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Coloured sticky traps to monitor thrips population in cotton

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Abstract
Different coloured sticky traps includes blue, white, yellow, red and green were used to monitor the movement of thrips and the number of thrips catches at different growth stages of cotton. Results of two field trials confirmed that yellow sticky trap attracted more number of thrips compared to other colours. Yellow sticky trap recorded maximum mean thrips catches of 124.00 and 102.47 Nos./trap in the first and second trial, respectively. Blue and white colour traps are the next best preferred by thrips in cotton ecosystem. Least numbers of thrips catches were recorded in red and green traps in both the trials. Thrips catches were also high during the vegetative and initial flowering stages (45 to 90 DAS) of cotton crop.

Keywords: cotton, sticky traps, thrips, yellow, blue, white

Introduction
Cotton is regarded as "white gold" due to it's impact on the economy of agricultural sector. India is a leading producer of cotton, next to China. In India, cotton is cultivated in Maharashtra, Gujarat, Andhra Pradesh, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu and Karnataka in an area of 9.5 million hectares with an average production of 31 million bales, accounting for 26 per cent of global production [24]. Productivity of cotton is largely hampered by biotic factors such as pest and diseases apart from abiotic factors.

In India, most of the newly released Bt cotton hybrids have become highly susceptible to sucking pests *viz*., thrips, leafhoppers and whiteflies which resulted in increased crop damage [18]. These sap feeders not only act as pests but also act as vectors of viral diseases. Among the viral diseases, cotton leaf curl transmitted by whiteflies and Tobacco streak virus (TSV) transmitted by thrips are more significant [24]. Recently, TSV is emerging as serious threat to cotton growers in southern India. The etiological viral agent causing necrosis disease belongs to the genus Ilarvirus, family Bromoviridae. Thrips, the early season cotton pest was suspected to be the vector of *Tobacco streak virus* in presence of TSV infected perennial weed, *Parthenium hysterophorus* [22].

Thrips (Order: Thysanoptera) are typically the first insect pest the growers encounter during growing season while other pests of cotton tend to be regional in occurrence and distribution. These significant plant feeders hinder plant growth, crop maturity and seed cotton yield [1]. The epidemic spread of TSV is 50 per cent in cotton hybrids and 21.27 per cent in varieties in Tamil Nadu [20].

Effective population monitoring is crucial for successful implementation of insect and vector control programs [11]. First step in controlling thrips involves monitoring of population to determine the most effective tactics that should be employed in their management. Traps are one of the effective tools for monitoring and control of insect pests in crop ecosystem. Traps based on the response of insects to colour have been widely used in integrated pest management programs in diverse agricultural crops [10, 12].

The objective of this study was to evaluate the relative attraction of thrips species to a range of different coloured sticky traps and to evaluate their efficacy in monitoring thrips population during different growth stages of cotton based on which management can be taken up.

Materials and methods
Two field experiments were conducted to compare the specificity of thrips towards coloured sticky traps at farmer's holdings in Kallapuram, Kinathukadavu block of Coimbatore district to

Monitor the thrips population in cotton ecosystem during 2016-2017. The cotton hybrid Ankur 3220 was used for the study with the spacing 90 x 60 cm. Five colours were used to monitoring the population of thrips *viz*., yellow, blue, red, green and white. The experiments were conducted in a Randomized Blocks Design (RBD) with a plot size of 10 x 10 m. Experiments were conducted with five treatments and four replications. No insecticides were applied throughout the sampling period.

Sticky traps were prepared with the respective coloured polythene sheets of size 45 cm x 25 cm which were erected in field across the wind direction with the help of bamboo stakes. Height of the stakes were adjusted each time @ 1 foot above the plant canopy. Castor oil and grease were mixed at the ratio of 1:1 and applied on the trap as sticking agent. The sticky traps were replaced at 15 days interval after recording thrips population.

Observations were made at 15 days interval from the date of sowing till harvest. Thrips numbers were recorded by counting the numbers sticking per trap. The thrips population stuck on different coloured traps were counted using zoom lens under field condition.

Data were subjected to analysis of variance (ANOVA) and the treatment means were statistically differentiated by performing Least Square Means test (LSD) at $p < 0.05$ level using Agress software.

Results

The thrips population predominating cotton ecosystem included *Thrips palmi, Thrips tabaci* and *Scirtothrips dorsalis*. The data on attraction of thrips to colour sticky traps at weekly intervals are furnished in Table 1. In the first trial, the thrips catches on yellow sticky trap after 45, 60, 75 and 90 days of sowing were very high with 89.65, 120.00, 124.00, 91.90 numbers per trap, respectively. This was followed by blue sticky trap with 85.43, 115.99, 116.99, 69.34 numbers of thrips per trap on 45, 60, 75 and 90 Days after sowing (DAS), respectively. Next to blue, white sticky trap attracted 74.59, 106.99, 107.99, 59.45 Numbers of thrips per trap during 45, 60, 75 and 90 DAS, respectively. Least thrips catches were recorded in green followed by red. Similar trend was observed on 105, 120, 135 and 150 DAS. Performance of coloured traps with regard to thrips catches was in the order of yellow > blue > white > green > red.

In the second trial, the thrips population was very low during the initial stage of crop development (i.e., during cotyledon stage (30DAS)). The yellow sticky trap attracted 78.34, 92.00, 102.47, 66.45 numbers of thrips per trap during 45, 60, 75 and 90 DAS, respectively. Blue sticky trap with thrips catches of 70.56, 89.67, 96.34, 60.34 numbers per trap on 45, 60, 75 and 90 DAS, respectively (Table 2) followed by white sticky trap. The least thrips catches were recorded in green followed by red. Similar trend was observed on 105, 120, 135 and 150 DAS also.

In both the trials, yellow sticky trap caught significantly more number of thrips followed by blue and white traps. Green colour and red colour caught relatively low number of thrips in both trials. In the present study, thrips attraction has revealed differential attraction to various colours in the sequence of yellow > blue > white > green > red under field condition.

Minimum thrips catches were recorded during the cotyledon stage (15 to 30DAS). Thrips catches gradually increased during the vegetative and flowering stage (30 to 90 DAS). After flowering stage (90 to 105 DAS) thrips catches started decreasing till boll and fiber formation stages (105-150 DAS) (Figure 1 & 2).

Table 1: Colour attraction of thrips to sticky traps in cotton (Kharif 2016) in Coimbatore district (Experiment – I)

Trap colour	*Mean number of thrips catches per trap										Mean
	Cotyledon stage	Vegetative stage				Flowering and boll development stage		Boll and fiber maturation stage			
	15DAS	30DAS	45DAS	60DAS	75DAS	90DAS	105DAS	120DAS	135DAS	150DAS	
Yellow (565-590 nm)	4.65^{a}	33.941^{a}	89.65^{a}	120.00^{a}	124.00^{a}	91.90^{a}	56.55^{a}	30.45^{a}	10.65^{a}	5.00^{a}	56.68
Blue (440 - 490 nm)	3.55^{b}	30.135^{b}	85.43^{b}	115.99^{b}	116.99^{b}	69.34^{b}	54.55^{b}	27.23^{b}	9.55^{b}	4.23^{b}	51.70
Red (625-740nm)	1.50^{d}	19.900^{d}	65.50^{d}	87.00^{d}	88.00^{d}	44.00^{d}	29.56^{d}	5.50^{d}	3.86^{d}	0.00^{d}	34.48
Green (520-565 nm)	0.00^{e}	15.555^{e}	60.56^{e}	82.00^{e}	83.00^{e}	35.00^{e}	26.45^{e}	4.34^{e}	2.50^{e}	0.00^{d}	30.94
White (380-720nm)	2.45^{c}	24.140^{c}	74.59^{c}	106.99^{c}	107.99^{c}	59.45^{c}	46.95^{c}	15.12^{c}	5.54^{c}	1.25^{c}	44.45
SEd	0.0137	0.0266	0.0400	0.0620	0.0722	0.0465	0.0544	0.0205	0.0206	0.0069	-
CD (0.05%)	0.0299	0.0580	0.0872	0.1352	0.1573	0.1013	0.1185	0.0447	0.0448	0.0151	-

*Mean of four replications; DAS- Days after sowing Values in parentheses are √x+0.5 transformed values of four replication In a column means followed by a common letter are not significantly different by LSD (P=0.05)

Table 2: Colour attraction of thrips to sticky traps in cotton (Kharif 2016) in Coimbatore district (Experiment – II)

Trap colour	*Mean number of thrips catches/trap										Mean
	Cotyledon stage	Vegetative stage				Flowering and boll development stage		Boll and fiber maturation stage			
	15DAS	30DAS	45DAS	60DAS	75DAS	90DAS	105DAS	120DAS	135DAS	150DAS	
Yellow (565-590 nm)	3.50^{a}	49.72^{a}	78.34^{a}	92.00^{a}	102.47^{a}	66.45^{a}	35.87^{a}	14.65^{a}	5.65^{a}	2.45^{a}	45.11
Blue (440 - 490 nm)	2.55^{b}	43.93^{b}	70.56^{a}	89.67^{a}	96.34^{b}	60.34^{b}	29.76^{b}	11.43^{b}	4.55^{b}	1.89^{b}	41.10
Red (625-740nm)	0.50^{d}	12.34^{d}	29.67^{b}	47.98^{c}	38.00^{d}	22.22^{d}	12.45^{d}	4.00^{d}	0.86^{d}	0.00^{d}	16.80
Green (520-565 nm)	0.00^{e}	9.00^{e}	25.00^{c}	32.33^{d}	23.00^{e}	17.67^{e}	9.34^{e}	1.55^{e}	0.00^{e}	0.00^{d}	11.79

White (380-720nm)	1.45^{c}	39.55^{c}	66.67^{a}	76.90^{b}	87.99^{c}	44.45^{c}	20.50^{c}	9.56^{c}	1.54^{c}	0.50^{c}	34.91
SEd	0.0101	0.0320	0.5234	0.0580	0.0716	0.0370	0.0353	0.0217	0.0119	0.0051	-
CD (0.05%)	0.0220	0.0698	1.1405	0.1264	0.1561	0.0806	0.0769	0.0472	0.0260	0.0110	-

*Mean of four replications; DAS- Days after sowing Values in parentheses are √x+0.5 transformed values of four replication In a column means followed by a common letter are not significantly different by LSD (P=0.05**)**

a. Sticky traps in field b. Yellow sticky trap attraction

Fig 1: Evaluation of different coloured sticky traps for thrips in cotton field.

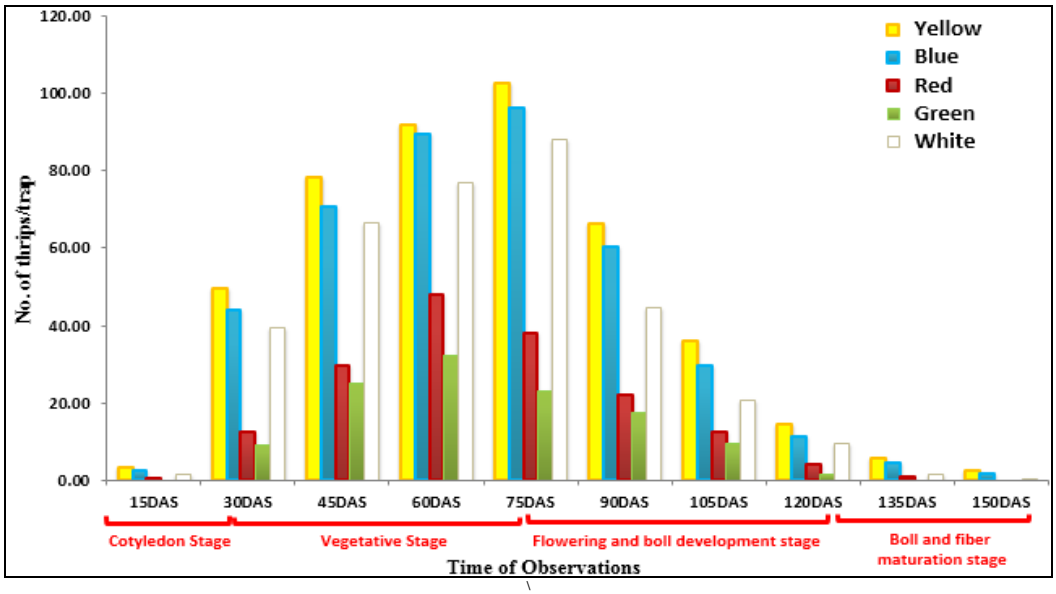

Fig 2: Graphical representation of mean number of thrips catches on different colour traps during different growth stages of cotton (Trial - Il)

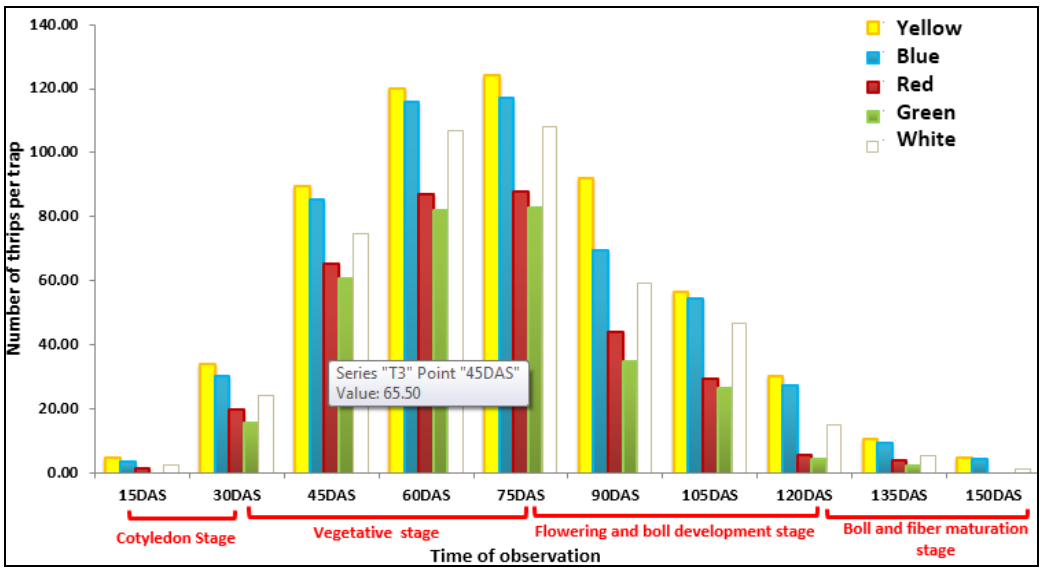

Fig 3: Graphical representation of mean number of thrips catches on different colour traps during different growth stages of cotton (Trial - l)

Discussion

Insect always has the innate characteristic to get attracted to colours. This innate character was mainly used here for mass trapping and monitor insects under field condition using colour traps. Thrips show greater phototactic response to bright yellow colour compared to other colours [14]. The effective attraction of thrips towards yellow traps in this study were in-line with studies by researchers in many crops.

Yellow sticky trap at 25 cm height attracted more number of sucking pest including *Frankliniella spp.*, *Bemisia tabaci* and *Empoasca spp*. in cotton ecosystem [9, 19]. Highest attraction of thrips toward yellow sticky trap was observed with *Scirtothrips dorsalis* in okra [16], tea thrips in tea [17], *Thrips tabaci* in onion [7]. Other reports included avocado thrips, *Scirtothrips perseae* Nakahara on avacados [13], the basswood thrips, *Thrips calcaratus* Uzel, pear thrips, *Taeniothrips in-cortsequem* (Uzel) and native basswood thrips, *Neohydatothrips tiliae* on deciduous forests [21] are highly attracted towards yellow sticky trap compared to other colour traps. Furthermore, neon yellow colour traps were significantly more attractive for *T. tabaci* on brassica crops [6]. An average catches of 18.19 thrips/trap/14 days on yellow sticky trap when compared to blue, green, orange, white and black traps where least catches were recorded in orchids [23].

Other reports also indicated that thrips were attracted to blue and white [3]. Blue sticky traps which caught significantly more thrips than the white ones in the present study are inline with the findings of other researchers in onion [15, 8]. *Frankliniella occidentalis, T. imaginis* and *T. tabaci* were highly attracted to yellow, blue and white sticky traps than clear, red, green or black sticky traps [4]. Similarly, the other findings [5] further confirms blue colour traps as the most attractive traps for *Frankliniella occidentalis*.

Thrips catches were high during the vegetative stage of the crop as thrips preferred lush green young leaves when compared to other stages of the crop. High chlorophyll content during the vegetative stage attracted maximum number of thrips towards cotton. [2] Researchers confirmed the attraction of western flower thrips towards the vegetative and initial flowering stage of cotton crop.

Conclusion

Thrips are very cryptic in nature and are difficult to trace the population under field condition to decide upon initiation of control measure till damage symptoms appear. Use of yellow coloured sticky trap helps us to monitor the buildup of thrips population in cotton and thereby help the farmers to protect the crop at the early stage of thrips infestation. This can also 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. Thrips has become an important economic pest of cotton because of the intense spread of Tobacco streak virus in the recent years. To overcome this disease spread and to counteract the adverse impacts of chemical insecticides, growers require an effective monitoring tool like yellow sticky trap to monitor the population of thrips for timely management of the pest.

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