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Estimation losses due to fruit fly, *Bactrocera cucurbitae* (Coquillett) on long melon in semi-arid region of Rajasthan

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Abstract
Investigations on "Estimation of losses due to Fruit Fly, *Bactrocera cucurbitae* (Coquillett) on Long Melon in Semi-Arid Region of Rajasthan" were carried out at Rajasthan Agricultural Research Institute, SKNAU, Durgapura, Jaipur during 2017 and 2018. The incidence of fruit fly in treated plots with malathion, the mean fruit damage on number basis was 17.72 and 18.98 per cent, while in untreated plots it was 41.35 and 44.06 per cent during 2017 and 2018. Similarly, the mean fruit damage on weight basis was 14.87 and 15.88 per cent in treated plots, while it was 37.03 and 39.88 per cent in untreated plots during both the years

Keywords: fruit fly, malathion, long melon, fruits

1. Introduction
Long melon (*Cucumis melo* var. *utilissimus* Duthic and Fuller) belong to the family cucurbitaceae, commonly known as *Kakri*, is an annual vine trailing or climbing in habit. During the recent years, interest in vegetable production is increasing rapidly as a result of greater appreciation of the food value of vegetables and the in important place in the nation economy. *Kakri* is commercially cultivated in the Indo-Gangatic plains of North India as summer and rainy season crops, especially in Rajasthan, Punjab and Western U.P. India is the second largest vegetables producer in the world next to China. In Rajasthan, the area under the cultivation of long melon during 2016-17 was 2,240 hectare, with annual production of 10,193 Metric tonnes and productivity of 4,550 kg per hectare (National Horticulture Board, 2018).
There has been a challenge to achieve the target of 182 million tonnes of vegetables to fulfill the recommended requirement by 2020 and also their recommended requirement of 300 g per capita per day of vegetables for a balanced diet (ICMR). However, in the past three decades, India has made a quantum jump in vegetables production in the world. Cucurbits are important crops grown in almost all states of the India, but Rajasthan provides optimum agro climatic conditions for their cultivation.
Among these pests, the fruit fly, *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae) is the most serious constraint in long melon cultivation all over the country. The pest is active throughout the year except in severe cold. The adults of the fruit fly puncture the soft and tender fruits with their stout ovipositor and lay eggs below the rind of the fruits, after hatching the maggots bore into the ripening fruits begin to rot and drop thereby reducing the yield and quality. Depending on the environmental conditions and susceptibility of the crop species, the extent of losses varies between 30 to 100% (Dhillion *et al*., 2005) [5]. It prefers to infest young, soft skinned ovaries even before anthesis. When the humidity is high, intensity of cucurbit fruit fly damage becomes severe. Its abundance increases with increase in daily temperatures, however, higher than 31°C is not ideal for its growth and reproduction (Dhillion *et al.*, 2005) [5]. The fruit fly, *B. cucurbitae* has been found to cause losses ranging from 29 to 95 per cent (Pruthi, 1941; Lall and Sinha, 1959; Nath, 1964, Patel, 1974, Singh *et.al*., 1977 and Patel 1994) [12, 7, 8, 9, 16, 11] to different cucurbits. About 30 to 40 per cent damage by the cucurbit fruit fly, *B. cucurbitae* have been recorded by Dhandapani and Vedamutha (1992) [4] in the Palani hills of Tamil Nadu. Patel (1974) [9] recorded 62.50 per cent fruit damage in bitter gourd by fruit fly (*D. cucurbitae*) in Junagadh. In south Gujarat, the damage in bitter gourd fruits (29.18 %) and little gourd (1 to 48 %) was recorded at Navsari (Patel, 1989 and Patel, 1994) [10, 11].

2. Materials and Methods

Estimation of losses due to fruit fly on long melon.

2.1 Experimental details

1. Season : Spring-2017 and spring 2018
2. Experimental design : Paired plot (Paired t-test)
3. Test crop : long melon
4. Treatments : 2 (Treated and untreated)
5. Replications : 14
6. Plot size : 3 m x 4 m
7. Row to Row distance : 1.5 m
8. Plant to plant distance : 0.50 m
9. Manures and Fertilizers : Malathion

2.2 Methodology

Treated plots was maintained free from fruit fly infestation by spraying the plots with insecticides as malathion, where as untreated plots were allowed to have natural infestation of fruit fly.

2.3 Method of Observations

The per cent infestation of fruits on number basis was calculated by counting the infested and healthy fruits separately from the five tagged plants and on weight basis, the weight of both healthy and infested fruits was taken separately and level of infestation in percentage was worked out.

The observations were recorded on number and weight of marketable and damaged fruit at the time of each picking. Whereas, percentage of fruit damaged was recorded from total number of damaged and marketable fruits by using following formula,

$$\text{Per cent fruit infestation (No. basis)} = \frac{\text{Number of infested fruits}}{\text{Total number of fruits}} \times 100$$

$$\text{Per cent fruit infestation (Wt. basis)} = \frac{\text{Weight of infested fruits}}{\text{Total weight of fruits}} \times 100$$

3. Results

Estimate the losses due to fruit fly in long melon

The estimation of losses caused by fruit fly *B. cucurbitae* in long melon was worked out by paired plot design. From the data on fruit damage recorded during the investigation, it become clear that the pest adversely affected the crop. The losses in terms of fruit damage on number and weight basis were worked out separately and presented in Table 1 and 2 during both the years of study.

3.1 Fruit damage on number and weight basis during 2017

The data presented Table 1. revealed that the fruit fly infestation caused significant effect on fruit damage. On number basis, it ranged from 39.08 to 44.08 per cent with mean of 41.35 per cent in untreated plots, while it was recorded to be 15.11 to 20.36 per cent with a mean of 17.72 per cent in treated plots. The data on weight basis of fruit damage presented in Table 1. also showed a significant difference between treated and untreated plots. The range of fruit damage in untreated plots was recorded 34.86 to 39.44 per cent with a mean of 37.03 per cent, whereas in treated plots the fruit damage reduced and ranged from 12.36 to 17.02 per cent with a mean of 14.87 per cent.

Table 1: Estimation of losses due to fruit fly on number and weight basis during 2017

Plot No.	Per cent Mean Fruit Infestation number Basis		D	D^2	Calculated Paired t-value	Per cent Mean Fruit Infestation weight basis		D	D^2	Calculated Paired t-value
	Untreated	Treated				Untreated	Treated			
1	39.4	15.11	24.29	590.00		35.06	13.31	21.75	473.06	
2	41.15	17.31	23.84	568.35		37.35	15.41	21.94	481.36	
3	40.55	16.25	24.30	590.49	2.16**	36.05	14.35	21.70	470.89	
4	42.62	19.31	23.31	543.36		38.72	16.11	22.61	511.21	2.16**
5	39.66	15.68	23.98	575.04		34.86	13.88	20.98	440.16	
6	41.25	18.14	23.11	534.07		36.85	15.64	21.21	449.86	
7	43.62	20.23	23.39	547.09		39.44	17.02	22.42	502.66	
8	40.85	16.18	24.67	608.61		36.05	13.34	22.71	515.74	
9	42.21	19.24	22.97	527.62		37.31	16.29	21.02	441.84	
10	39.08	15.67	23.41	548.03		35.18	12.36	22.82	520.75	
11	40.28	16.58	23.70	561.69		36.38	13.08	23.30	542.89	
12	42.55	19.43	23.12	534.53		38.64	15.83	22.81	520.30	
13	41.6	18.62	22.98	528.08		37.12	15.33	21.79	474.80	
14	44.08	20.36	23.72	562.64		39.42	16.28	23.14	535.46	
Mean	41.35	17.72	23.63	558.54		37.03	14.87	22.16	491.50	

** calculated paired ‘t’ value

D = Difference between treated and untreated

D^2 = Difference square

Table 2: Estimation of losses due to fruit fly on number and weight basis during 2018

Plot No.	Per cent Mean Fruit Infestation number Basis		D	D^2	Calculated Paired t-value	Per cent Mean Fruit Infestation weight basis		D	D^2	Calculated Paired t-value
	Untreated	Treated				Untreated	Treated			
1	41.15	16.02	25.13	631.52		37.85	13.15	24.70	610.09	2.16**
2	43.18	18.11	25.07	628.50		39.28	15.26	24.02	576.96	
3	42.65	17.35	25.30	640.09		38.15	14.45	23.70	561.69	
4	44.54	19.08	25.46	648.21		39.64	15.88	23.76	564.54	
5	46.11	21.15	24.96	623.00	2.16**	42.31	18.03	24.28	589.52	
6	45.34	20.37	24.97	623.50		40.84	17.43	23.41	548.03	
7	47.21	21.67	25.54	652.29		43.31	18.46	24.85	617.52	
8	44.17	19.15	25.02	626.00		40.26	15.79	24.47	598.78	
9	46.19	21.72	24.47	598.78		42.09	17.62	24.47	598.78	
10	45.39	20.04	25.35	642.62		40.88	16.92	23.96	574.08	
11	43.12	18.24	24.88	619.01		38.34	15.08	23.26	541.03	
12	41.27	16.35	24.92	621.01		36.54	13.88	22.66	513.48	
13	42.43	17.09	25.34	642.12		38.63	14.22	24.41	595.85	
14	44.11	19.33	24.78	614.05		40.21	16.11	24.10	580.81	
Mean	44.06	18.97	25.09	629.34		39.88	15.87	24.00	576.51	

** calculated paired 't' value
D = Difference between treated and untreated
D^2 = Difference square

3.2 Fruit damage on number and weight basis during 2018

From the data in Table 2. It become clear that fruit fly infestation manifested significant adverse effect on long melon fruits. The mean fruit damage on number basis in untreated plots was recorded as 44.06 per cent with a range of 41.15 to 47.21 per cent. While in treated plot the mean fruit damage was reduced to 18.98 per cent with a range of 16.02 to 21.72 per cent. Likewise result on weight basis damage of fruit (Table 2) evinced that untreated plots incurred mean fruit damage of 39.88 per cent which ranged from 36.54 to 43.31 per cent. The mean fruit damage on weight basis in treated plots was recorded to be 15.88 per cent with a range of 13.15 to 18.46 per cent.

4. Discussion and Conclusion

Results on estimation of losses infer that the pest adversely affected the long melon crop when kept untreated and the fruit infestation was recorded more than 40 per cent. In early studies on cucurbits, Singh *et al.* (2000) [15], Dhillon *et al.* (2005) [5] and Sapkota *et al.* (2010) [14] observed 27 to 31 per cent, 30 to 100 per cent and 32.9 per cent losses, respectively due to attack of melon fruit fly depending upon cucurbit species and the season. Thus, the findings of present investigation are more or less in conformity with the previous reports of these authors. However, Hollingsworth (1997) [6] reported 95 per cent damage in bitter gourd in New Guinea, 90 per cent in snake gourd and 60-87 per cent in pumpkin fruits in Soloman Island which were infested by melon fruit fly and these results contradicted with the present findings. This significant variation in extent of per cent fruit damage caused by melon fruit fly might be due to different geographical experimental locations, crops and the season in which the particular crop was grown.

The fruit fly infestation caused significant effect on fruit damage and it ranged from 39.08 to 44.08 per cent with mean of 41.35 per cent on number basis in untreated plots, while it was recorded to be 15.11 to 20.36 per cent with a mean of 17.72 per cent in treated plots. The fruit damage on weight basis also showed a significant difference between treated and untreated plots. The range of fruit damage in untreated plots was recorded as 34.86 to 39.44 per cent with a mean of 37.03 per cent, whereas, in treated plots it reduced and ranged from 12.36 to 17.02 per cent with a mean of 14.87 per cent.

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