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Assessment of avoidable yield losses in bitter gourd due to melon fruit fly, *Bactrocera cucurbitae* (Coquillett)

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Abstract
The estimation of crop losses is essential for the scheduling of integrated management tactics as it helps to determine priorities on the basis of relative importance of pests. Cucurbits, the most economically nutritious crops, suffer a quiet high damage by fruit flies. Therefore, the current investigation was carried out to estimate the avoidable yield losses due to melon fruit fly, *Bactrocera cucurbitae* in the bitter gourd variety 'Pusa Do Mausami'. The study was conducted at Experimental Area, Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar during *Kharif* 2019. The results revealed significant differences in the yields of treated (Malathion 50% EC@ 2 ml + jaggery @ 3 g/litre water) and untreated plots. The average yield of bitter gourd in the untreated plots was 1.57 fold less (53.72 q/ha) compared with 84.24 q/ha for the treated plots. The calculated avoidable yield loss due to *B. cucurbitae* was 36.24 per cent in bitter gourd.

Keywords: *Bactrocera cucurbitae*, avoidable yield losses, bitter gourd, malathion

Introduction
In the agro-ecosystems, sustainable agriculture can indefinitely meet the demands for food and fibre at socially acceptable, economic and environment cost. Ultimately, the aim is to develop farming systems that are productive and profitable, conserve the natural resources, protect the environment, and enhance health and safety for a long period of time. Considering these objectives, Integrated Pest Management could be the key for each agro-ecological zone to achieve full yield potential. To schedule the integrated management tactics, information on crop losses is must which determines the relative importance of pests.

Among the cucurbitaceous vegetables, bitter gourd (*Momordica charantia* L.) is one of the most important and well known vegetable crops cultivated all around the globe. It is a cross-pollinated annual, tropical and subtropical vine with inexplicable medical advantages, about the treatment of diabetes [6], dysentery, gout and rheumatism [15] and prevention of breast cancer [11]. It is laxative and consumption imparts heating and wormicidal power to the human body. In India, it is cultivated over an area of 99,000 ha with the production of 12.05 lakh MT and productivity of 12.17 MT/ha [2].

More than a dozen insect pests have been reported to cause varying degrees of damage to bitter gourd crop [16] among which melon fruit fly, (*Bactrocera cucurbitae* Coquillett) has been reported as the key pest. The two major species, *B. cucurbitae* and *B. tau* (Walker) cause a heavy infestation in cucurbits, the former being a major threat [5]. About 81 cucurbitaceous vegetables have been reported to get attacked by *B. cucurbitae*, especially bitter gourd, bottle gourd, snake gourd, musk melon, snap melon, ridge gourd and cucumber [3].

The gravid females of *B. cucurbitae* puncture the soft and tender fruits by their sharp ovipositor to lay eggs in fruit tissues and watery fluid oozes from the puncture. Sometimes fruits have also been accounted for punctures without egg (pseudo-punctures), which reduces the market value of the produce [9]. Soon after hatching, the maggots feed on the pulp of the fruits by making galleries and then lead to the secondary infection, resulting in rotting of fruits. The melon fruit fly, *B. cucurbitae* is reported to causes 30.0 to 100.0 per cent losses in cucurbits depending on the host species and season [4, 7] reported 95.0 per cent infestation in

the bitter gourd fruits in New Guinea while 60.0 to 87.0 per cent in pumpkin fruits and 90.0 per cent in snake gourd in the Solomon Islands. However, the fruit infestation of 31.3 and 28.6 per cent was recorded in bitter gourd and water melon, respectively in India by [14] in 2000. The tremendous increase in pest population during the fruiting stage causes detrimental effects on fruits; thereby making them unfit for consumption and reduce their marketability. Thus, it is necessary to assess the avoidable yield losses which may contribute towards the development of safe, economical and sustainable methods of pest management, as well as food security, for the future. Therefore, the present investigation was conducted to generate location specific information about the amount of damage inflicted on bitter gourd by *B. cucurbitae* which can be avoided using suitable management tactics.

Material and Methods

The field experiment for the estimation of avoidable losses was carried out at Experimental Area, Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar during *Kharif* 2019 using the variety 'Pusa Do Mausami' of bitter gourd. The experiment was laid out in twenty six plots of size 3 x 3 m^2 with a spacing of 150 x 45 cm^2 where two treatments *viz.* treated and untreated, were replicated thirteen times. The treated plots were sprayed with Malathion 50% EC @ 2 ml + jaggery @ 3 g/litre of water to prevent the losses caused by *B. cucurbitae*. Healthy and infested fruits were sorted out at each picking.

The yield from these plots was recorded and analysed statistically using the 'paired t' test. Avoidable losses were calculated as per [10] using the following formula:

$$\text{Avoidable yield loss } (\%) = \frac{T - C}{T} \times 100$$

Where,

T = yield of treated plots (q/ha)

C = yield of untreated/control plots (q/ha)

Results and Discussion

The results of the recent study estimated the avoidable yield losses caused by melon fruit fly which are presented in Table 1. It revealed the significant difference between the treated and untreated plots. The average yield of treated and untreated plots was recorded as 84.24 and 53.72 quintals per hectare (q/ha), respectively. The average mean yield difference among treated and untreated plots was recorded as 30.53q/ ha. Accordingly, the untreated plots fetched 1.57 times lower yield and the avoidable yield loss on the basis of difference in yield among treated and untreated plots was 36.24 per cent.

These results are in agreement with those of [1] who reported the yield loss of 35.48 and 37.16 per cent in bitter gourd and bottle gourd, respectively due to melon fruit fly and further revealed 1.55 and 1.58 fold increase in yield of bitter gourd and bottle gourd fruits in Malathion (0.1%) treated plots compared to untreated control plots. Congruous with the current findings [8], estimated the avoidable loss of 38.69 per cent in cucumber due to *B. cucurbitae*, when the plants were treated with Fenthion (0.1%) and Malathion (0.1%) alternatively starting from fruit formation to fruit maturity [12]. estimated the avoidable yield loss of 41.67% in cucumber due to the attack of *B. cucurbitae* when treated with Malathion (0.1%). Their findings also revealed that the yield in untreated plots was 1.71 times lower than the Malathion (0.1%) treated plots. From the findings of [5] it can also be concluded that the treatment of Malathion 50% EC + jaggery to bitter gourd plants against melon fruit fly accounted for 1.61 times more yield than untreated (control) plots [13]. Reported the highest per cent avoidable yield loss (49.02%) in cucumber treated with Spinosad 45SC.

Table 1: Avoidable yield loss caused by *Bactrocera cucurbitae* in bitter gourd during *Kharif* 2019

	Yield (q/ha)		Difference	Deviation from mean (d)	Square of deviation (d^2)	Value of T at 5% level of significance		Avoidable yield loss (%)
Replications	Treated	Untreated				Calculated	Tabulated	
1	86.14	53.64	32.50	-1.97	3.90	78.78*	1.78	36.24
2	81.37	51.62	29.75	0.78	0.60			
3	85.01	52.24	32.77	-2.24	5.03			
4	83.47	54.31	29.16	1.37	1.87			
5	84.82	54.31	30.51	0.02	0.00			
6	85.53	52.63	32.90	-2.37	5.64			
7	81.62	52.88	28.74	1.79	3.19			
8	86.54	56.49	30.05	0.48	0.23			
9	85.61	54.87	30.74	-0.21	0.05			
10	86.35	57.25	29.1	1.43	2.03			
11	84.96	54.78	30.18	0.35	0.12			
12	83.89	53.13	30.76	-0.23	0.05			
13	79.86	50.18	29.68	0.85	0.72			
	84.24	53.72	30.53		23.42			

Conclusion

In the present investigation, the bitter gourd crop (Pusa Do Mausami) suffered a significant reduction in yield due to the infestation of *B. cucurbitae*. The average yield of bitter gourd in the untreated plots was 1.57 folds less (53.72 q/ha) compared with 84.24q/ha for Malathion 50% EC @ 2 ml + jaggery @ 3 g/litre treated plots. A significant difference of 30.53q/ha was reported in treated and untreated conditions. The avoidable yield loss of 36.24 per cent was estimated in bitter gourd due to *B. cucurbitae*.

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