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Management of fruit flies (*Bactrocera* spp.) in guava (*Psidium guajava*) by pheromone traps

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ABSTRACT

Guava (*Psidium guajava* L.) is one of the most important commercial fruits grown in Punjab. Fruit flies (*Bactrocera* spp.) (Diptera: Tephritidae) are considered the key insect pest of guava causing yield losses and quality degradation during rainy season and thus decreasing fruit production. The present studies emphasis on ecofriendly management of fruitflies using the methyl eugenol pheromone traps (PAU traps) during 2017 and 2018. Fruit flies analysis by traps installation in guava orchard characterized high population of fruit flies (24.8–760.9) captured per trap per week (pooled mean of two years) in July to September. Population of fruit fly increased rapidly reaching its peak with weekly trap catches of 801.5 and 720.4 fruit flies/trap/week during the second week of August (32nd SMW) during 2017 and 2018 respectively, when the trees were at the maximum fruiting period. Maximum fruit infestation in control was observed in 34th and 35th SMW, i.e 67 and 81% as compared to 45 and 48% in treatment. The marketable fruits/tree was 96 and 85 fruits/tree in treated plots as compared to 52 and 47 fruits/tree in untreated plots during 2017 and 2018 respectively. Mean fruit yield was 15.4 kg/tree and 12.6 kg/tree in treatment as compared to control with 8.8 kg/tree and 8.1 kg/tree during 2017 and 2019 respectively. There was significant increase in number of marketable fruits/tree and fruit yield. The results clearly depict that fruit fly traps offer one of the most effective method for the management of fruit flies especially in the rainy season.

Keywords: Fruit flies, Guava, Methyl eugenol, Traps

In Punjab guava (*Psidium guajava* L.) crop occupies 9.730 thousand hectares area with yield of 22596 kg/ha and productivity of 219.850 thousand metric tonnes (Anonymous 2021). Guava bears the fruiting in the rainy, spring and winter season but rainy season crop is deteriorated with the infestation of several insect pests from time to time, however, guava fruit flies, *Bactrocera* spp., viz. *Bactrocera dorsalis* and *Bactrocera zonata* are the major limiting factors in successful cultivation causing almost 100% damage to rainy season guava crop (Singh and Sharma 2013) as it is the most preferred host of fruit flies. Fruit loss varies from a 10–100% depending on fruit flies population, locality, variety and season (David and Ramani 2011, Kumar *et al.* 2011). Female fruit flies lay eggs under the skin of the fruit and infested fruits start rotting and become inedible or drop on the ground, thus causing direct loss to the farmer. High fecundity, polyhagous in nature, multivoltine, maggots protected in host tissue and high adult mobility, leads to ineffective management of fruit flies.

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In present scenario, there is need for pesticide free fruits, which has turned attention to alternative control methods like use of trapping system, i.e use of eco-friendly strategies for management of insect-pest. The most widely used technique of this kind is male annihilation technique (MAT) where methyl eugenol, a para-pheromone is used together with an insecticide impregnated into a suitable substrate ((Singh and Sharma 2012, Singh and Sharma 2013, Rizk *et al*. 2014). This technique has been successfully used for the management of several *Bactrocera* species (Singh *et al*. 2015, Bajaj and Singh 2018). Keeping this in view studies were conducted to manage fruit flies infestation in guava in submontaneous region of Punjab using methyl eugenol based fruit flies traps designated as PAU Fruit fly traps. The objective of this study was to assess number of fruit flies trapped, the % fruit infestation, number of marketable fruits and its effect on yield.

MATERIALS AND METHODS

The studies on monitoring and management of fruit flies by methyl eugenol baited pheromone traps (PAU Fruit Fly traps) in guava were carried out at Regional Research Station, Ballowal Saunkhri, District SBS Nagar, Punjab during 2017 and 2018. Sixteen traps were fixed at equal distance per acre along with an untreated control area.

These traps were fixed in the first week of the July till end-September when the fruit harvesting was over. Fruit flies trapped/trap were collected at weekly interval and counted in laboratory. From both the treatments (16 traps/per acre and control), a sample of 50 fruits at random/treatment collected at weekly interval were sorted out as infested (based on the oviposition punctures), maggots emerging out of fruits, fallen fruits and healthy fruits. Impact of traps on the number of marketable fruits was also assessed by counting number of marketable fruits from five trees (Sandeep *et al*. 2014).

RESULTS AND DISCUSSION

Population of fruit flies trapped in fruit traps: The present study was conducted in the Dr D R Bhumbla Regional Research Station at Ballowal Saunkhri, District SBS Nagar, Punjab during rainy season crop in 2017 and 2018 using PAU fruit fly traps. The incidence of fruit fly, *Bactrocera dorsalis* commenced from 2nd week of July both in 2017 and 2018 (28th SMW) at the time of fruit set stage. Results revealed that mean catches of 98.5 and 92.8 fruit flies/trap/week was observed during 2017 and 2018 respectively in 28th SMW (Table 1). Thereafter the population increased rapidly reaching its peak with weekly mean trap catches of 801.5 and 720.4 fruit flies/trap/week during the second week of August (32nd SMW) during 2017 and 2018 respectively, when the trees was at the maximum fruiting period. Thereafter, the trap catches of fruit fly declined gradually and the lowest mean trap catches of 22.8 and 26.8 fruit flies/trap/week during the last week of September (38th standard week) when the crop was to be last harvested (Table I). Population monitoring of any pest species is a prime requisite to understand the behaviour of pests in different cropping stages for developing effective management strategies so that they can be controlled before reaching peak population.

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 (Fig 1). 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. 31 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 last harvested. These results agree with the findings of Fazlullah *et al.* (2015) who observed that fruit fly population was maximum before ripening of fruit and afterwards decreased towards the end of the cropping season. Our studies are in line with Vignesh *et al.* (2020) who reported that population of guava fruit flies, *B. correcta* and *B. dorsalis* in guava orchards showed a distinct population peak, which coincided with the fruit ripening and was recorded in August (110 fruit flies /trap). The documentation of maximum activity by Kumar *et al.* (2018) from the mid of July (407 fruit flies/10 traps) to August (698 fruit flies/10 traps) with respect to *B. dorsalis* in Uttar Pradesh in mango that strengthens the current record. Hence, the results clearly indicated and confirmed that activity of fruit flies was maximum in the month of July to August in guava ecosystem irrespective of its species complex. Vargas *et al*. (2015) also reported the maximum infestation (17.18–34.56%) of *B. zonata* on guava in September which are at par with our studies. Math *et al.* (2018) reported the first major peak population (80.25 flies per trap/week) during 27th SMW in guava and first major peak (71.50 fruit flies/trap/week) was observed during 29th SMW which are in close relation to our findings. The results are in accordance with Khosravi *et al*. (2018) and Sumathi *et al*. (2019) who revealed that combination of methyl eugenol and malathion attracted the male mango fruit flies and hence mating would be disrupted and reduce fruit flies populations to very low levels effectively. Our studies are in line with Bajaj and Singh (2018) who reported that PAU fruit flies traps captured significantly more population when compared with other traps like cylindrical spherical traps in guava.

Fruit infestation %: Data on % infested fruits revealed that the fruits infested with fruit flies were 1 % in treatment as compared to 7% in untreated orchard (Table 2) during 28th SMW when fruit flies traps were installed in the orchards in 2017 while it was 3% as compared to 10% in untreated orchard during 2018. Pooled mean data of two years data on % fruit infested revealed that impact of captured male fruit flies on infestation of fruits indicated that first fruit infestation was observed in 28th SMW (Table 2) when 2% infestation was recorded in PAU fruit fly traps orchards and 8.5% infestation was recorded in untreated control when the fruits were near colour break stage. As the season progressed (with the initiation of colour break stage on fruits and later on with the onset of maturity of the fruits),

Table 1 Population of fruit flies captured on guava using fruit fly traps (16 traps/acre) during 2017 and 2018 at RRS, Ballowal Saunkhri

	Total fruit flies males/trap/week*										
Year	SMW* 28	SMW 29	SMW 30	SMW 31	SMW 32	SMW 33	SMW 34	SMW 35	SMW 36	SMW 37	SMW 38
2017	98.5	223.5	386.5	570.5	801.5	212.1	169.6	93.4	77.9	42.8	22.8
2018	92.8	207.4	379.9	604.1	720.4	218.9	198.0	81.0	73.3	37.3	26.8
Pooled mean	95.6	215.5	383.2	587.3	760.9	215.5	183.8	87.2	75.6	40.0	24.8

*Standard Meteorological Weeks

Table 2 Percent fruit flies infested fruits, quality of marketable fruits and yield of guava using fruit fly traps during 2017 and 2018

Year	Treatment (Traps/ acre)	% infested fruits*											No. of marke-table fruits/ tree	Fruit yield (kg/ tree)	Yield/ acre (MT)
		July 11-17	July 18-24	July 25- 31	Aug 1-7	Aug 8-14	Aug 15-21	Aug 22-29	Aug 30 to Sept 5	Sept 6-13	Sept 14-21	Sept 22-30			
		SMW 28	SMW 29	SMW 30	SMW 31	SMW 32	SMW 33	SMW 34	SMW 35	SMW 36	SMW 37	SMW 38			
2017	16	1	4	19	20	29	38	42	50	40	34	24	102	15.4	1.28
	Control	7	19	34	38	48	64	72	82	64	48	38	52	8.8	0.79
2018	16	3	6	14	26	36	42	48	46	37	28	20	86	12.6	1.15
	Control	10	21	30	44	58	70	78	80	74	52	34	47	8.1	0.74
Pooled mean	16	2	5	16.5	23	32.5	40	45	48	38.5	31	22	92	13.6	1.22
	Control	8.5	20	32	41	53	67	75	81	69	50	36	47	7.8	0.71
$t_{.995}(0.01)$		NS	S*	NS	S*	S**	S*	S**	S*	S**	S*	S*	S*	S**	S*

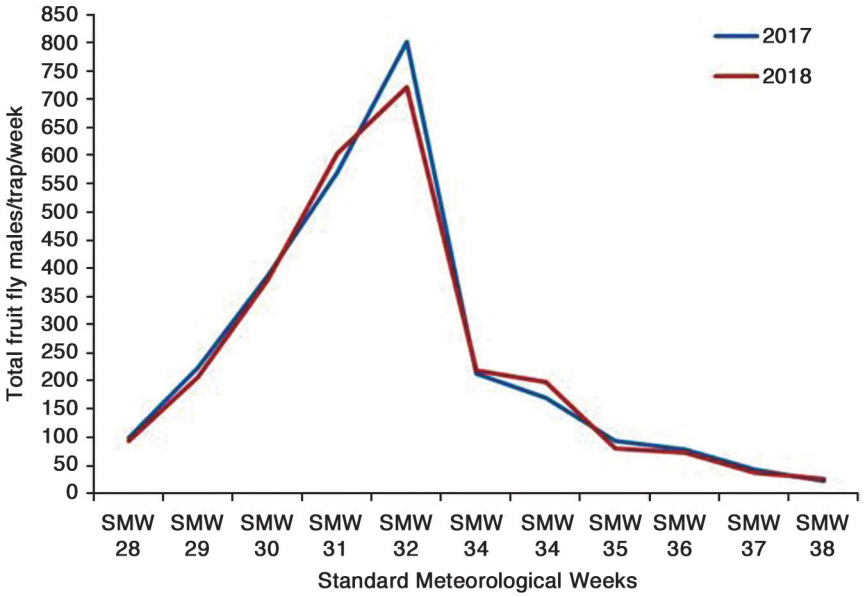

Fig 1 Population fluctuation of fruit flies on guava monitored using fruit fly traps during 2017 and 2018 at RRS, Ballowal Saunkhri.

the % infested fruits in treatment with PAU fruit fly traps showed the progressive increase till 35th SMW and started decreasing after 36th SMW. While for untreated control, mean of weekly data of two years observations showed that there was significant increase in % fruit infestation from 29th SMW (20%) till the crop was harvested in 38th SMW (36%). Maximum fruit infestation in control was observed in 34th and 35th SMW, i.e 67 and 81%. So, there was significant reduction in % infested fruits in treatment as compared to control. The number of marketable fruits/tree was 96 fruits/tree in treated orchards where 16 traps/acre were fixed as compared to 52 fruits/tree in untreated plots during 2017 and the results follow same pattern in 2018 with 85 fruits/tree in treated orchards where 16 traps/acre were fixed as compared to 47 fruits/tree in untreated plots (Table 2). There was significant increase in number of marketable fruits/tree and fruit yield. Mean fruit yield was 15.4 kg/tree and 12.6 kg/tree in treatment as compared to control with 8.8 kg/tree and 8.1 kg/tree during 2017 and 2018 respectively. These results are in agreement with studies conducted by Kaur *et al*. (2016) who reported that 25.4% infested fruits in guava orchards fixed with fruit fly traps as compared to 81.3% in control. Similarily maximum fruit number of marketable fruits in these treated orchards was 1203 fruits/ tree as compared to 721 in untreated plots.

From the above description, it is clear that fruit fly traps offer one of the most effective methods for the management of fruit flies especially in the preoviposition stage. An integrated approach can be adopted for the management of fruit flies that including cultural practices such as collection and deep burying of infested and fallen fruits, tillage around the trees in the fields in summer along with fruit fly traps. This eco-friendly approach have great advantages as it requires less labour cost, cheap and safe as compared to chemical insecticides, insecticide residue free fruits and has no harmful effect on natural enemies, human health and environment.

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