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Assessing the crop losses due to insect pests of brinjal (*Solanum melongena* Linn.)

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Abstract
Brinjal is the most popular vegetable throughout the world. The crop is attacked by 26 species of insect and pest. If the losses can be reduced it will lead to increase in production of the brinjal. Thus a study was conducted at crop research centre, SVPUA&T, Meerut (U.P.) India during 2013 and 2014. The crop was raised in a paired plot size 5x3 m^2. Observations on the eggplant yield of treated and control plots were recorded after each picking. The result of the study was that increase in yield over control was 95.60 and 90.93 percent during 2013 and 2014, respectively. Avoidable loss was 48.87 and 47.63 percent in 2013 and 2014, respectively.

Keywords: Crop losses, *Solanum melongena*, eggplant

Introduction
Brinjal, often known as eggplant, is a popular vegetable crop farmed all over the world. It is grown almost in all parts of India except higher altitudes, throughout the year. The total area under brinjal crop cultivation in India is around 0.74 million hectares, where the annual production is around 13.14 million tonnes. In Uttar Pradesh the land under cultivation is 0.003 million hectare area and the annual production of brinjal is 0.092 million tonnes (Anonymous, 2019) [1].

The crop is attacked by as many as 26 species of insect pests and non-insect pests right from the germination stage till the harvesting stage (Afzal, 2018) [2]. Among these 26 insect and non-insect species, jassid (*Amrasca biguttula biguttula* Ishida), aphid (*Aphis gossypii* Glover), white fly (*Bemisia tabaci* Genn.), lace wing bug (*Urentius echinus* Distant), shoot and fruit borer (*Leucinodes orbonalis* Guenne), epilachna beetle (*Epilachna vigintioctopunctata* Fab.), and stem borer (*Euzophera perticella* Rag.) Radical are major insect and pest in achieving good economic yield whereas few of them are active throughout the year and have many overlapping generations. Crop losses which occurred only due to the fruit and shoot borer have majorly been reported in the 30-79 percent of various parts of India (Raju *et al*., 2017) [3]. The infestation level which was up to 60 percent (Anil, 2014) [4], 38.72 percent (Tewari *et al*., 2018) [5] and 42.82 percent (Sharma *et al.*, 2019) [6] on fruits have been reported on the brinjal crop. (Rosaih, 2015) [7] reported that the losses caused by the brinjal insect pest complex were as high as 70-90 percent. The larvae of this pest bore into petiole and midribs of the large leaves or young growing shoots, close the opening with their frass and feed within. In later stages, it bores into flowers, buds and fruits entering from under the calyx having no visible sign of infestation and feed inside the fruits. The epilachna beetle defoliates the leaves and thus reduces the area of photosynthesis ultimately reducing the yield. As a result of continuous desaping by different sucking insect pests, the vitality of the plant is adversely affected and yield potential is hampered.

In order to reduce and prevent the losses caused by insect pests to the harvested produce, it is very important to manage their population at appropriate time with suitable control measures. The chemical control has been suggested by many researches to combat with the insect pests of brinjal (Patil, 2015, Singh *et al.*, 2016, Abrol and Singh, 2013, Nayak *et al.*, 2015 and Sharma *et al.*, 2018) [8-12] but due to one or the other reasons it could not become universal remedy for the protection of the crop. Therefore, development of integrated pest management (IPM) modules may be considered as one of the measures controlling the insect pests. Integrated pest management is the farmer's best mix of compatible tactics in order to curtail or curb the .

Suitable understanding of the seasonal incidence of insect pests is important due to variation in the weather conditions and changing pest scenario on the crop.

Material and Methods

A field experiments were conducted for two consecutive kharif seasons (2013 and 2014) at crop research center, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) India. The crop was raised in a paired plot with alternate spray of chlorpyriphos @ 3 ml l^{-1} and quinolphos @ 1.2 ml l^{-1} at weekly interval and three replications were done. The plot size was about 5x3 m^2 with row to row and plant to plant distance of 60 cm each. Observations on the eggplant yield of treated and control plots were recorded after each picking. The collected data on fruit yield were then converted to per hectare area. To understand the result on the crop losses inflicted due to incidence by insect pests on brinjal crop, paired t test was applied on the data and came to a conclusion. The avoidable losses and increase in the crop yield as compared to control were calculated for each treatment by following formula (Pradhan, 1964) [13]

$$\text{Avoidable loss (\%)} = \frac{\text{Highest yield in the treated in the treatment}}{\text{Highest yield in the treated plot}} \times 100$$

$$\text{Increase in the yield (\%)} = \frac{\text{Yield in the treatment-yield in control}}{\text{Yield in the control}} \times 100$$

Result and Discussion

Table-1: Assessment of crop losses due to insect pests of brinjal (*Kharif*, 2013, 2014 and pooled)

Treatment	Yield (q ha^{-1})			Increase in yield over control (%)			Avoidable losses (%)		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	pooled
Treated	220.44	218.83	219.64	95.60	90.93	93.24	48.87	47.63	48.12
Untreated	112.70	114.61	113.66						
Increase in yield	107.74	104.22	105.98						
t- calculated	18.34	20.84	19.59						
t-tabulated @ 5% (df-12)	2.18	2.18							

Table 1 reveal that the average fruit yield which was obtained during 2013 and 2014 were 220.44 and 218.83 qha^{-1} respectively in treated plots as compared, it was 112.70 and 114.61 qha^{-1} in control plots during 2013 and 2014, respectively. At a 5% threshold of significance, the t value for both years was more than the tabulated t value (2.18, df-12) and was found to be significant. As a result, during the investigation, the yield obtained in the treatments, i.e. treated and untreated, differed significantly. During Kharif 2013 and 2014, the increase in fruit output over control was 107.74 and 104.22 q ha-1, respectively, in the current study. The increase in the yield during 2013 and 2014 was 95.60 and 90.93% respectively.

If the crop losses which is due to insect and pests of brinjal crop could be avoided by pests management, the production can be significantly increased. The percent preventable yield losses recorded in Kharif 2013 and 2014 were 48.87 and 47.63 percent, respectively, with a pooled mean of 48.12 percent. The similar results were also reported by various researchers. Tripathi *et al*. (2018), Muthukumar and Kalyansundaram (2013), Singh *et al*. (2016), and Verma *et al*. (2019) [14-17] reported that average fruit damage varied from 13.30 percent to 67.71 percent due to *L. orbonalis*. Mane and Kulkarni (2016) [18] reported 23.49 percent loss in the yield of brinjal due to its pest complex, which are contrary with the present findings. The biotic and abiotic elements of diverse locations contributed to the varied damage caused by insect pests of brinjal.

Conclusion

The increase in yield over control was 95.60 and 90.93 percent during 2013 and 2014, respectively. Avoidable loss was 48.87 and 47.63 percent in 2013 and 2014, respectively.

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