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Attraction of Sucking Pests on Different Coloured Sticky Traps in *Bt* Cotton (*Gossypium hirsutum* L)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In cotton ecosystem, number of insect pests simultaneously occur and cause enormous damage to crop. There are many sampling methods that are being used to monitor insect pests and among them the sticky traps are widely used to sample insect worldwide. Hence, studies on trapping efficiency of coloured sticky trap against sucking pests was carried out during 2022 and 2023 at S. D. Agricultural University, Sardarkrushinagar, Gujarat, India. The data on aphid trapping revealed that population of aphid per trap was ranged between 1.90 to 7.23 aphids per trap. The highest number of aphid capturing was recorded from yellow coloured sticky trap (7.23 aphids/trap) and proved as the most effective sticky traps against aphids. Yellow coloured sticky trap significantly attracted more number of jassids with a population of 13.56 jassids per trap and found most

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effective. The data on whitefly trapping indicated that population of whitefly was ranged between 1.04 to 5.45 whiteflies per trap. The highest number of whitefly capturing was recorded from yellow coloured sticky trap (5.45 whiteflies/trap) and registered as the most effective sticky traps. The data on thrips trapping revealed that population of thrips per trap was varied from 1.40 to 8.38 thrips per trap. The maximum 8.38 thrips per trap were attracted to blue coloured sticky trap and it was statistically at par with yellow coloured sticky trap (7.51 thrips/trap).

Keywords: Aphid; jassid; whitefly; thrips; traps; sticky.

1. INTRODUCTION

Cotton is considered as the white gold and globally known as “King of Fibre” which belongs to family Malvaceae and genus *Gossypium*. In India, over 160 species of insect pests have been reported damaging to cotton crop (Agrawal, 1978). The greenish brown soft-bodied small aphids infest the tender shoots and under the surface of leaves in large numbers and suck the sap. Jassid is one of the most serious sucking pests of cotton in India causing a reduction in yield to an extent of 20 per cent (Dhawan et al*.,* 1988). Nymphs and adults of jassid suck the plant sap from the under surface of leaves. Nymphs and adults of whitefly are found in large numbers at the under surface of leaves and drain out the cell sap. Rolling of margins and shrivelling of leaves is observed due to scraping of the epidermis by thrips. In cotton ecosystem, number of insect pests simultaneously occur and cause enormous damage to crop. The management strategy rather becomes difficult when minor pest become major. There are many sampling methods that are being used to monitor insect pests and among them the sticky traps are widely used to sample harmful and beneficial insect worldwide. Uses of different colour sticky traps are an important part of an integrated pest management programme.

Coloured sticky traps consisting of squares pieces of card board with sticky substances placed throughout the growing area among the plants, attract them. Different sticky material like castor oil, motor oil, white grease, vegetable oil, eucalyptus oil, automobile grease, petroleum jelly, insect gum, mustard oil, plant resin etc. used by several worker for preparation of sticky trap for trapping various flying insect of various crops like cotton, okra, eucalyptus, tomato, cabbage, mungbean and various fruit crops etc. Abdel Megeed et al*.* (1998) reported that yellow sticky traps can decisively reduce the density of *B. tabaci* during plant growth. Yellow sticky traps were more attractive to whitefly and leafhoppers (Atakan and Canhilal, 2004). So, colour sticky traps play an important role in the trapping of adult stage of sucking insects. Hence, studies on trapping efficiency of coloured sticky trap against sucking pests in *Bt* cotton was carried out as per methodology described in following headings.

2. MATERIALS AND METHODS

A field experiment was carried out on trapping efficiency of coloured sticky trap against sucking pests in *Bt* cotton cultivar during *kharif* 2022 and 2023 at Agronomy Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar, Gujarat, India. The cotton cv. GTHH 49 (BG II) was grown in 22.80 m × 8.20 m area with the spacing of 1.20 m × 0.45 m after following standard agronomical practices. Evaluation of eight different coloured sticky traps was carried out during 2022 and 2023. The trials consisted of different coloured sticky traps *viz*., Black, Yellow, Purple, Red, Blue, Orange, Green and Transparent, replicated three times by using randomized block design. The number of adults (aphid, jassid, whitefly, thrips) trapped on the sticky traps were recorded at weekly interval after the installation of traps. After each observation, the traps were cleaned thoroughly and smeared with sticky castor oil and replaced at the same position. The data was subjected to statistical analysis.

2.1 Preparation and Installation of Sticky Trap

The sticky traps were prepared from the card board having different coloured stickers on both the sides with 20 cm × 25 cm size. Thin coating of castor oil was applied on both surfaces of the traps to act as a sticky medium. A border of 2 cm width was kept for handling of the traps without disturbing sticky material (castor oil). These traps were tied using wire with bamboo sticks and installed within the crop canopy throughout the crop season. All these traps were installed at 30 days after sowing at the distance of 0.60 m and

replicated thrice. The height of the traps was adjusted every week to maintain uniform height within the crop canopy.

3.1 RESULTS AND DISCUSSION

3.1 Aphid

A close perusal of pooled data on aphid trapping presented in Table 1 and depicted in Fig. 1 revealed that population of aphid per trap was ranged between 1.90 to 7.23 aphid per trap. The highest number of aphid capturing was recorded from yellow coloured sticky trap (7.23 aphids/trap) and proved as the most effective sticky trap against aphids however, it was significantly superior over rest of the other sticky traps. The next effective sticky trap was green coloured sticky trap (5.07 aphids/trap) and it was statistically at par with orange coloured sticky trap (4.47 aphids/trap). Least numbers of aphids were caught in red, purple, blue and black coloured sticky trap which captured 2.92, 2.39, 2.29 and 2.19 aphids per trap, respectively which were statistically at par with each other. While, the minimum aphid captured was recorded in the transparent sticky trap (1.90 aphids/trap).

The present results are in agreement with the findings of Kaur and Sangha (2016) who observed that populations captured on yellow sticky traps revealed that rectangular yellow sticky traps were better in capturing aphid, whitefly, coccinellid, dipteran and hopper populations as compared to cylindrical yellow sticky traps. Highest mean population of aphids trapped were 33.33 and 21.33 aphids/trap on rectangular and yellow sticky traps, respectively during the month of June. According to Nair et al. (2021), among the various sticky traps evaluated, yellow colour and rectangular trap proved best among the other shapes and colour against the aphids and whiteflies infesting tomato under protected conditions.

3.2 Jassid

Results of pooled data presented in Table 2 and depicted in Fig. 2 showed that yellow coloured sticky trap significantly attracted more number of jassids per trap with a population of 13.56 jassids per trap and found most effective. The next best sticky trap in attracting jassid population was blue coloured sticky trap (9.49 jassids/trap) and remained second highest to attracting the jassid population. Of the remaining colour sticky traps, highest jassids attracted towards green coloured sticky trap (6.84 jassids/trap) which was statistically at par with purple coloured sticky trap with 5.70 jassids per trap. During the entire investigation period the remaining colour traps *viz*., orange, red, and black coloured sticky trap attracted 3.74, 2.42 and 2.26 jassids per trap, respectively. The minimum attraction was observed in the transparent sticky trap (1.90 jassids/trap). However, population of jassids captured to coloured sticky trap was varied from 1.90 to 13.56 jassids per trap.

The present results were in agreement with the findings of Demirel and Yildirim (2008), the yellow, blue and white sticky color traps for thrips species and the yellow and orange sticky color traps for leafhoppers species are strongly suggested for monitoring their population densities in cotton crops. Krishnan (2012) prepared locally innovated yellow sticky traps at the farm level in cotton field. Where trying out different coloured sticky traps and observed that the yellow colour attracted the maximum number of sucking pests like jassids (2640), whiteflies (1166) and thrips (352) *etc*. when yellow sticky traps were 50 per ha.

3.3 Whitefly

Looking to the pooled data on whitefly trapping revealed that population of whitefly per trap was ranged between 1.04 to 5.45 whiteflies per trap (Table 3 and depicted in Fig. 3). It can be seen from the data that all the treatments showed significant difference while trapping the whiteflies. The highest number of whitefly capturing was recorded from yellow coloured sticky trap (5.45 whiteflies/trap) and registered as the most effective sticky traps however, it was significantly superior over rest of the other sticky traps. The next effective sticky trap was green coloured sticky trap which attracted 3.54 whiteflies per trap. It was followed by orange coloured sticky trap (2.60 whiteflies/trap) however, it was statistically at par with red coloured sticky trap (1.96 whiteflies/trap). Least numbers of whiteflies were attracted to blue, purple and black coloured sticky trap, which recorded 1.75, 1.49 and 1.35 whiteflies per trap, respectively which was statistically at par with each other. While, the minimum whitefly attraction was seen in the transparent sticky trap (1.04 whiteflies/trap).

Table 1. Aphid population trapped on different coloured sticky traps in *Bt* cotton

Sr. No.	Treatments	Aphid/trap		
		2022	2023	Pooled
T_1	Black	1.66^{d} (2.27)	1.62^{d} (2.11)	1.64^{cd} (2.19)
T_2	Yellow	2.71^{a} (6.82)	2.85^{a} (7.60)	2.78^{a} (7.23)
T_3	Purple	1.72^{d} (2.44)	1.68^{d} (2.33)	1.70^{cd} (2.39)
T_4	Red	1.83^{cd} (2.83)	1.87^{cd} (3.04)	1.85^{c} (2.92)
T_5	Blue	1.70^{d} (2.39)	1.65^{d} (2.21)	1.67^{cd} (2.29)
T_6	Orange	2.19^{bc} (4.31)	2.28^{bc} (4.69)	2.23^{b} (4.47)
T_7	Green	2.31^{ab} (4.85)	2.42^{b} (5.34)	2.36^{b} (5.07)
T_8	Transparent	1.60^{d} (2.05)	1.51^{d} (1.79)	1.55^{d} (1.90)
S.Em.±	T	0.14	0.14	0.091
	Y	-	-	0.050
	Y×T	-	-	0.140
C. D. at 5%	T	0.43	0.42	0.26
	Y×T	-	-	NS
C.V. (%)		12.57	12.08	12.33

Figures in parentheses are retransformed values of $\sqrt{X+0.5}$ transformation; Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance

Table 2. Jassid population trapped on different coloured sticky traps in *Bt* cotton

Sr. No.	Treatments	Jassid/trap		
		2022	2023	Pooled
T_1	Black	1.71^{e} (2.41)	1.63^{de} (2.16)	1.66^{e} (2.26)
T_2	Yellow	3.62^{a} (12.59)	3.87^{a} (14.49)	3.75^{a} (13.56)
T_3	Purple	2.60^{bc} (6.26)	2.38^{c} (5.16)	2.49^{c} (5.70)
T_4	Red	1.77^{e} (2.62)	1.66^{de} (2.26)	1.71^{de} (2.42)
T_5	Blue	3.01^{b} (8.57)	3.32^{b} (10.51)	3.16^{b} (9.49)
T_6	Orange	1.99^{de} (3.46)	2.13^{cd} (4.05)	2.06^{d} (3.74)
T_7	Green	2.41^{cd} (5.30)	3.01^{b} (8.56)	2.71^{c} (6.84)
T_8	Transparent	1.59^{e} (2.03)	1.51^{e} (1.78)	1.55^{e} (1.90)
S.Em.±	T	0.17	0.16	0.121
	Y	-	-	0.059
	Y×T	-	-	0.166
C. D. at 5%	T	0.51	0.50	0.35
	Y×T	-	-	NS
C.V. (%)		12.45	11.61	12.02

Figures in parentheses are retransformed values of $\sqrt{X+0.5}$ transformation; Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance

Table 3. Whitefly population trapped on different coloured sticky traps in Bt cotton

Sr. No.	Treatments	Whitefly/trap		
		2022	2023	Pooled
T_1	Black	1.40^{cd} (1.46)	1.31^{d} (1.23)	1.36^{de} (1.35)
T_2	Yellow	2.37^{a} (5.10)	2.51^{a} (5.79)	2.44^{a} (5.45)
T_3	Purple	1.44^{cd} (1.59)	1.38^{d} (1.40)	1.41^{de} (1.49)
T_4	Red	1.54^{cd} (1.88)	1.60^{cd} (2.06)	1.57^{cd} (1.96)
T_5	Blue	1.51^{cd} (1.77)	1.49^{cd} (1.71)	1.50^{d} (1.75)
T_6	Orange	1.72^{bc} (2.47)	1.79^{bc} (2.70)	1.76^{c} (2.60)
T_7	Green	1.95^{b} (3.32)	2.08^{b} (3.83)	2.01^{b} (3.54)
T_8	Transparent	1.22^{d} (0.98)	1.27^{d} (1.10)	1.24^{e} (1.04)
S.Em.±	T	0.11	0.11	0.072
	Y	-	-	0.039
	Y×T	-	-	0.110
C. D. at 5%	T	0.33	0.34	0.21
	Y×T	-	-	NS
C.V. (%)		11.41	11.61	11.52

Figures in parentheses are retransformed values of $\sqrt{X+0.5}$ transformation; Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance

Table 4. Thrips population trapped on different coloured sticky traps in *Bt* cotton

Sr. No.	Treatments	Thrips/trap		
		2022	2023	Pooled
T_1	Black	1.61^{cd} (2.11)	1.53^{cd} (1.84)	1.57^{de} (1.96)
T_2	Yellow	2.76^{ab} (7.11)	2.90^{a} (7.89)	2.83^{a} (7.51)
T_3	Purple	1.65^{cd} (2.22)	1.72^{cd} (2.45)	1.68^{cd} (2.32)
T_4	Red	1.95^{c} (3.32)	1.91^{bc} (3.15)	1.93^{c} (3.22)
T_5	Blue	2.90^{a} (7.88)	3.06^{a} (8.87)	2.98^{a} (8.38)
T_6	Orange	1.79^{cd} (2.70)	1.81^{c} (2.78)	1.80^{cd} (2.74)
T_7	Green	2.39^{b} (5.19)	2.26^{b} (4.61)	2.32^{b} (4.88)
T_8	Transparent	1.41^{d} (1.48)	1.36^{d} (1.36)	1.38^{e} (1.40)
S.Em.±	T	0.13	0.13	0.085
	Y	-	-	0.046
	Y×T	-	-	0.130
C. D. at 5%	T	0.40	0.39	0.25
	Y×T	-	-	NS
C.V. (%)		11.05	10.76	10.90

Figures in parentheses are retransformed values of $\sqrt{X+0.5}$ transformation; Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance

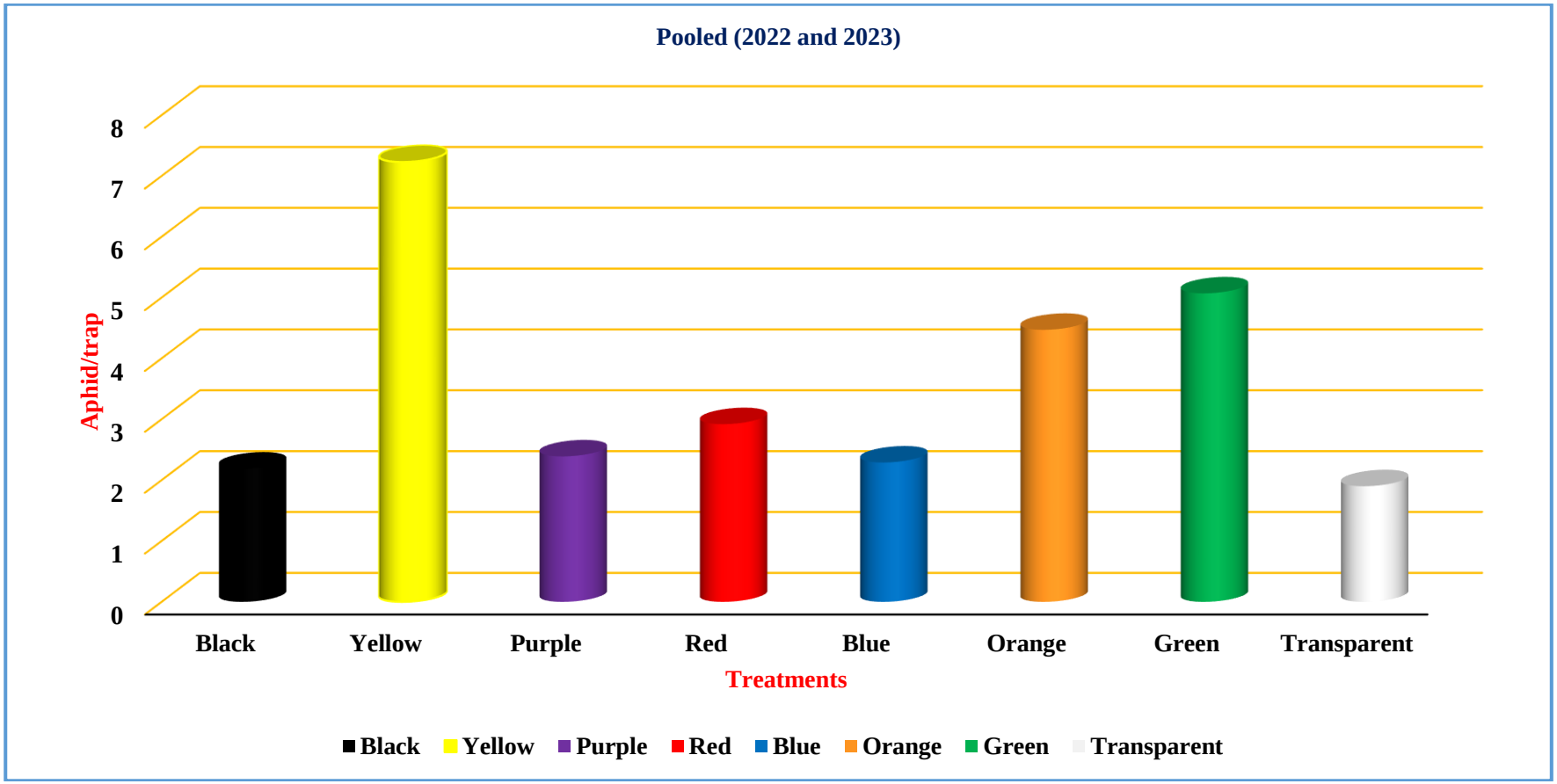

Fig. 1. Aphid population trapped on different coloured sticky traps in *Bt* cotton

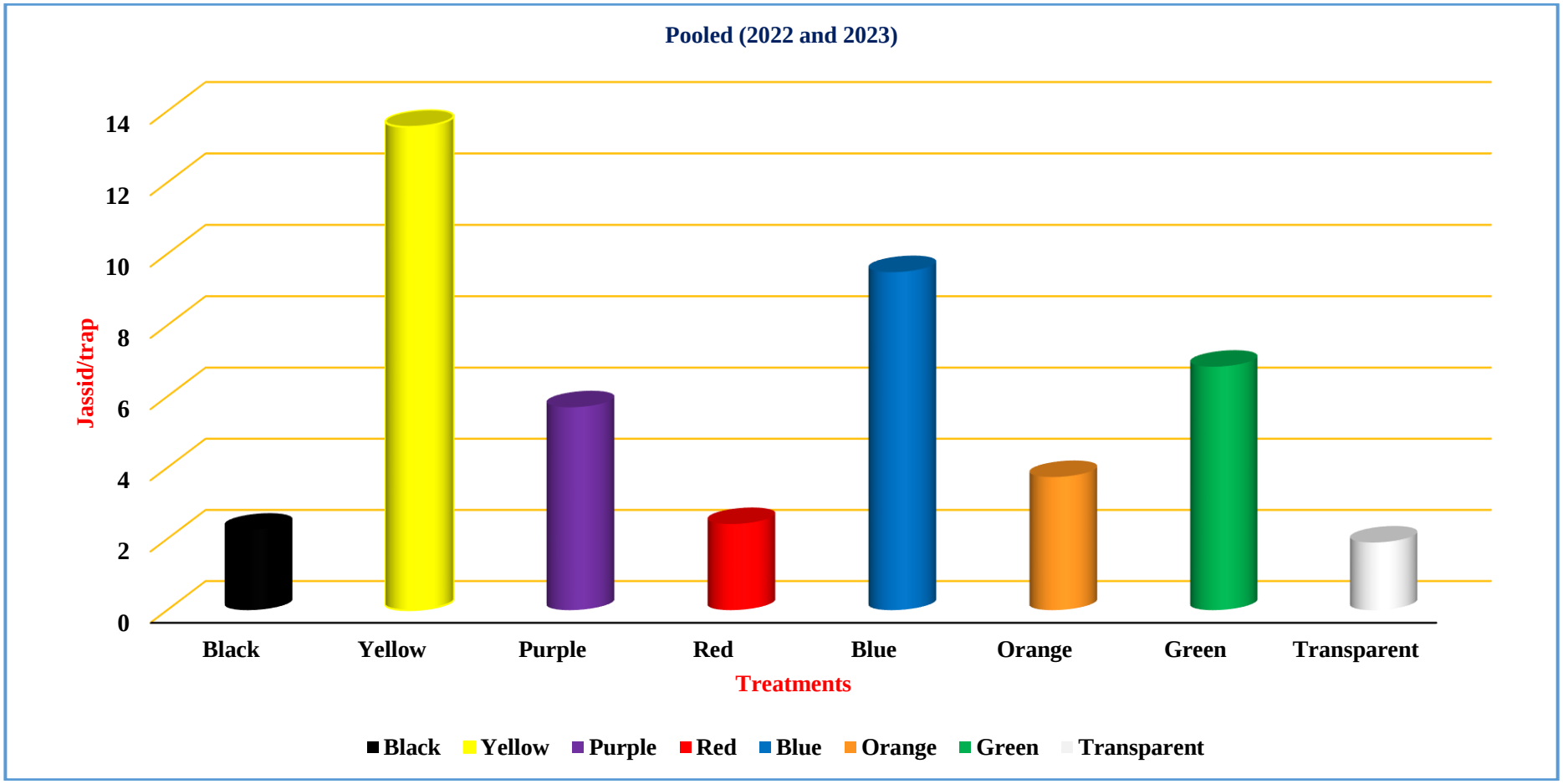

Fig. 2. Jassid population trapped on different coloured sticky traps in *Bt* cotton

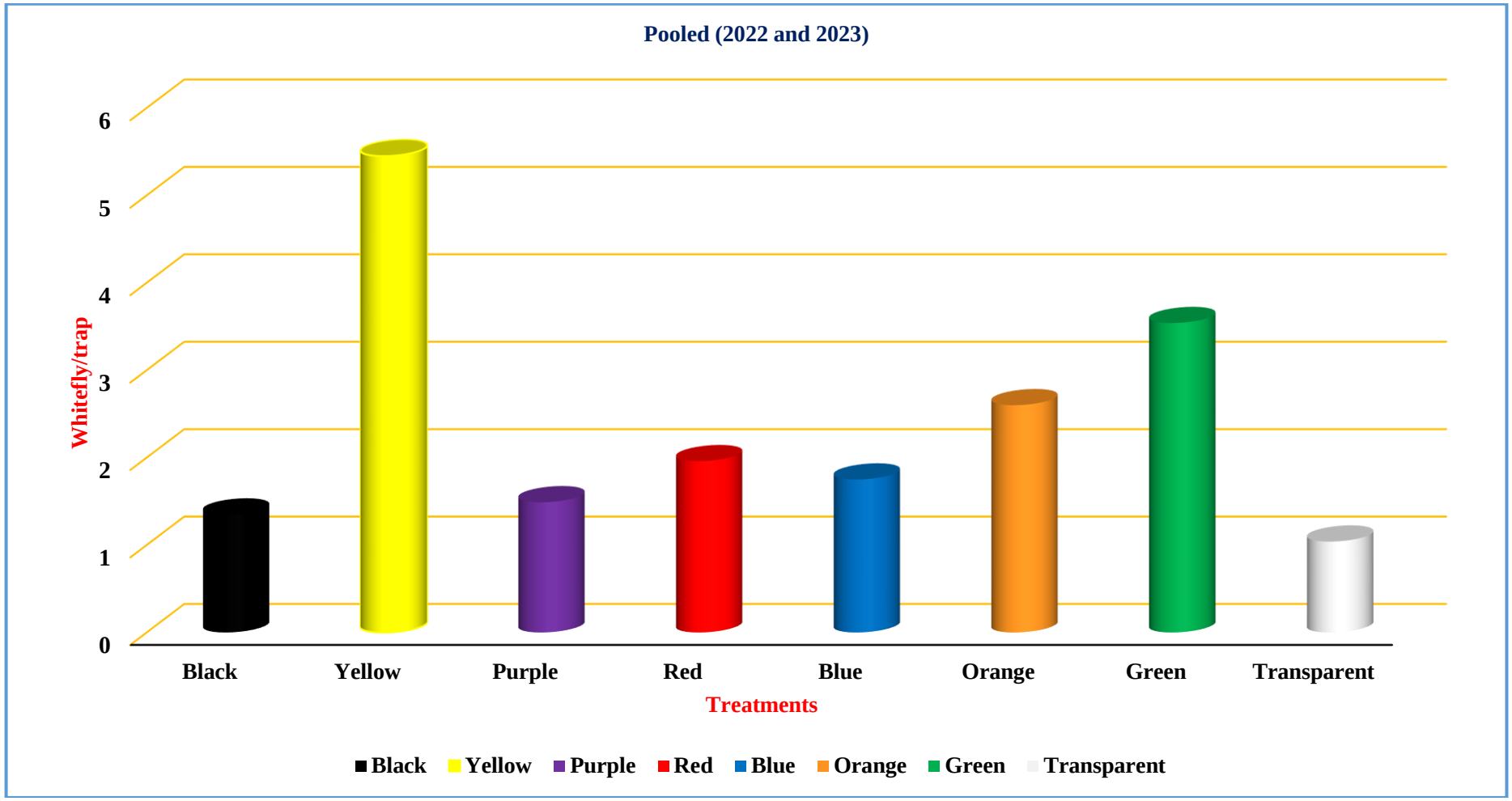

Fig. 3. Whitefly population trapped on different coloured sticky traps in *Bt* cotton

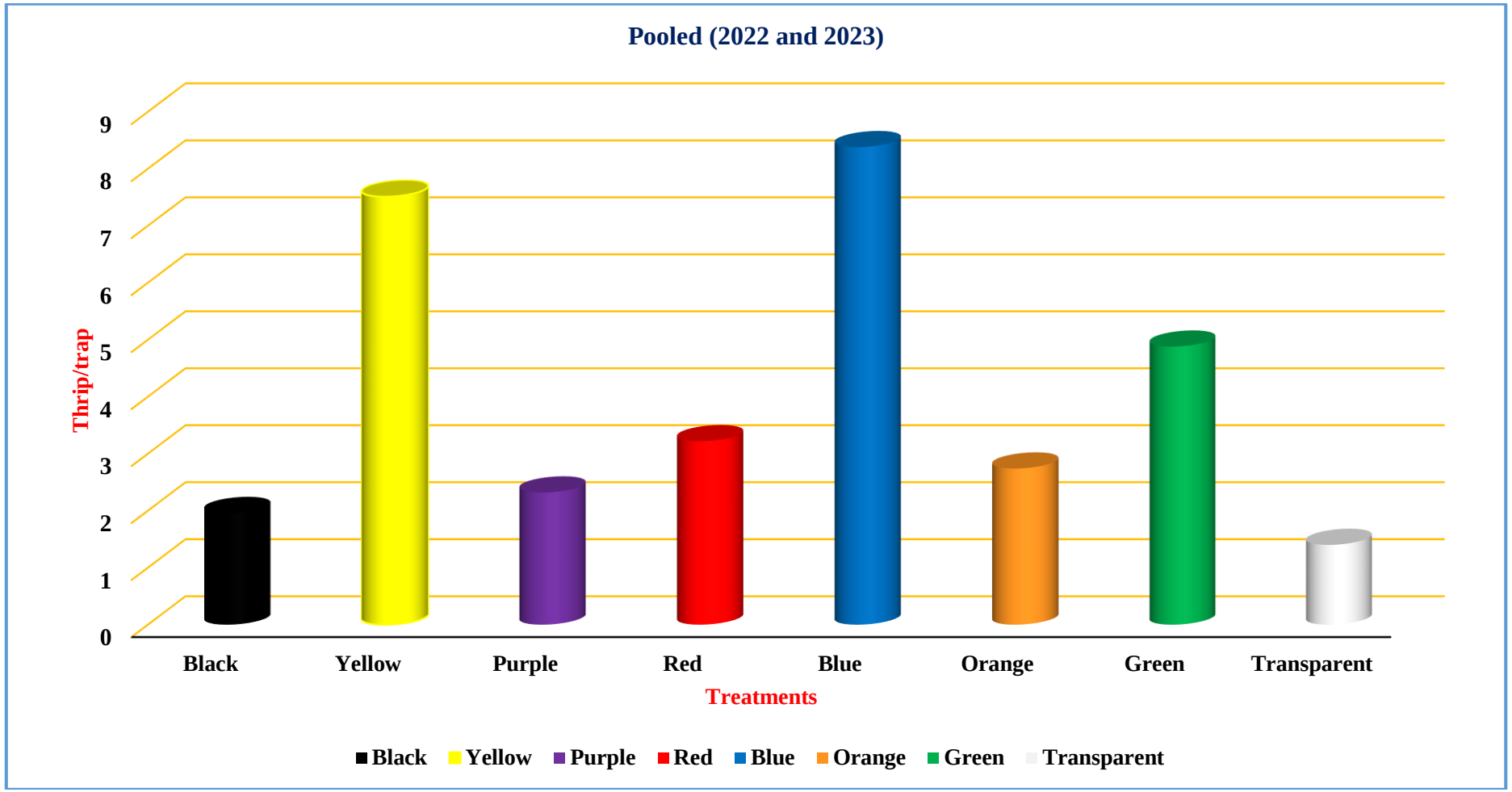

Fig. 4. Thrips population trapped on different coloured sticky traps in *Bt* cotton

Earlier, similar findings were reported by Khatake et al. (2023), who found that yellow was most effective trap colour by recording maximum of 2.99 whiteflies/trap. It was followed by green, white, red and blue which recorded 0.88, 0.73, 0.73 and 0.53 whiteflies/trap, respectively. Kaneria et al. (2022) reported that among the different colour, yellow sticky trap was found most effective in trapping and attracting whitefly which on par with dark green sticky trap, light green sticky trap and orange sticky trap. Bantewad and Thakare (2017) suggested that use of yellow colour trap was most efficacious with respect to trapping of adult whitefly followed by combination of yellow and blue colour.

3.4 Thrips

Perusal of pooled data on thrips trapping presented in Table 4 and depicted in Fig. 4 revealed that population of thrips per trap was varied from 1.40 to 8.38 thrips per trap. The maximum 8.38 thrips per trap was attracted to blue coloured sticky trap and it was statistically at par with yellow coloured sticky trap (7.51 thrips/trap) and both sticky traps proved as the most effective colour sticky traps against thrips. It was followed by green coloured sticky trap which captured 4.88 thrips per trap. The next effective sticky trap was red coloured sticky trap (3.22 thrips/trap) and it was statistically at par with orange coloured sticky trap (2.74 thrips/trap) and purple coloured sticky trap (2.32 thrips/trap). Least numbers of thrips were caught in black and transparent sticky trap which captured 1.96 and 1.40 thrips per trap, respectively which was statistically at par with each other.

The present results are in agreement with the Amutha (2023) who studied during 2018-19 and found that blue colour sticky traps attracted maximum thrips (93.67/ trap) and remain superior over rest of the sticky trap and it was followed by yellow sticky traps (78.89/ trap) and green sticky trap (48.22/ trap). The performance of colour traps was in the order of blue > yellow > white > green > red >orange. Prema et al. (2018) reported that yellow sticky trap attracted more number of thrips compared to other colours. Yellow sticky trap recorded maximum mean thrips catches in the first and second trial, respectively. Blue and white colour traps are the next best preferred by thrips in cotton ecosystem. According to Chen et al. (2004) studied that the traps were mounted vertically on wire stakes and the trap bottom edges were equally 3 cm above cotton plant tops. Blue sticky cards caught 104.6-321.6 thrips weekly compared with 33.8-98.4 caught on yellow and 0-0.2 caught on white cards, indicating that blue was the best trap color for western flower thrips, white was the least attractive and yellow was intermediate in attractiveness. So, the present observations were conformity with earlier research.

4. CONCLUSION

The overall results show that the highest number of aphid (7.23/trap), jassid (13.56/trap) and whitefly (5.45/trap) were attracted on yellow coloured sticky trap and it was found most effective sticky trap. However, the highest number of thrips were attracted on blue coloured sticky trap (8.38 thrips/trap) and it was at par with yellow coloured sticky trap (7.51 thrips/trap).

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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