5) and (4.6±1.2 - 7.3±1.1) for 24h & 48h respectively (Table 1). According to data of adult caught by traps yellow sticky trap> sky blue sticky trap> wheat>bluish-green> blue> red> cup trap. In

this experiment, we found a red colored trap was least attractive to whitefly.

In replicated trials the yellow sticky trap got an average of (374±48.7 - 824±49.3), cup trap (4.64±1.23- 7.28±1.12), sky blue or cyan (374±48.7 - 824±49.3), wheat (391.4±54.4- 569.4±44.54), bluish-green (59±5.99- 94.36±8.69), blue (99.28±7.13- 206.5±21.09) and red (101.0±6.73- 192.7±18.48) in 24h and 48h period/card (Table 2). The whitefly has a higher attraction rate to fluorescent colors traps.

Table 1. Overall means adult population of whitefly (*Bemisia tabaci*) catches by different types of the mechanical trap in 24h and 48h

TRAPS USED	24H	48H
Yellow sticky trap	374.2±48.65a	823.6±49.32a
Cup trap	4.6±1.236d	7.28±1.122f
Sky blue or cyan (flouesent)	299.4±49.08b	488.9±87.34c
Wheat (flouesent)	391.4±54.40a	569.4±44.54b
Bluish green (flouesent)	59.0±5.69c	94.4±8.686e
Blue (flouesent)	99.3±7.13c	206.5±21.09d
Red (flouesent)	101.0±6.74c	192.7±18.48d

Overall mean in the same column followed by the same letter are not significantly different using General AOV/AOCV LSD ($\alpha = 0.05$)

Table 2. Overall means value of RGB and HSB of color sticky card used against whitefly in tomato crop

Value	Yellow sticky trap	Sky blue or cyan (flouesent)	Wheat (flouesent)	Bluish green (flouesent)	Blue (flouesent)	Red (flouesent)
Red	171.6±1.13	0.33±0.26	163.3±3.91	1.67±0.68	70.7±6.42	222.6±2.54
Green	135.0±0.48	170.3±7.65	150.7±2.11	181.0±12.78	152.3±6.07	59.3±2.11
Blue	50.3±18.09	197.0±7.44	131.3±4.59	185.6±11.03	245.3±2.88	50.7±2.88
Hue	41.3±3.64	188.0±0.45	35.3±4.09	181.6±0.93	211.3±1.13	3.0±0.45
Saturation	76.3±13.28	99.67±0.26	19.7±1.37	99.33±0.26	72.7±3.04	77.0±1.55
Brightness	67.0±0.48	77.67±2.88	64.0±1.61	73.00±4.41	96.0±1.18	87.3±1.13

Correlation between RGB and HSB value of cards with whitefly adult

In this study, both positive and negative correlation was observed between the whitefly and color sticky traps (Table 3). The red and green values showed a weak positive correlation with the adult population, where the coefficient of the correlation in R-value is observed as 0.263 and 0.141 in red, 0.152 and

0.286 in green for 24h and 48h period. The value of The blue showed a weak negative correlation with the adult, negative R-value recorded -0.332 and -0.259. In HSB, the hue recorded a negative correlation with the adult whitefly, recorded R-value of -0.401 and -0.233, Saturation recorded R-values -0.507 and -0.317 and Brightness R-value recorded -0.712 and -0.663 (Table 3).

Table 3. Correlations between RGB and HSB mean value with adult whitefly (*Bemisia tabaci*) trapped

VALUE OF RGB AND HSB	24h	Direction/strength of correlation	48h	Direction/strength of correlation
Red	0.263	Weakly positive	0.141	Weakly positive
Green	0.152	Weakly positive	0.286	Weakly positive
Blue	-0.332	Weakly negative	-0.259	Weakly negative
Hue	-0.401	Moderately negative	-0.233	Weakly negative
Saturation	-0.507	Moderately negative	-0.317	Weakly negative
Brightness	-0.712	Strongly positive	-0.663	Strongly positive

Discussion

We found that the fluorescent yellow and wheat color were more attractive than the rest of the colors. In previous studies, the yellow-colored traps count more, as compare to the blue and white traps [15]. Similar results were found by Dimisel & Cranshaw (2005), that neon yellow-colored traps were found to be more attractive to the whitefly, than blue, neon green, silver & orange colored traps on the brassica crop. In previous experiments conducted on different crops such as cotton, sugar beets, lucerne, yard long bean & groundnut field with nine different color traps to measure the attraction of *Empoasca Spp.* adult [23]. Successfully used yellow colored traps against whitefly in a greenhouse [11]. [12] were used yellow sticky trap combine with parasitoid for control of whitefly on cucumber, high parasitism was favoured by yellow sticky cards as compared to un-treated plot.

Yellow Sticky Card Traps, efficiency depend on timing, crop foliage and position of trap installation. Position of sticky card traps effect adeptness of traps because the clear view of trap is more like seen by pest from far away. The foliage of the crop also affects the view of traps. Also mentioned by [24, 25] that disperse whiteflies being attracted to the shorter wavelength. Flies in the 20cm range seen yellow sticky trap and attract [26] but no confirm by my experiment. The most number of whitefly captured in the day time or active period from 0900 to 1600h. same motioned

that whitefly more active from 0900 to 1200 hours [1].

The lime green, yellow and spring green sticky traps were found to be more attractive for *Empoasca Spp.* adult, then white, rum, red, woodland green, trace blue & black [23]. On the contrary [26] reported that red colors are more attractive than white, yellow and blue for *S.Titanus*.

[20] stated that CC traps got a normal of 264 grown-up whiteflies an amid 24-h trials, which contrasted the 523 adult whiteflies on the yellow sticky traps which is partially confirmed by the data. In other words, cup traps are not able to get the numbers mentioned by Hoelmer, but the yellow sticky card result is acceptable.

Conclusion

According to findings of this experiment, we are convinced that some fluorescent colored sticky traps are very useful in controlling and monitoring of whitefly, as well some other major pests of vegetable crops such as aphid and jassid. Yellow, sky blue and wheat color are more attractive for whitefly (*Bemisia tabaci*) than blue, bluish-green, red and cup trap. In other words, the yellow, sky blue and wheat color sticky traps not only useful for monitoring but also useful in controlling of whitefly population. According to the outcome of this study, we say that sticky traps with fluorescent colors are more susceptible to whitefly as compared to dull colors and cup traps. The names and email addresses entered in this journal site will be used exclusively for the stated purposes of this

journal and will not be made available for any other purpose or to any other party.

Authors' contributions

Conceived and designed the experiments: R Hamid, A Bukero & AG Lanjar, Performed the experiments: R Hamid, Analyzed the data: R Hamid, A Bukero & AG Lanjar, Contributed materials/ analysis/ tools: B Lubna, L Zainab & SA Nahiyoon, Wrote the paper: R Hamid B, Lubna & SA Nahiyoon.

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