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Relative performance of different colored sticky traps against *Thrips tabaci* L. in onion

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Abstract

Thrips tabaci (Lind.) is one of the most important insect pests which damage all stages of onions. Therefore, the present study was conducted to determine the influence of various colored sticky traps to attract *T. tabaci*. Onion variety Phulkara was used in the study. Five colored sticky traps i.e., blue, green, yellow, white and transparent were used in the study. Observations were taken from both sticky traps and onion plants weekly from transplanting till harvesting. The experiment was arranged in an RCBD design with four replications. Results showed that the blue sticky trap was significantly more effective in attracting *T. tabaci* (39.49±1.60 thrips/sticky trap), followed by yellow sticky traps (32.66±1.27 thrips/sticky trap). Green, white and transparent were found less attractive for *T. tabaci* with the mean attraction of 15.37±0.75, 8.27±0.47 and 3.20±0.19 thrips/sticky trap, respectively. *Thrips tabaci* population on onions plants were significantly higher (24.621±1.080 thrips/plant) on transparent sticky trap treatment, followed by white (22.92±0.930 thrips/plant) and green (21.951±0.94 thrips/plant) sticky trap treatments. The lowest number of *T. tabaci* population on onion plants were recorded on the blue sticky trap (19.369±0.99 thrips/plant) treatment. Considering the maximum attraction of thrips to blue sticky traps, thus lowering its population on onion plants, the highest onion yield was recorded in blue trap treatment (80.33+1.73 mds/acre), whereas, the lowest yield was recorded in transparent sticky trap treatment (64.67+2.00 mds/acre). Therefore, it is suggested that blue sticky traps should be considered for better monitoring and integrated management of *T. tabaci*.

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Introduction

Onion, *Allium cepa* L. belongs to family Amaryllidaceae or Liliaceae is a biennial herbaceous plant and ranked among the five most profitable vegetables around the world (Gopal, 2015; Hafeez *et al.,* 2016). It is an important condimental bulbous crop where the bulbs developed very distinctly depending on the cultivars (Dawar *et al.,* 2007; Malik *et al.,* 2010). Several insect pests infest onion crops from sowing till harvesting causing severe yield losses. Among pests, thrips *Thrips tabaci* (Lindeman, 1889) (Thysanoptera: Thripidae) is one of the most severe and polyphagous pests that damages all stages of onion crop. Besides onions, it also damages many important crops, vegetables, fruits and flowers (Daine and Daniela, 2008; Mohan *et al.,* 2016). Thus, over the past two-decades, *T. tabaci* has become a global and major pest of onion, widely, distributed from tropical and subtropical areas into the temperate regions (Diaz-Montano *et al.,* 2011; Al-Karboli and Al-Anbaki, 2014). Both, nymphs and adults of *T. tabaci* feed on young leaves using their piercing and sucking mouthparts, leaving silvery areas on leaves, flowers and fruits, with potential yield losses up to 34 to 59% (Waiganjo *et al.,* 2008; Diaz-Montano *et al.,* 2011). It also vectors many important plant diseases belonging to *Tospovirus*, *Ilarvirus*, *Carmovirus*, *Sobemovirus* and *Machlomovirus* genera (Kritzman *et al.,* 2001; Hsu *et al.,* 2010).

The management of thrips mainly depends on synthetic pesticides, however, these pesticides cause severe health and environmental problems (Blair *et a.,* 2015). However, many studies have shown the potential of different colored sticky traps in the monitoring and management of many insect pests, especially sucking pests with varying degree of success (Böckmann and Meyhöfer, 2017; Devi and Roy, 2017; Prema *et al.*,2018; Uppar *et al.,* 2019). Thus, use of sticky traps could be a simple and low-cost method not only for determining the relative abundance of insects in field and vegetable crops but, if properly employed can keep the pest populations below threshold levels (Muvea *et al.,* 2014; Wagan *et al.,* 2017). Accordingly, different colored sticky traps have been evaluated for sampling, monitoring and estimating the population of different thrips species under field and greenhouse conditions (Thongiua *et al.,* 2015; Prema *et al.,* 2018). Thus, the purpose of this study was to determine the performance of different colored sticky traps to attract *T. tabaci,* so, it can be included in its integrated management.

Materials and methods

The experimental field of Entomology Section, Agriculture Research Institute, Tandojam was used to conduct this study on the performance of various colored sticky traps against *T. tabaci* during the 2018 cropping season. Nursery of onion variety Phulkara was collected from the Onion Research Station, Husri under the Directorate of Sindh Horticulture Research Institute, Mirpur Khas. The transplanting of the nursery was done at its recommended rate of 2 kg/acre keeping row to row and plant to plant distance of 30 cm and 20 cm, respectively. In all the treatments, agronomic practices were performed as per recommendation. Five colored sticky traps i.e., white, blue, yellow, green and transparent were used in the study. The size of each sticky trap was 1x1 sq. feet that were glued from both sides using a transparent lubricant. Various colored sticky traps were installed using a Randomized Complete Block Design with five replications for each treatment. Thus, the size of each replicated plot was 15×30 sq. feet. The data collection was started since the transplanting of onion and continued till harvesting every week. All the attracted *T. tabaci* on each colored sticky trap was collected, identified and counted. After each observation, individual traps were washed thoroughly and re-glued with lubricant to enhance the efficiency of data collection. Moreover, the population of *T. tabaci* was also observed from onion plants in each replication by counting the numbers of thrips from 15 randomly plants. The yield data of individual treatments were obtained by harvesting the entire replicated plots. Analysis of Variance (ANOVA) was used to analyze the data, whereas, the means with a significant difference were separated using the Least Square Difference (LSD) at 5% probability level. All the Analysis was run using STATISTIX 8.1 computer software.

Results

The population of T. tabaci attracted to various colored sticky traps

The population of *T. tabaci* appeared on onions since its transplanting, thus, the same was attracted to various colored sticky traps installed in the field. Among traps, significantly higher attractiveness of *T. tabaci* was recorded towards the blue sticky traps, followed by yellow, whereas, the least preference of *T. tabaci* was recorded on transparent traps. The maximum attracted a population of *T. tabaci* (59.60±4.54 thrips/trap) was recorded on blue sticky traps on 04.11.2018. Among other traps i.e., yellow, green, white and transparent, the maximum population attracted was 52.13±3.90 thrips/trap, 27.87±1.68 thrips/trap, 17.07±1.80 thrips/trap and 5.93±0.74 thrips/trap, respectively on different observation dates. Accordingly, a significant difference ($F = 684.10$, $P < 0.001$) was observed in the attractiveness of different sticky traps against *T. tabaci*, where overall maximum (39.49±1.60 thrips/trap) and minimum (3.20±0.19 thrips/trap) attractiveness was recorded on blue and transparent sticky traps, respectively (Table 1).

Table 1. The weekly mean population of *Thrips tabaci* attracted different colored sticky traps.

Observation dates	Sticky traps				
	Yellow	Blue	Green	White	Transparent
09/09/2018	6.53±1.07	5.67±0.52	2.53±0.41	1.53±0.36	1.13±034
16/09/2018	10.53±1.06	13.00±2.00	6.33±1.24	3.73±0.59	1.47±0.42
23/09/2018	17.67±1.47	22.80±2.34	9.27±1.42	4.54±0.82	2.13±0.42
30/09/2018	24.00±1.77	32.00±2.80	13.00±2.04	6.33±0.78	3.27±0.53
07/10/2018	30.20±2.01	38.67±4.36	17.33±1.85	9.78±0.98	4.53±0.64
14/10/2018	38.87±1.53	42.80±3.87	21.20±2.08	15.00±1.61	5.93±0.74
21/10/2018	45.00±2.43	54.33±3.15	25.13±2.51	17.07±1.80	5.07±0.59
28/10/2018	52.07±3.15	58.80±3.36	27.87±1.68	14.53±1.39	4.60±0.83
04/11/2018	52.13±3.90	59..60±4.54	23.80±2.49	10.93±0.95	3.67±0.65
11/11/2018	47.73±2.03	52.00±3.90	18.13±1.60	7.53±0.86	2.47±0.45
18/11/2018	37.13±2.09	49.80±4.24	12.67±1.74	4.47±0.59	2.27±0.52
25/11/2018	30.07±2.13	44.47±4.04	11.53±1.53	3.67±0.78	1.87±0.46
Overall mean population	32.66±1.27b	39.49±1.60a	15.37±0.75c	8.27±0.47d	3.20±0.19e

*Means followed by the same letters are not significantly different (LSD, $P < 0.05$).

The population recorded on onions installed with various colored sticky traps

The population of *T. tabaci* recorded on an onion crop where different colored sticky traps were installed (Table 2). A significant impact of the attractiveness of *T. tabaci* on different sticky traps was recorded to lower its population on onions. Thus, a relatively lower population of *T. tabaci* was recorded on blue sticky treatment, whereas, maximum populations of thrips were recorded on transparent treatment onions. Accordingly, the maximum population (33.07±3.20 thrips/plant) of *T. tabaci* was recorded on onions cultivated in transparent treatment on 21.10.2018. Moreover, the maximum population of *T. tabaci* observed on yellow, blue, green and white sticky traps treatment onions was (25.03±2.43 thrips/plant), (24.77±2.40 thrips/plant), (27.02±3.10 thrips/plant) and (28.36±3.21 thrips/plant), respectively.

The overall mean population on onions thus showed a significant difference in various treatments with the minimum (19.37±0.99 thrips/plant) and maximum (24.62±1.08 thrips/plant) attack of *T. tabaci* recorded on blue and transparent sticky traps treatment onion, respectively.

Table 2. The weekly mean population of *Thrips tabaci* on onions plants due to the effect of different colored sticky traps.

Observation dates	Sticky traps				
	Yellow	Blue	Green	White	Transparent
09/09/2018	16.10±1.27	14.60±1.13	17.03±1.14	18.60±1.78	21.10±1.20
16/09/2018	18.60±2.05	16.73±1.92	19.10±2.53	20.20±2.06	22.70±2.26
23/09/2018	19.33±2.24	17.67±2.11	20.87±2.56	21.53±2.10	22.73±2.39
30/09/2018	22.20±2.11	19.30±2.14	23.40±3.14	24.63±2.16	25.40±2.58
07/10/2018	22.23±2.21	22.60±2.17	23.50±2.56	25.43±2.64	26.20±2.68
14/10/2018	25.03±2.43	24.77±2.40	26.63±2.72	27.13±2.87	29.20±2.98
21/10/2018	23.67±2.63	24.20±2.69	27.02±3.10	28.36±3.21	33.07±3.20
28/10/2018	23.77±2.45	21.43±1.11	25.17±2.65	25.33±2.39	26.73±2.27
04/11/2018	21.00±2.36	21.47±1.98	22.40±2.47	23.23±2.37	24.13±2.11
11/11/2018	19.60±1.13	17.90±1.88	20.80±2.22	21.1±1.32	22.67±2.12
18/11/2018	18.07±1.05	16.63±1.01	19.43±1.06	20.46±1.17	21.40±2.16
25/11/2018	17.03±1.18	15.13±0.60	18.07±0.90	19.10±1.05	20.13±1.26
Overall mean population	20.55±0.83cd	19.37±0.99d	21.95±0.94bc	22.92±0.93ab	24.62±1.08a

*Means followed by the same letters are not significantly different (LSD, P < 0.05).

Impact of various sticky traps on the yield of onion

A significant impact of the installation of various colored sticky traps was recorded on the yield of onions, as significantly higher (F =66.88, P < 0.05) higher yield of onions (80.33+1.73 mds / acre) was recorded in blue sticky trap treatment. The yield recorded in the yellow sticky trap (77.33+2.33 mds / acre) was also non-significant from blue and green (73.00+1.73 mds / acre) sticky trap treatments.

The lowest onion yield (64.67+2.00 mds / acre) was recorded in transparent sticky treatment as it attracted the lowest number of *T. tabaci* and thus, maximum *T. tabaci* attacked onions (Table 3).

Table 3. Effect of various colored sticky traps on the yield of onion affected by *T. tabaci*.

Treatment	Yield (Mds/acre)
Yellow	77.33+2.33^{ab}
Blue	80.33+1.73^{a}
Green	73.00+1.73^{b}
White	69.00+2.08^{c}
Transparent	64.67+2.00^{c}

*Means followed by the same letters are not significantly different (LSD, P < 0.05).

Discussion

The colored sticky traps have widely used not only to sample and monitor the insect pests, especially sucking pests but also integrated with other control measures to manage their populations below threshold levels (Malik *et al.,* 2012; Prema *et al.,* 2015; Sathe *et al.,* 2015). The yellow-colored sticky traps are frequently used on large scale to catch insects from Thysanoptera, Coleoptera, Hemiptera, Hymenoptera and other insect orders (Bayisa *et al.,* 2017; Buragohain *et al.,* 2017; Badran *et al.,* 2018). Among the various colored traps evaluated, yellow and blue colored traps have shown relatively higher attractiveness for different insect pests (Matsukura *et al.,* 2011; Sathe *et al.,* 2015). In the present study, comparatively higher attractiveness of *T. tabaci* was

also recorded on blue colored sticky traps, followed by yellow and green sticky traps, whereas, the least attraction was observed towards transparent traps. The studies of Masatoshi *et al.* (2009) also found the maximum population attraction of thrips blue traps. Other studies also have confirmed that in comparison to white traps, thrips are more attracted to blue sticky traps (Liu and Chu, 2004; Eric *et al.,* 2007). Not only *T. tabaci,* but other thrips species i.e., *Ceratothripoides claratris, Scirtothrips dorsalis* have also shown a preference for blue traps (Ranamukhaarachchi and Wickramarachchi, 2007; Tang *et al.,* 2016; Mueva *et al.,* 2017). Broughton *et al.* (2015) reported that the capture of *F. occidentalis* and *T. tabaci* could be increased on blue sticky traps using the volatile attractants such as methyl isonicotinate. Thus, these findings indicated that thrips species are relatively more attracted to blue sticky traps than yellow or other colors, hence, blue sticky traps can be used for monitoring and mass trapping of horticultural crop ecosystems (Sridhar and Naik, 2015). As the cryptic nature of thrips makes it very difficult to trace their population to decide for an appropriate management program, it could be useful to add a specific colored sticky trap to determine their relative population and start appropriate management measures (Atakan and Pehlivan, 2015).

Conclusion

Blue colored traps were found to be more effective in trapping *T tabaci* as compared to yellow, green, white and transparent trap. However, the use of blue-colored sticky traps may not be solely able to restrict the buildup of thrips population during the entire crop growing period. However, they can be integrated with other components of IPM program where detection and monitoring of thrips population is an integral part to decide upon commencement of pesticide application.

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