

Evaluation of coloured sticky traps for monitoring the population of budfly *Dasyneuralin* on Linseed crop.

Abstract

The study of the use of different coloured sticky traps to assess in colour magnetism of budfly on linseed crop was evaluated at field condition at Indira Gandhi Krishi Vishwavidyalaya Raipur, Chhattisgarh during *Rabi* 2022-23 and 2023-24. To understand the preference of colour by the budfly study was conducted using different coloured traps yellow, light yellow, blue, light blue, white, green, grey, pink, orange, brown, black and transparent (check) were used to monitor the movement of budfly weekly interval. Among the tested colour sticky traps average budfly attracted were maximum in the yellow coloured sticky traps during both the seasons as in 2022-23 it was 14.53 budfly/trap and 2023-24 it was 14.70 budfly/trap invariably with the cumulative value of 14.62 budfly/trap. The yellow-coloured sticky trap attracted a greater number of budfly over the crop growth period than other sticky traps. Least numbers of budfly catches were recorded in black traps in the trials.

Keywords: Coloured sticky traps, linseed, budfly

1.1 Introduction

Linseed, or flaxseed (scientific name: *Linum usitatissimum*), is one of the oldest oilseed crops, often referred to in India as the "poor man's crop." This crop, belonging to the Linaceae family (Freeman *et al.*, 1995), is cultivated globally for its oil and fiber. The term "Linum" comes from the Celtic word for "thread," while "usitatissimum" means "most useful" in Latin, reflecting the crop's significant utility. Linseed ranks as the sixth largest oilseed crop worldwide and is known for its various applications (Singh *et al.*, 2014). In India, it is commonly known as "Alsi," "Tisi," "Mosina," and "Arise," and is primarily grown during the *rabi* season. It is valued for both its oil and high-quality fibers. The fibers produced from linseed are strong and aesthetically pleasing, making them ideal for manufacturing linen.

Linseed (*Linum usitatissimum*) is highly valued for its multifaceted uses across various industries. According to Gill (1987), linseed is utilized in producing high-quality handkerchiefs, suit and dress materials, bedding, napery, hand towels, and other decorative

items. Every part of the linseed plant finds commercial application, either in its natural state or after processing. Approximately 80 percent of the linseed oil is allocated for different uses. Flax seeds serve multiple purposes, including industrial, food, and feed applications. The seeds are rich in both non-edible and edible oils. Industrially, flaxseed oil is a key ingredient in the production of paints, varnishes, and linoleum. Edible linseed oil, which contains alpha-linolenic acid (ALA) a polyunsaturated fatty acid offers notable nutritional and health benefits (Neil and Alister, 2003). The burgeoning bio-fibre sector shows significant interest in flax stem fiber. This fiber is increasingly recognized for its value in the manufacturing industry and is used to produce a range of products, including paper, coarse textiles, ropes, fiberboard, molded panels, and insulation materials. The versatility and utility of linseed highlight its importance across various sectors, from textiles to industrial applications.

Despite its promising potential for use in composites and bio-based industries, linseed production remains economically marginal. Although linseed has a range of industrial applications, the majority of the crop is used for oil production, with only a small fraction allocated for edible purposes. Linseed oil cake, a by-product of oil extraction, is highly valued in agriculture. It is typically priced about 5% higher than rapeseed-mustard cake due to its superior quality as feed for dairy cattle and poultry. Additionally, linseed oil cake is used as an organic manure and is known for its pleasant odour. It is rich in protein, containing 36% protein with 85% digestibility, and has significant nutrient content, including 5% nitrogen, 1.4% phosphorus, and 1.8% potash. In cultivation, linseed is a major oilseed crop grown during the *rabi* season, ranking second in production in India after rapeseed-mustard, and is a leader in technical oil production. Linseed oil is valued for its high linoleic acid content, which exceeds 66%, making it suitable for drying applications. The crop typically yields between 33% and 45% oil, underscoring its importance in both nutritional and industrial uses.

Among economically significant insect pests, the linseed bud fly (*Dasyneuralini* Barnes) is considered a major threat to linseed crops, particularly in Asia, including India, Pakistan, and Bangladesh, where it can cause yield losses of up to 88% (Biswas and Das, 2011). The first incidence of bud fly infestation was observed on pigeon pea flower buds in Pusa, Bihar, India (Pruthi and Bhatia, 1937). This pest primarily attacks linseed during its flowering stage by infesting flower buds. The adult bud fly resembles a small orange midge and feeds on the growing buds, laying eggs on the sepals or other parts of the flower bud. The

larvae, which are tiny and pinkish, consume the reproductive parts of the buds. As a result, the infested buds become hollow due to the crumpling of the corolla, and the reproductive parts are severely reduced in size. At the green bud stage, the infested buds fail to fertilize and develop into capsules (Singh *et al.*, 2015). The larvae eventually drop into the soil to pupate, completing their development in 14 to 27 days. There are typically four overlapping generations of bud flies per crop season. Infestation levels are influenced by factors such as favorable environmental conditions, the presence or absence of natural predators or parasites, the population density of adult flies, and the cultivation of susceptible linseed varieties. The pest can also overwinter in soil or crop residues, emerging as adults in the next growing season to start new infestations. The degree of damage caused by bud flies can vary, with severe infestations potentially leading to total crop failure (Malik, 1999).

By the end of the fiscal year 2023, India is anticipated to produce approximately 140,000 metric tons of linseed, marking an increase from the previous year. In comparison, during fiscal year 2022, the country's total oilseed production exceeded 38 million metric tons, underscoring India's substantial presence in the global oilseed market and its commitment to boosting production across various oilseed crops. (Anonymous, 2023).

Linseed (*Linum usitatissimum*) is a valuable crop known for its seeds and oil, but its growth is often impacted by various insect pests. Among these pests, the budfly (*Dasyneuralini* Barnes), belongs to Cecidomyiidae family (Diptera), is particularly problematic. This pest attacks the flower buds of linseed plants, leading to significant declines in both yield and quality. Budfly infestations can lead to severe economic losses in linseed cultivation. Research indicates that losses due to budfly can range from 17% to 49%, with an average loss of around 40% at national level (Malik *et al.*, 2008). These figures highlight the critical need for effective pest management strategies to address the challenges posed by this pest. Such heavy losses in seed yield due to bud fly incidence can be reduced up to respectable extent by manipulations in agronomic practices (Malik *et al.* 2008). Understanding the life cycles and population dynamics of these insect pests is crucial for developing effective pest management strategies. Detailed studies on insect infestations can aid in crafting targeted control measures to mitigate the adverse effects on linseed crops and improve overall yield and quality. In addition, resistant varieties are one of the fundamental, widely accepted and eco- friendly tools of integrated pest management.

In order to find the best sticky traps to use against budfly, the current study on the evaluation of coloured sticky traps for monitoring the population of budfly *Dasyneuralini* on linseed crop.

2.1 Materials and Methods

An experiment was conducted at Indira Gandhi Krishi Vishwavidyalaya Raipur, Chhattisgarh (India) during *Rabi* 2022-23 and 2023-24. The each plot was divided into 5mx4m. Used a completely randomized blocks design to evaluate the budfly attraction to color traps in the linseed crop. Each treatment (colors) was replicated three times and three cardboard with color paper were placed in one plot of each treatment. The acetates with the stuck insects replaced at weekly interval after recording linseed budfly population. No insecticides were applied throughout the sampling period. Experiments began on January 2022-23 and 2023-24, following the initiation of linseed flower bud and finished on March 2022-23 and 2023-24.

2.2 Preparation of sticky trap and Observation

Different colored sticky traps used in this study were handmade constructed, using a 30 x 21 cm² cardboard with colored paper by attaching to the iron rod at the canopy level. Selected the following colors: yellow, blue, white, green, grey, orange, brown, black and colorless as a check. Separately, an acetate sheet same size of the cardboard was slightly coated on one side with petroleum jelly (Crop guard). Acetates were attached with one side of the colored cardboards to catch insects on the traps. The advantage of using acetates over the color cardboards is that traps did not need replacing after each sampling, as we only removed the acetates with the stuck insects. The number of individuals caught on traps was counted.

3.1 Results and Discussion

Coloured sticky traps (Yellow, Blue, White, green, grey, orange, brown, black and colourless) were tested for two years (2022-23 & 2023-24) in the season of january-march and the data of budfly trapped on them is presented in the (Table 1 & 2) and their cumulative data is presented in the (Table 3). The table presents the capture rates of budflies on sticky traps of various colors over a period of 63 days after inoculation (DAI). The treatments include yellow, blue, white, green, grey, orange, brown, black, and colorless traps. Each color's effectiveness is evaluated through mean capture rates and their variability.

During 2022-23, yellow sticky traps consistently showed the highest capture rates of budflies throughout the study period. Capture rates increased from 1.40 at 7 DAI to 14.53 at 63 DAI. Blue traps exhibited lower capture rates compared to yellow traps, starting at 0.37 at 7 DAI and reaching 3.90 by 63 DAI. Although less effective, blue traps still showed a steady increase in capture rates. White traps had the lowest capture rates, with values starting at 0.00 at 7 DAI and rising to 2.77 at 63 DAI. Green traps had a moderate capture rate, starting at 0.00 and increasing to 1.50. Grey traps started at 0.00 and reached 1.47. Orange traps showed moderate effectiveness, with capture rates increasing from 0.00 to 1.87. Brown traps had higher initial captures (2.00) but had similar final capture rates (1.53). Black traps had a moderate performance, with rates ranging from 0.00 to 1.50. Colorless traps showed similar effectiveness to black traps but with higher variability.

During 2022-23, yellow traps consistently demonstrated the highest capture rates throughout the study period. Starting at 1.40 captures at 7 DAI, the rate increased significantly to 14.70 by 63 DAI. The data show a clear upward trend in budfly captures, with notable increases at each observation point. Blue traps had relatively lower capture rates compared to yellow, with values starting at 0.40 at 7 DAI and rising to 4.23 at 63 DAI. Although less effective than yellow traps, blue traps still showed a steady increase. White traps had the lowest capture rates, with an initial value of 0.00 at 7 DAI and reaching 2.43 by 63 DAI. The capture rates were consistently low across the study period. Green traps had moderate capture rates, starting at 0.00 and increasing to 1.50. Grey traps also had moderate capture rates, from 0.00 at 7 DAI to 1.47 at 63 DAI. Orange traps showed an increase in capture rates from 0.00 at 7 DAI to 1.90 at 63 DAI. Brown traps had an initial capture rate of 0.73, increasing to 1.54 by 63 DAI. Black traps had moderate capture rates, starting at 0.00 and reaching 1.27 by 63 DAI. Colorless traps showed a notable increase from 0.45 at 7 DAI to 13.97 at 63 DAI, with high variability.

Among the tested colour sticky traps average budfly attracted were maximum in the yellow coloured sticky traps during both the seasons as in 2022-23 it was 14.53 budfly/trap (Table 1) and 2023-24 it was 14.70 budfly/trap (Table 2) invariably with the cumulative value of 14.62 budfly/trap (Table 3). But it was statistically not different with the yellow sticky traps on both the seasons which had recorded 14.53 budfly/trap during 2023 and 14.70 budfly/trap during 2024 with the pooled value of 14.62 budfly/trap during both the seasons (2022-23 & 2023-24 jan-march). Blue (T2) and White (T3) traps had moderate capture rates.

Blue traps were more effective than white ones initially but showed lower capture rates over time.

Among the colour sticky traps used, Black colour sticky traps attracted less number of bud fly during both the seasons as it was 1.20 budfly/trap while 2023 and with slight variation 1.27 budfly/trap during 2024 with the cumulative value of 1.23 budfly/trap which was little lesser than the other sticky traps but statistically on par with each other on both the seasons after 63 days after installation of trap. Same result has been obtained during both the seasons of 2023 and 2024 as it is depicted in the Tables (1, 2 &3) As there was no significant difference between number of budfly were found less attracted to white and blue colour on both the seasons.

Yellow Traps (T1) demonstrated the highest pest capture rates throughout the study period, peaking at 14.62 pests per trap by 63 days after installation of sticky trap in both season 2023 and 2024. This indicates that yellow sticky traps were the most effective in capturing pests compared to other colors. Colourless/Check Traps (T9) also showed a high capture rate, particularly from 21 DAT onwards, with a peak of 12.15 pests per trap by 63 days after installation of sticky trap in both season 2023 and 2024. This suggests that the absence of color did not significantly reduce the effectiveness of these traps. T2 and T6 display gradual growth, starting from lower initial values and showing steady increases, reaching 4.07 and 1.88 at 63 DAT, respectively. T5 and T8 show more moderate increases compared to T1 and T9. They start at lower values and have less pronounced growth trends.

Table 1 Evaluation of colored sticky traps for the monitoring of linseed budfly during 2022-23.

Treatment	7 DAI	14 DAI	21 DAI	28 DAI	35 DAI	42 DAI	49 DAI	56 DAI	63 DAI
T1	1.40 (1.38)	0.73 (1.11)	2.60 (1.76)	3.53 (2.01)	4.00 (2.12)	4.47 (2.23)	7.73 (2.87)	11.67 (3.49)	14.53 (3.88)
T2	0.37 (0.93)	0.30 (0.89)	0.67 (1.08)	0.57 (1.03)	1.40 (1.38)	1.07 (1.25)	1.80 (1.52)	2.80 (1.82)	3.90 (2.10)
T3	0.00 (0.71)	0.20 (0.84)	0.40 (0.95)	0.53 (1.02)	0.60 (1.05)	1.30 (1.34)	1.80 (1.52)	2.13 (1.62)	2.77 (1.81)
T4	0.00 (0.71)	0.60 (1.05)	0.53 (1.02)	0.57 (1.03)	0.43 (0.97)	1.03 (1.24)	1.07 (1.25)	1.60 (1.45)	1.50 (1.41)
T5	0.00 (0.71)	0.00 (0.71)	0.37 (0.93)	0.90 (1.18)	0.60 (1.05)	0.73 (1.11)	1.20 (1.30)	1.47 (1.40)	1.47 (1.40)
T6	0.00 (0.71)	0.70 (1.10)	0.57 (1.03)	0.83 (1.15)	0.40 (0.95)	1.07 (1.25)	1.40 (1.38)	1.93 (1.56)	1.87 (1.54)
T7	0.00 (0.71)	2.00 (1.58)	0.70 (1.10)	0.90 (1.18)	0.87 (1.17)	0.73 (1.11)	1.00 (1.22)	1.67 (1.47)	1.53 (1.43)
T8	0.00 (0.71)	0.00 (0.71)	0.13 (0.80)	0.20 (0.84)	0.47 (0.98)	0.87 (1.17)	1.00 (1.22)	1.50 (1.41)	1.20 (1.30)
T9	1.37 (1.37)	1.00 (1.22)	2.33 (1.68)	3.83 (2.08)	3.40 (1.97)	4.40 (2.21)	7.50 (2.83)	11.50 (3.46)	10.33 (3.29)
C.D.	0.235	0.209	0.167	0.449	0.382	0.473	0.441	0.32	1.043
SE(m)	0.078	0.069	0.055	0.148	0.126	0.156	0.146	0.106	0.345
C.V.	11.858	10.782	7.052	17.576	14.817	17.015	13.862	8.733	13.752

*DAI = Date after installation, CD at 5%

Figures in the parenthesis are square root transformed value.

Table 2 Evaluation of colored sticky traps for the monitoring of linseed budfly during 2023-24.

Treatment	7 DAI	14 DAI	21 DAI	28 DAI	35 DAI	42 DAI	49 DAI	56 DAI	63 DAI
T1	1.40 (1.38)	0.67 (1.08)	2.57 (1.75)	3.50 (2.00)	4.67 (2.27)	4.80 (2.30)	8.57 (3.01)	11.80 (3.51)	14.70 (3.90)
T2	0.40 (0.95)	0.27 (0.88)	0.67 (1.08)	0.50 (1.00)	1.63 (1.46)	1.40 (1.38)	2.23 (1.65)	3.30 (1.95)	4.23 (2.18)
T3	0.00 (0.71)	0.07 (0.75)	0.40 (0.95)	0.57 (1.03)	1.00 (1.22)	1.63 (1.46)	1.93 (1.56)	2.23 (1.65)	2.43 (1.71)
T4	0.00 (0.71)	0.57 (1.03)	0.50 (1.00)	0.67 (1.08)	0.77 (1.13)	1.03 (1.24)	1.13 (1.28)	1.47 (1.40)	1.50 (1.41)
T5	0.00 (0.71)	0.00 (0.71)	0.40 (0.95)	0.53 (1.02)	0.70 (1.10)	0.83 (1.15)	1.27 (1.33)	1.53 (1.43)	1.47 (1.40)
T6	0.00 (0.71)	0.13 (0.80)	0.57 (1.03)	0.83 (1.15)	1.10 (1.26)	1.13 (1.28)	1.50 (1.41)	1.93 (1.56)	1.90 (1.55)
T7	0.00 (0.71)	0.73 (1.11)	0.67 (1.08)	1.03 (1.24)	0.87 (1.17)	0.80 (1.14)	1.07 (1.25)	1.57 (1.44)	1.54 (1.43)
T8	0.00 (0.71)	0.00 (0.71)	0.17 (0.82)	0.20 (0.84)	0.67 (1.08)	1.00 (1.22)	1.07 (1.25)	1.50 (1.41)	1.27 (1.33)
T9	0.45 (0.97)	0.33 (0.91)	2.20 (1.64)	3.40 (1.97)	4.47 (2.23)	4.73 (2.29)	8.83 (3.06)	11.87 (3.52)	13.97 (3.80)
C.D.	0.294	0.198	0.198	0.352	0.527	0.565	0.344	0.439	0.463
SE(m)	0.097	0.065	0.066	0.117	0.174	0.187	0.114	0.145	0.153
C.V.	15.33	10.001	8.418	13.952	18.979	19.684	10.368	11.921	11.959

*DAI = Date after installation, CD at 5%

Figures in the parenthesis are square root transformed value.

Table 3 Evaluation of colored sticky traps for the monitoring of linseed budfly during 2022-23 and 2023-24.

Treatment	7 DAI	14 DAI	21 DAI	28 DAI	35 DAI	42 DAI	49 DAI	56 DAI	63 DAI
T1 Yellow	1.40 [1.38]	0.70 [1.10]	2.58 [1.76]	3.52 [2.00]	4.33 [2.20]	4.63 [2.27]	8.15 [2.94]	11.73 [3.50]	14.62 [3.89]
T2 Blue	0.38 [0.94]	0.18 [0.83]	0.67 [1.08]	0.53 [1.02]	1.52 [1.42]	1.23 [1.32]	2.02 [1.59]	3.05 [1.88]	4.07 [2.14]
T3 White	0.00 [0.71]	0.07 [0.75]	0.40 [0.95]	0.55 [1.02]	0.80 [1.14]	1.47 [1.40]	1.87 [1.54]	2.18 [1.64]	2.60 [1.76]
T4 Green	0.00 [0.71]	0.38 [0.94]	0.52 [1.01]	0.62 [1.06]	0.60 [1.05]	1.03 [1.24]	1.10 [1.26]	1.53 [1.43]	1.50 [1.41]
T5 Grey	0.00 [0.71]	0.00 [0.71]	0.38 [0.94]	0.72 [1.10]	0.65 [1.07]	0.78 [1.13]	1.23 [1.32]	1.50 [1.41]	1.47 [1.40]
T6 Orange	0.00 [0.71]	0.18 [0.83]	0.57 [1.03]	0.83 [1.15]	0.75 [1.12]	1.10 [1.26]	1.45 [1.40]	1.93 [1.56]	1.88 [1.54]
T7 Brown	0.00 [0.71]	0.70 [1.10]	0.68 [1.09]	0.97 [1.21]	0.87 [1.17]	0.77 [1.13]	1.03 [1.24]	1.62 [1.45]	1.54 [1.43]
T8 Black	0.00 [0.71]	0.00 [0.71]	0.15 [0.81]	0.20 [0.84]	0.57 [1.03]	0.93 [1.20]	1.03 [1.24]	1.50 [1.41]	1.23 [1.32]
T9 Colourless/check	0.91 [1.19]	0.33 [0.91]	2.27 [1.66]	3.62 [2.03]	3.93 [2.11]	4.57 [2.25]	8.17 [2.94]	11.68 [3.49]	12.15 [3.56]
C.D.	0.224	0.199	1.092	0.388	0.439	0.516	0.358	0.251	0.268
SE(m)	0.074	0.066	0.361	0.128	0.145	0.17	0.118	0.083	0.088
C.V.	11.481	10.165	12.576	15.284	16.37	18.242	11.007	6.808	7.027

*DAI = Date after installation, CD at 5%

Figures in the parenthesis are square root transformed value.

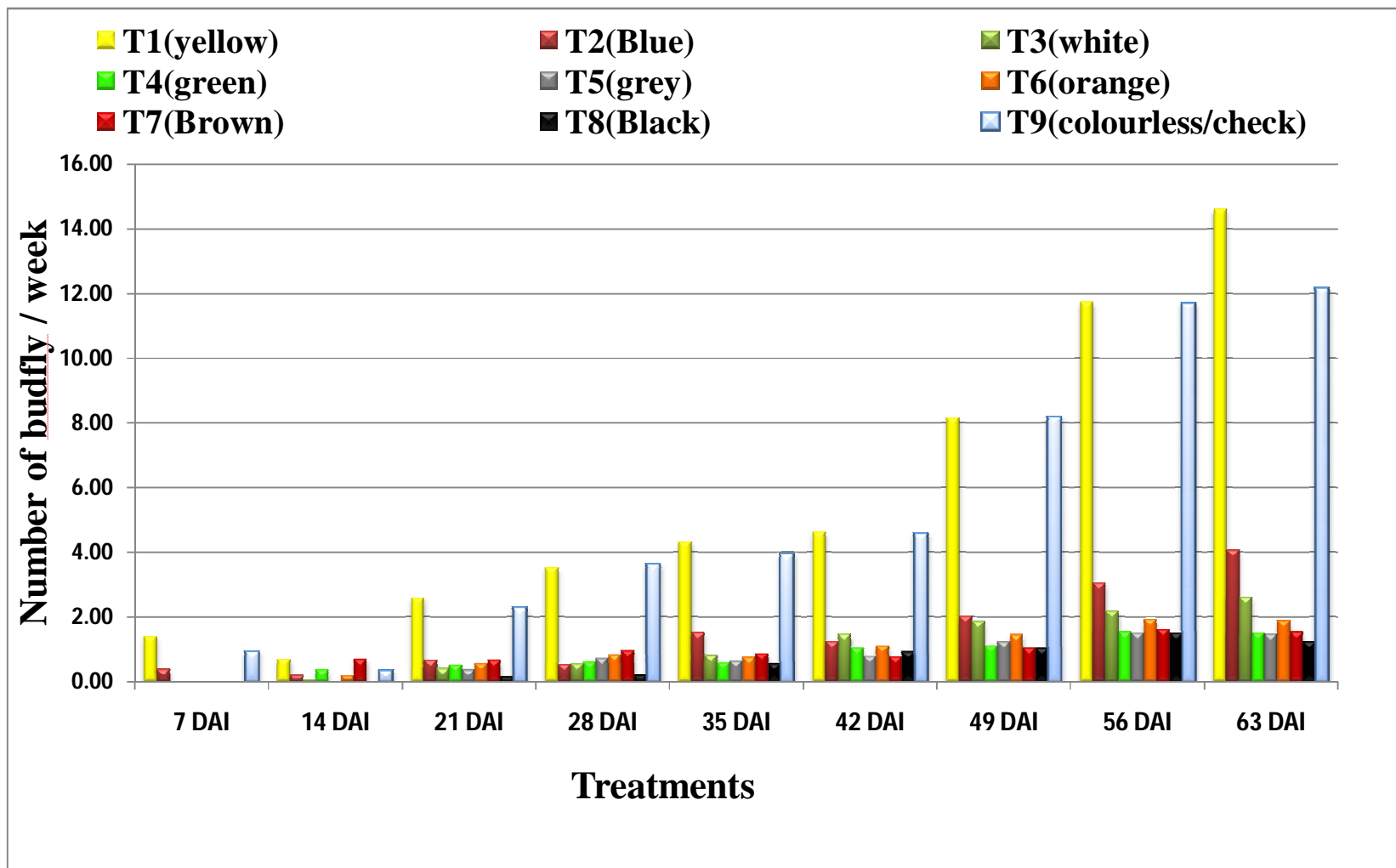


Image 1: Diversity of budfly with different treatment efficacy



Fig 1 Budfly caught in yellow sticky trap

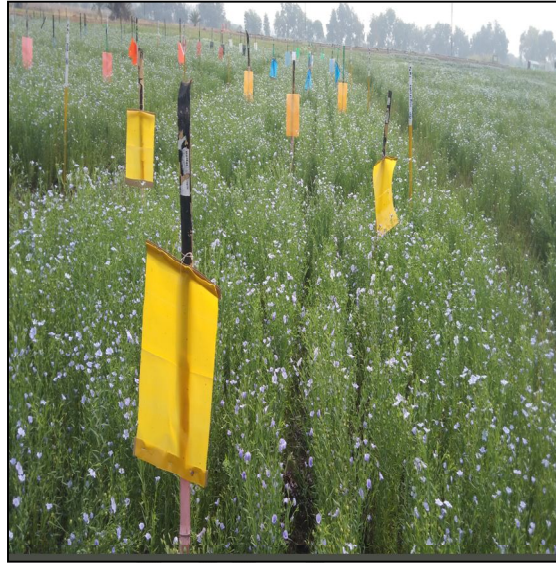


Fig 2 Photograph of field

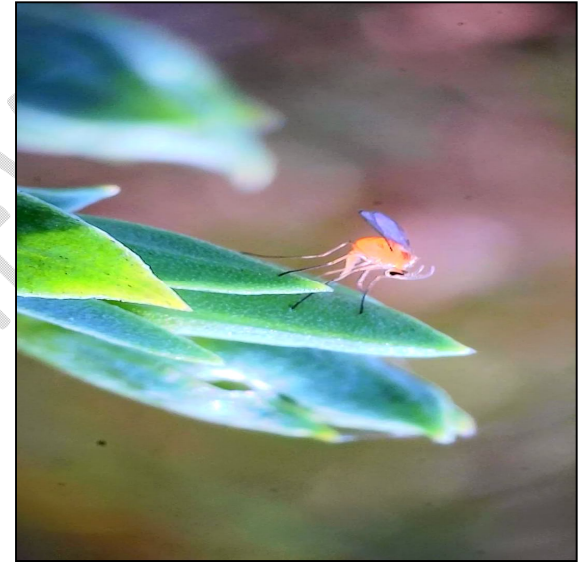


Fig 3 Adult of budfly

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Conclusion :-

From the above mentioned results it is concluded that sticky traps are an alternative tool for the monitoring of the insects which are one of the cheaper and almost equal effective method for budfly. The data indicate that treatments vary in their effects over time, with some treatments showing more consistent and pronounced responses than others. Treatments T1 and T9 exhibit significant increases, suggesting a strong effect that grows over the study period. Other treatments like T2, T3, and T5 show more gradual increases, and some like T4 and T8 have modest effects. Among the different coloured sticky traps; yellow sticky trap attracted more number of budfly in both the season except the slight variation in number of budfly attracted with the cumulative value of (14.62 adults/week) followed by blue sticky traps as 4.07 and 2.60 adults/week in white trap.

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