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Impact of Eco-Friendly PAU Fruit Fly Traps against Fruit Flies Infesting Guava under Central Punjab Conditions

Suman Kumari, Harinder Singh and Sandeep Singh[1]

Krishi Vigyan Kendra, Kapurthala-144 601, India
[1]Department of Fruit Science, Punjab Agricultural University, Ludhiana-141 004, India
E-mail: suman60@pau.edu

***Abstract*:** Guava (*Psidium guajava* L.) is one of the most important commercial fruits grown in Punjab. However, fruit flies, *Bactrocera* spp. are considered the key insect pests of guava causing heavy yield losses ranging from 10-100 per cent and quality degradation. Methyl eugenol based eco-friendly pheromone traps (PAU Fruit Fly Traps) were tested at farmer's fields in guava during 2023 and 2024 in the central Punjab. In the demonstrated technology, the fruit infestation was only 20.99 per cent while maximum percentage was recorded in untreated control (55.67 %). Similarly, yield was highest (88.06 q/ha) in technology demonstrated orchards in comparison to untreated control (83.69 q/ha). Similar trend was observed for maximum number of marketable fruits (365 fruits/plant) in the treated plots, as compared to 222 fruits/plant in untreated control. Mean fruit yield was also highest i.e. 57.8 kg/tree in technology demonstrated orchards as compared to untreated control with 37.8 kg/tree. After harvesting of crop, an average of 6899 fruit flies was collected from PAU fruit fly traps.

***Keywords*:** Frontline demonstrations, Fruit flies, Guava, Pheromone traps, Yield

Guava (*Psidium guajava* L.) occupies an area of 3.10 lakh ha with a production of 4469 metric tonnes in India (DAC&FW 2020-21), whereas in Punjab, it covers 12.173 thousand hectares with yield of 276685 kg/ha and productivity of 227.29 thousand metric tonnes (Anonymous 2024). Rainy season guava fruits are severely infested by fruit flies. Fruit flies are one of the most important pests of fruits and vegetables because of their effects on the crop, environment, society and economy. *Bactrocera dorsalis* and *B. zonata* are the most damaging fruit flies and major constraints in successful guava cultivation and results in quality degradation, decreased fruit production and heavy yield losses (10-100 per cent) (Singh and Sharma 2013, Singh et al 2020, Mohanpuria et al 2021, Yue et al 2023 a,b). Fruit flies are highly challenging to control as they are multivoltine, polyphagous, highly mobile adults, and unexposed during all developmental phases. Adults are most vulnerable as eggs and maggots are shielded in the host tissues and are non responsive to most of the insecticidal treatments (Verghese et al 2012). So, in the present scenario, an eco-friendly approach to manage these fruit flies is currently necessary as the use of the insecticides disturbs the ecosystem and poses number of risks. As an alternate strategy, male annihilation technique (MAT) is widely used in which methyl eugenol which is primarily a para-pheromone, is combined with an insecticide that infused on a wooden substrate in a plastic bottle trap. These traps are very effective in the management of several *Bactrocera* spp. (Manrakhan et al 2014, Shelly et al 2014, Bhowmik et al 2015, Singh et al 2015). In this context, eco-friendly technology of PAU Fruit Fly Traps was tested at farmer's fields by Krishi Vigyan Kendra, Kapurthala, Punjab (India) in guava orchards during 2023 and 2024 with an objective to manage these fruits flies effectively in the rainy season crop.

MATERIAL AND METHODS

Krishi Vigyan Kendra, Kapurthala conducted demonstrations over five locations (Nadala (N 31.5458˚ E 75.4388˚), Subhanpur (N 31.5424156˚ E 75.4355317˚), Mand dhillwan (N 31.4972492˚ E74.3333884˚, Mand Kuka (N31.586304˚ E75.450432˚ and Feroz Sangwal (N 31.627˚ E 75.5015˚) of Dhillwan and Nadala blocks of district Kapurthala, Punjab (India) to manage the infestation of fruit flies in rainy season guava during 2023 and 2024 on an area of 2.5 ha. Sixteen PAU Fruit Fly Traps per 0.40 ha were fixed in each guava orchard along with an untreated control area. The baited bottles were hanged with the trees at equidistance. The traps were fixed in the first week of the July till fruit harvesting was over. PAU Fruit Fly Traps were installed in guava orchards to assess losses to the fruits and to measure the efficacy of different local and recommended management options at weekly intervals. The traps used in MAT technique consisted of immersing water absorbable plywood blocks (7.5 cm x 6.0 cm x 2.0 cm) in a solution of ethyl alcohol, methyl eugenol (98%) and malathion mixed in a glass jar in the ratio of 6:4:1 (v/v) for 72 h so that the solution was properly absorbed in the plywood blocks (Singh and Sharma 2013). Bottles were fixed/ hanged at a height of 1-1.5 m from ground level, depending upon the height of tree, at a

place receiving no direct sunlight. The selected tress were demarked with red coloured reflecting tape for easy an easy identification of traps. The lower cut portion of bottle (lid) was removed and all the fruit flies trapped in bottle were collected in carry bag after every seven days and then, the lid was again re-fixed. The carry bags were labelled and fruit flies trapped/trap were counted. Impact of traps on the number of marketable fruits was also assessed by counting number of marketable fruits from five trees (Singh et al 2014). In both treated (16 traps per 0.40 ha) and untreated control areas, a sample of 50 guava fruits was collected at random from each treatment at weekly intervals. The fruits were categorized as infested (based on oviposition punctures), fallen infested fruits, or healthy fruits. The percentage of fruit infestation was then calculated. Marketable yield was worked out by using data on per cent fruit damage on weight basis. Impact on the quality of marketable fruits and yield was also assessed from 5 trees at full maturity (Singh et al 2014). The obtained data was statistically analyzed and coefficient of variation were also calculated.

RESULTS AND DISCUSSION

Population of fruit flies captured in fruit traps: The incidence of fruit flies started from 2nd week of July both in 2023 and 2024 (28th SMW). Results revealed that mean male population capture of 500.26 fruit flies/trap/week was observed in 28th SMW from different locations of Kapurthala district (Table 1). After that, the population increased rapidly reaching its peak with weekly mean trap catches of 1132.1 fruit flies/trap/week during the second week of August (32nd SMW), when the trees was at the maximum fruiting stage.

Thereafter, the trap catches of fruit fly declined gradually and the lowest mean trap catches of 382.46 fruit flies/trap/week during the last week of September (37th standard week) when the crop was to be last harvested (Table 1). The pooled mean revealed that the maximum fruit flies were captured from Feroz Sangowal (7509), followed by Mand Kuka (7448), Nadala (6625) and Mand Dhillwan (7448) whereas, the least population was captured in Subhanpur (6338) . First criteria to understand the behaviour of any pest is the record of population monitoring data, so that they can be effectively controlled by devising appropriate management strategies before reaching their peak potential to damage the crop. Similarly, in this study, population of fruit flies fluctuated widely from very low to peak level in both years of study depending on the stage of the crop and weather conditions.

During both years, initial population of fruit flies was observed at fruit set up stage on the 28th SMW, whereas peak population of fruit flies was observed when the fruits were at peak fruiting period, *i.e*. 31st and 32nd SMW. Highest population was recorded when the crop reaches its maximum fruiting period during 32nd SMW and subsequently, there was decrease in the population as fruits were harvested. Fazlullah et al (2015) also reported that fruit fly population was maximum before ripening of fruits and then decrease afterwards. Vignesh et al (2020) reported that population of guava fruit flies *B. correcta* and *B. dorsalis* reached its peak in August. Hence, it is vividly confirmed that activity of fruit flies was maximum in the month of July and August. Vargas et al (2015) and Math et al (2018). Singh and Sharma (2013) also revealed that 16 traps/acre trapped significantly more population of males of *B. dorsalis* and *B. zonata.* Bajaj and Singh (2018) also highlighted the importance of PAU fruit fly traps in capturing significantly more fruit flies in comparison to other cylindrical spherical traps.

The maximum percentage of fruit infestation was observed in untreated control *i.e.* 55.67 per cent as compared to 20.49 per cent in technology demonstrated orchards. Kaur et al (2016) also reported that 25.4 per cent of fruits in guava orchards were infested when fruit fly traps were used compared to 81.3 per cent in the control orchards. Marketable fruits in technology demonstrated orchards were higher (362 fruits/tree) in comparison to untreated orchards (222 fruits/tree). Singh et al (2014) assessed that successful eco-friendly management of fruit flies in guava can be achieved by placing PAU fruit fly traps @ 16 traps per acre during the first

Table 1. Fruit flies trap catch during different weeks per trap in different blocks of Kapurthala (2023 & 2024)

Name of blocks	SMW* 28	SMW 29	SMW 30	SMW 31	SMW 32	SMW 33	SMW 34	SMW 35	SMW 36	SMW 37	Total catch
Nadala	467.3	539.5	675.3	684.9	1056.5	965.4	811.5	624.5	472.5	327.6	6625
Subhanpur	464.5	529.5	616.5	794.4	1061.5	897.2	642.8	516.8	462.9	352.3	6338
Mand Dhillwan	456.5	489.5	716.4	780.5	1092.5	889.6	719.2	603.8	459.8	366.1	6573
Mand Kuka	528.5	574.5	787.5	995.5	1198.5	869.4	829.1	693.4	542.8	429.2	7448
Feroz Sangowal	584.5	619.5	686.3	784.4	1251.5	1007.2	849.5	716.8	572.5	437.1	7509
Mean	500.26	550.5	696.4	807.94	1132.1	925.76	770.42	631.06	502.1	382.46	6899

*Standard meteorological weeks
**16 PAU Fruit fly traps per 0.40 ha

Table 2. Impact of PAU Fruit fly traps on percent fruit infestation, marketable fruits and yield parameters in guava orchards

Year (2023 & 2024)	Per cent fruit infestation		Marketable fruits (number)		Mean fruit yield/tree (kg/tree)		Yield (q/ha)	
Blocks	Control	*DP	Control	DP	Control	DP	Control	DP
Nadala	62.67	23.17	218.0	376.5	37.53	55.0	17.08	27.32
Subhanpur	59.25	18.06	227.0	358.0	42.58	62.05	19.96	28.61
Mand Dhillwan	60.59	28.26	224.0	362.5	37.54	65.5	17.37	22.92
Mand Kuka	50.33	16.13	214.5	365.0	32.4	55.5	16.61	27.66
Feroz Sangowal	45.51	16.86	226.0	348.0	38.97	50.95	18.02	27.95
Average	55.67	20.49	222.0	362.0	37.80	57.8	17.81	26.89

*Demonstrated practice

week of July in order to obtain a higher number of marketable fruits. The cumulated mean yield was again highest (26.89 q/ha) in technology demonstrated orchards in comparison to untreated control (17.81 q/ha). The present study is further strongly supported with the findings of Kaur et al (2016) and Sharma et al (2022) where maximum number of marketable fruits/tree and mean fruit yield was observed in orchards having PAU Fruit Fly Traps as compared to untreated plots.

CONCLUSIONS

The fruit flies cause significant damage to guava fruits. Use of chemical insecticides for its control is costly as well as usually ineffective also. The demonstrated technology of PAU fruit fly traps is highly effective, especially when installed @ 16 traps per 0.40 ha in the first week of July, during the pre-oviposition stage. Use of these pheromone traps, along with integrated management strategies such as collection and burying infested and fallen fruits, tillage around the trees in the fields during summer, proved a very effective approach. Regular monitoring and analysis during the growing season showed a clear reduction in infestation rates also demonstrating the effectiveness of PAU fruit fly traps. This eco-friendly technology also offers several advantages; lower labour costs, affordability, safety compared to chemical insecticides, residue-free fruits, and no adverse effects on natural enemies, human health, and the environment. Hence, to achieve fruit fly suppression on a large scale, there should be more emphasis on promotion and adoption of 'PAU Fruit Fly Traps by creating mass awareness among the large number of fruit growers by demonstrating this technology.

AUTHORS' CONTRIBUTION

Dr Suman Kumari conducted the research work, analyzed the data; Dr Harinder Singh provided critical feedback and revised the manuscript and Dr Sandeep Singh helped in planning the experimentation and drafting the manuscript. All authors read, provided critical feedback, and approved the manuscript.

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