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Eco-friendly Management of Guava Fruit Fly, *Bactrocera* spp.

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ABSTRACT: Studies were carried out on rainy season guava crop at farmer's field in village Sunderpur, District Rohtak, Haryana to test various management strategies *i.e.* methyl eugenol traps @ 40 traps ha^{-1} alone and in combination with sprays of NSKE 5%, mulching with black polythene sheet, raking under tree canopy twice, collection and destruction of dropped fruits on alternate days against guava fruit fly, *Bactrocera* spp. The highest overall reduction in fruit infestation over untreated control ranged from 18.08 to 39.97 and 12.43 to 41.45 per cent on number and weight basis, respectively in the management strategy having methyl eugenol traps and 3 sprays of neem seed kernel extract 5%. There was an increase of 175.33% in marketable yield of guava over control where as the highest total marketable yield and net profit were recorded as 95.76 q ha^{-1} and Rs.65674 ha^{-1}, respectively. Among all the management strategies, two sprays of neem seed kernel extract alone proved to be the least effective in managing guava fruit fly.

Keywords: Guava, Fruit fly, *Bactrocera* spp., Methyl eugenol, traps, NSKE.

INTRODUCTION

Guava is an important commercial fruit crop. It is successfully grown under both tropical and subtropical climates. It is commonly called a poor man's apple in the tropics and known for its delicious, pleasant aroma and outstanding nutritional values throughout the world. It is highly rich in minerals like phosphorus and calcium. In India, it occupies an area of 276 thousand ha with a production of 4253 thousand Mt (Anonymous, 2020).

Different biotic and abiotic factors are responsible for low yields of guava. Out of biotic ones, the insect-pests have been reported to attack guava at different stages particularly during rainy season crop. It is infested by around 80 species of insect pests like fruit flies, bark eating caterpillar, capsule borer, mealy bug, hairy caterpillar and many sucking pests, out of which fruit fly is the major one causing a heavy loss in the yield (Butani, 1979; Tandon and Verghese, 1987; Verghese and Sudhadevi, 1998; Singh *et al.*, 2003; Rajitha and Viraktamath, 2005; Atwal and Dhaliwal, 2009). Fruit flies belong to the family Tephritidae which is one of the largest, most diversified families of order Diptera.

In India, 392 species of fruit flies have been recorded (Kapoor, 1993). From economic point of view, fruit flies, *Bactrocera dorsalis* (Hendel) and *Bactrocera zonata* (Saunders) are highly destructive pests of peach, pear, guava and kinnow mandarin causing up to 80, 70, 100 and 60 to 80 per cent fruit infestation, respectively depending on population, locality, variety and season (Kumar *et al.*, 2011; Sharma *et al.*, 2011; Bajaj and Singh 2020).

In general, fruit flies are very difficult to manage due to the fact that they are polyphagous, multivoltine, adults have high mobility and fecundity, and all the developmental stages are unexposed (Vargas *et al.*, 2010, Kumar and Agarwal, 1998). Farmers use a variety of chemical insecticides for the management of fruit fly in guava. Most of the insecticidal treatments are ineffective to control fruit fly since eggs and maggots remain protected in the host tissues and only adults are exposed. Moreover, the use of chemical insecticides causes residue problems. So, there is strong need for integrated pest management practices (Vargas *et al.*, 2008; Verghese *et al.*, 2004).

As an alternate strategy, methyl eugenol traps can be used for male annihilation technique (MAT) for the management of *Bactrocera* spp. (White and Elson Harris, 1992; Bhowmik *et al.*, 2015; Singh *et al.*, 2015). Methyl eugenol traps have been standardized by different institutes, but this technique is still less exploited in India. Fruit flies can be controlled over local area upto some extent by fruit bagging, field

sanitation, protein bait, annihilation technique, growing fly resistant genotypes, augmentation of biological control, incorporation of neem seed kernel extract and insecticides (Akhtaruzzaman *et al.*, 1999; Singh *et al.*, 2003; Dhillon *et al.*, 2005). Therefore, in the present studies, methyl eugenol traps in combination with other eco-friendly approaches were evaluated for the management of fruit fly in guava.

MATERIALS AND METHODS

The studies were carried out at farmer's field in village Sunderpur, District Rohtak, Haryana during rainy season of 2016-17. The methyl eugenol traps were purchased from PAU, Ludhiana and fixed with the 7 year old guava trees var. Hisar Safeda at equidistance from each other @40 traps ha^{-1} in the last week of May. The following eco-friendly management strategies were evaluated against *Bactrocera* spp.

Eco-friendly management strategies

S1: PAU Methyl eugenol trap @40 traps ha^{-1}

S2: S1+3 sprays of Neem Seed Kernel Extract (NSKE) 5% (1^{st} spray in last week of June, subsequent sprays at 15 days interval)

S3: S1+2 sprays of NSKE 5% (1^{st} spray in last week of June and 2^{nd} at 15 days interval)

S4: S1+1 spray of NSKE 5% in last week of June

S5: S1+Mulching (Black polythene sheet) under tree canopy

S6: S1+Raking under tree canopy twice (1^{st} at 1^{st} fortnight of June and 2^{nd} at 2^{nd} fortnight of June)

S7: S1 + Collection and destruction of dropped fruits on alternate days

S8: 3 sprays of NSKE 5% (1^{st} spray in last week of June, subsequent sprays at 15 days interval).

S9: 2 sprays of NSKE 5% (1^{st} spray in last week of June and 2^{nd} at 15 days interval)

S10: Untreated control

S8, S9 and S10 were laid out at an isolation distance of 300 m from other strategies (S1 to S7) so as to avoid the effect of methyl eugenol trap. The experiment was laid out in Randomised Block Design in 3 replications (1 tree replication^{-1}).The fallen fruits (infested by fruit flies) were collected and destroyed on alternate days by burying them into soil at faraway place so as to prevent multiplication of fruit fly population. The fruit fly catches were collected and removed from the traps every week.

Recording of observations:

a) Fruit infestation. For this, a sample of 10 fruits at random were collected at weekly interval from each replication during 31^{st} to 36^{th} Standard Meteorological Week. The infested (based on oviposition puncture) and healthy fruits were counted and weighed separately. The fruit infestation on number and weight basis were calculated by using formula given by Abott (1925).

$$\% \text{ of fruit damage (number basis)} = \frac{\text{Number of damaged fruits}}{\text{Total number of fruits (damaged+healthy)}} \times 100$$

$$\% \text{ of fruit damage (weight basis)} = \frac{\text{Weight of damaged fruits}}{\text{Total weight of fruits (damaged+healthy)}} \times 100$$

b) Marketable yield. Reduction in yield due to fruit fly damage was worked out by using data on per cent fruit damage on weight basis recorded at weekly interval during crop season

Marketable yield = Total yield – Reduction in yield

c) Benefit cost ratio

Benefit cost ratio of each management strategy was worked out by using the following formula

$$\text{Benefit cost ratio} = \frac{\text{Value of increased yield (Rs)}}{\text{Total cost incurred on management strategy(Rs)}}$$

Statistical analysis of data. The obtained data were statistically analyzed using angular root transformation wherever needed.

RESULTS AND DISCUSSION

Fruit infestation due to guava fruit fly, *Bactrocera* spp. On the basis of effects of different management strategies against guava fruit fly *Bactrocera* spp. on guava crop, it is evident that strategy S2 (methyl eugenol traps + 3 sprays of NSKE 5%) was most effective among all the strategies (Table 1). There was minimum fruit infestation in S2 *i.e.* 38.33 and 35.82 per cent both on number and weight basis, respectively and that was at par with strategy S3 (methyl eugenol traps + two spray of NSKE 5%) *i.e.* 47.77 and 44.87 per cent both on number and weight basis, respectively. In rest of the management strategies, S1, S4, S5, S6, S7 and S8, the fruit infestation varied from 54.44 to 57.78 per cent and 49.27 to 54.81 per cent on number and weight basis, respectively. The management strategy S9 was found to be the least effective as there was high infestation *i.e.* 64.44 and 65.04 per cent on number and weight basis, respectively which was at par with untreated control (75.04 % and 72.32% on number and weight basis, respectively).

Table 1: Effect of various management strategies on fruit infestation against *Bactrocera* spp. on guava.

Strategy (S)	Fruit infestation (%)		Reduction in infestation over control (%)	
	Number basis	Weight basis	Number basis	Weight basis
S1	57.78 (49.61)^{bc}	52.72 (47.19)^{b}	25.66	23.52
S2	38.33 (38.50)^{a}	35.82 (36.40)^{a}	39.97	41.45
S3	47.77 (44.30)^{ab}	44.87 (41.91)^{ab}	33.20	34.61
S4	54.44 (48.91)^{bc}	49.27 (44.54)^{b}	28.50	27.88
S5	55.00 (48.92)^{bc}	51.87 (46.18)^{b}	27.85	25.95
S6	57.77 (50.25)^{bc}	52.10 (46.26)^{b}	26.43	24.78
S7	55.62 (49.39)^{bc}	46.68 (44.32)^{b}	25.75	26.22
S8	57.22 (50.22)^{bc}	54.81 (47.74)^{b}	22.93	20.22
S9	64.44 (54.88)^{cd}	65.04 (54.04)^{c}	18.08	12.43
S10 (Untreated control)	75.04 (60.07)^{d}	72.32 (58.16)^{c}	-	-
SE(m)	2.31	1.99		
C.D.(p=0.05)	(6.91)	(5.97)		

Figures in parentheses are arc sin angular transformed values
Figures with same letter are non significant

Under different management strategies the highest reduction in fruit fly infestation over untreated control in guava was recorded in S2 (methyl eugenol + three sprays of NSKE 5%) *i.e.* 39.97 and 41.45 per cent both on number and weight basis, respectively followed by S3 (methyl eugenol +two spray of NSKE 5%). The other management strategies S1, S4, S5, S6 and S7 were having almost similar reduction in percentage infestation. The management strategy S9 (two sprays of NSKE 5%) was found to be the least effective as it was having only 18.08 and 12.43 per cent reduction in infestation both on number and weight basis respectively.

Marketable yield of guava under different management strategies. The data presented in Table 2 indicated that the highest marketable yield of guava (95.76 q ha^{-1}) was recorded in S2 during rainy season as against 34.78 q ha^{-1}in untreated control. In the remaining management strategies, the marketable yield ranged from 44.92 to 78.36 q ha^{-1} being lowest in S9. In S2, there was an increase of 175.33 per cent in marketable yield of guava over untreated control followed by S3 (125.3%) whereas minimum increase in marketable yield over control was obtained in S9 (29.15%). There was not much difference in total marketable yield in remaining management strategies *i.e.* S1, S4, S5, S6, S7 and S8. On the basis of increase in marketable yield of guava over untreated control, the efficacy of various management strategies in descending order was S2, S3, S7, S4, S5, S6, S1, S8 and S9.

Table 2: Effect of different management strategies against fruit fly, *Bactrocera* spp. on productivity of guava.

Strategy (S)	Total yield (q ha^{-1})	Marketable yield (q ha^{-1})	Increase in marketable Yield over control (%)
S1	130.35	64.98	86.83
S2	149.21	95.76	175.33
S3	142.14	78.36	125.30
S4	137.25	69.63	100.20
S5	138.16	66.50	91.20
S6	133.60	65.27	87.55
S7	127.56	71.53	105.66
S8	138.16	62.43	79.49
S9	128.50	44.92	29.15
S10 (Untreated control)	125.66	34.78	-
SE (m)		3.94	
C.D.(p=0.05)		(11.82)	

Economics of different management strategies. The data presented in Table 3 indicated the economics of different management strategies against *Bactrocera* spp. during rainy season. The highest net profit (Rs. 65674 ha^{-1}) was obtained in S2 (methyl eugenol traps + 3 sprays of NSKE 5%) followed by S3 (methyl eugenol + two sprays of NSKE 5%) *i.e.* Rs. 44173 ha^{-1}. The total cost incurred on management strategy was found to be almost similar in S2 and S5 (methyl eugenol traps + mulching under tree canopy) but S5 proved to be the least effective strategy showing minimum net profit (Rs. 21611 ha^{-1}). On the basis of net profit, different management strategies were placed in descending order as S2, S3, S7, S4, S1, S6, S8, S5, S9. The highest BCR (3.78) was found in S1 obviously because of less total plant protection cost (Rs.12000 ha^{-1}) incurred on management of fruit fly.

Table 3: Economics of different management strategies against *Bactrocera* spp. *on* guava.

Strategy (S)	No. of spray	Cost of Traps (Rs ha^{-1})	Cost of NSKE 5% (Rs ha^{-1})	Cost of mulching (Rs ha^{-1})	Labour Cost (Rs ha^{-1})	Total Cost (Rs ha^{-1})	Marketable Yield (q ha^{-1})	Increased Yield (q ha^{-1})	Value of increased yield (Rs ha^{-1})	Net profit (Rs ha^{-1})	BCR
S1	-	12000	-	-	-	12000	64.98	30.20	45302	33302	3.78
S2	3	12000	10800		3000	25800	95.76	60.98	91474	65674	3.55
S3	2	12000	7200	-	2000	21200	78.36	43.58	65373	44173	3.08
S4	1	12000	3600	-	1000	16600	69.63	34.85	52270	35670	3.15
S5	-	12000	-	12464	1500	25964	66.50	31.72	47575	21611	1.83
S6	-	12000	-	-	1500	13500	65.23	29.21	43822	30322	3.25
S7	-	12000	-	-	8400	20400	71.53	36.75	55123	36723	2.70
S8	3	-	10800	-	3000	13800	62.43	27.65	41482	27682	3.01
S9	2	-	7200	-	2000	9200	44.92	10.14	15215	6015	1.65
S10 (Untreated Control)	-	-	-	-	-		34.78	-	-	-	-

Cost of plant protection:
Methyl eugenol traps -Rs100 trap^{-1}, Neem Seed Kernel - Rs.100 kg^{-1}, Black polythene mulching sheet –Rs.45.32 tree^{-1}, Cost of labor Rs.1000 day^{-1}.
Average Market value of guava fruit = Rs. 1500 q^{-1}.

The results of present studies on evaluation of methyl eugenol trap based eco-friendly management strategies against *Bactrocera* spp. in rainy season guava crop indicated that all the strategies were found better than untreated control. The strategy S2 (methyl eugenol traps+3 spray of NSKE 5%) was found best among all the strategies in all respect. The present findings are strongly in agreement with the studies conducted by Bhowmik *et al*. (2015); Shivendra and Singh (1998).

CONCLUSION

It can be concluded from the present study that among all the management strategies, S2 (methyl eugenol traps + three sprays of NSKE 5%) proved most effective against guava fruit fly, *Bactrocera* spp. as it was having lowest fruit infestation (38.33 and 35.82 per cent both on number and weight basis, respectively), highest marketable yield (95.76 q/ha) and maximum net profit (Rs. 65674/ha).

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Conflict of Interest. None.

REFERENCES

Abott, W. S. (1925). A method of computing the effectiveness of insecticide. *Journal of Economic Entomology, 18*: 265-267.

Akhtaruzzaman, M., Alam, M. Z. and Ali-Sardar, M. M. (1999). Suppressing fruit fly infestation by bagging cucumber at different days after anthesis. *Bangladesh Journal of Entomology, 9*: 103-112.

Anonymous (2020). Area and production of horticultural crops, 2018-19. Pocket Book of Agricultural Statistics. Ministry of Agriculture & Farmers Welfare, Government of India, p. 36.

Atwal, A. S. and Dhaliwal, G. S. (2009). Agricultural pests of South Asia and their management. Kalyani Publishers, p. 380.

Bajaj, K. and Singh, S. (2020). Preference of *Bactrocera* spp. to methyl eugenol based different coloured traps. *Indian Journal of Agricultural Sciences, 90*(1): 233-235.

Bhowmik, P., Mandal, D. and Chatterjee, M. L. (2015). *Bactrocera dorsalis* (Diptera: Tephritidae) management through lure and kill traps. *Indian Journal of Entomology, 77*: 39-44.

Butani, D. K. (1979). Insects and Fruits. Periodical Expert Book Agency, New Delhi, p.55.

Dhillon, M. K., Singh, R., Naresh, J. S. and Sharma, H. C. (2005). The melon fruit fly, *Bactrocera cucurbitae*: A review of its biology and management. *Journal of Insect Science, 5*(40): 1-16.

Kapoor, V. C. (1993). Indian Fruit Flies. Oxford and IBH Publishing Company, New Delhi, pp.80-91.

Kumar, P., Abubakar, Linda, A., Ketelaar, J. W. and Shanmugam, V. (2011). Fruit fly Damage and Crop Losses. In: Field Exercise guide on Fruit Flies Integrated Pest Management, Asian Fruit fly IPM Project, Bangkok, Thailand, p.17.

Kumar, V. and Agarwal, M. L. (1998). Efficacies of different bait combinations against oriental fruit fly, *Bactrocera dorsalis* (Hendel). *Journal of Research, Birsa*

Agricultural University, 10: 83-86.
Rajitha, A. R. and Viraktamath, S. (2005). Evaluation of protein food baits in attracting female fruits flies in guava and mango orchards. *Pest Management in Horticultural Ecosystems, 11*(1): 1-5.
Sharma, D. R., Singh, S., Aulakh, P. S. (2011). Management of Fruit Flies in Fruit Crops. *Indian Journal of Horticulture, 70*(4): 512-518.
Shivendra, S. and Singh, R. P. (1998). Neem (*Azadiracta indica*) seed kernel extracts and azadirachtin as oviposition deterrents against the melon fly (*Bactrocera cucurbitae*) and the oriental fruit fly (Bactrocera dorsalis*). Phytoparasitica, 26*(3): 191–197.
Singh, G., Misra, A. K., Masarrat, H., Tandon, D. K. and Pathak, R. K. (2003). The Guava. Central Institute of Subtropical Horticulture, Lucknow, p. 38.
Singh, S., Sharma, D. R. and Kular, J. S. (2015). Eco-friendly management of fruit flies. *Bactrocera* spp. in peach with methyl eugenol traps in Punjab. *Agricultural Research Journal, 52*: 47–49.
Tandon, P. L. and Verghese, V. A. (1987). New Insect Pest of certain crops. *Indian Journal of Horticulture, 44*(1-2): 121-122.
Vargas, R. I., Pinero, J. C., Mau, R. F. L., Jang, E. B., Klungness, L. M., McInnis, D. O., Harris, E. B., McQuate, G. T., Bautista, R.C. and Wong, L. (2010). Area-wide suppression of the Mediterranean fruit fly, *Ceratitis capitata* and the Oriental fruit fly, Bactrocera dorsalis in Kamuela, Hawaii. *Journal of Insect Science, 10*: 135.
Vargas, R. I., Stark, J. D., Hertlein, M., Neto, A. M., Coler, R. and Pinero, J. C. (2008). Evaluation of SPLAT with spinosad and methyl eugenol or cue-lure for 'attract-and-kill' of Oriental and melon fruit flies (Diptera: Tephritidae) in Hawaii. *Journal of Economic Entomology, 101*(3): 759-768.
Verghese, A. and Sudhadevi, K., (1998). Relation between trap catches of *Bactrocera dorsalis* (Hendel) and abiotic factors. In: Reddy, Krishna P. P., Kumar, N. K., and Verghese, A. (Eds.), Advancement in IPM for Horticultural Crops. Proceeding of First National Symposium on Pest Management in Horticultural Crops, Bangalore, India, pp. 15-18.
Verghese, A., Tandon, P. L. and Stonehouse, J. M. (2004). Economic evaluation of the integrated management of the oriental fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae) in mango in India. *Crop Protection, 23*: 61-63.
White, I. and Elson Harris, M. M. (1992). Fruit flies of Economic Significance: Their identification and bionomics. CAB international with Australian Center of Agriculture Research, Australia, p. 601.

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