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Effect of Different Dates of Transplanting of Brinjal on Shoot and Fruit Borer *Leucinodes orbonalis* (Guenee) in Hill Region of North Western Himalayas, India

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***Abstract*:** The incidence of *L. orbonalis* on brinjal was noticed in different dates. The result obtained from the present study revealed that among the three different dates of transplanting of brinjal, the crop transplanted 15th of May recorded the lowest mean shoot infestation (9.87 per cent) and fruit infestation on number (9.66 per cent) as well as on weight basis (8.83 percent) as compared to the crop transplanted on 15th of June, which recorded mean shoot infestation of 13.33 per cent and mean fruit infestation of 21.70 per cent on number basis and 19.91 percent on weight basis. This could be attributed to the less population build up of *L. orbonalis* on the crop transplanted on 15th of May as compared to the crop transplanted on 15th of June.

Keywords: *L. orbonalis*, Different dates, Transplanting, Shoot/fruit damage, Incidence

Brinjal (*Solanum melongena* Linnaeus) also known as egg plant, is an important solanaceous plant originated from India and now grown as a vegetable throughout the tropical, sub-tropical and warm temperate regions of the world. Brinjal is referred as "King of Vegetables". In India, brinjal is extensively grown under diverse agro climatic conditions throughout the year (Nayak et al 2014). It is grown in almost all the states, with an area of 730.35 thousand hectares under cultivation and with total production of about 12,801 thousand metric tons (Indian Horticultural database, 2019). Different insect pests attack brinjal right from seedling stage to final harvesting stage. Some important insect pests of brinjal, which cause enormous damage to this crop are brinjal shoot and fruit borer (*Leucinodes orbonalis*), hadda beetle (*Epilachna* spp), jassid (*Amrasca bigutella bigutella*), aphid (*Aphis gossyppii*) and white fly (*Bemisia tabaci*) (Latif et al 2009). Among these major insect pests, brinjal shoot & fruit borer *Leucinodes orbonalis* is considered to be the most destructive pest of brinjal (Latif et al 2010, Chakraborti and Sarkar 2011, Saimander and Gopal 2012) and is found in all brinjal growing countries (Dutta et al 2011). In India, the yield reduction by this pest has been reported to be around 20-30 per cent (Bhargava et al 2008) and as high as 70 per cent (Dhandapani et al 2003) or 70-92 per cent (Chakraborti and Sarkar 2011). The pest poses serious problem because of its high reproductive potential, rapid turnover of generations and intensive cultivation of brinjal both in wet and dry seasons of the year. Brinjal shoot and fruit borer is practically monophagous but attacks other plants which belong to solanaceae family and has attained global importance in recent years. The caterpillars bore into tender shoots at vegetative stage, flower and fruit (CABI 2007). The higher percentage of larvae has been reported in fruits followed by shoots, flowers, flower buds and mid-rib of leaves (Alpurutto 1994).

The larvae feed on the mesocarp of fruit and feeding and excretion result in fruit rotting (Neupane 2001), making it unfit for human consumption (Baral et al 2006). On an average a larva can infest 4-7 fruits during its lifespan (Jayaraj and Manisegaran 2010). Larval feeding in flower has been reported to be rare, if it happens, there will be no fruit formation from damaged flowers (Alam et al 2006). Once the fruit setting has been initiated, shoot infestation becomes negligible (Kumar and Dharmendra 2013) or completely disappear (Naqvi et al 2009). The infestation by this pest results in lowering the vitamin C content up to 80 per cent in infested brinjal fruits (Sharma 2002).

The time of transplanting is an important cultural practice having a bearing on the population build up of the associated pest complex in brinjal. Pest attack can be suppressed or escaped by altering the transplanting dates. In this way most vulnerable period of crop growth may not synchronize with peak activity of the pest organism. Thus manipulation of the date of transplanting of this crop may reduce the incidence of

this pest and indirectly it may lessen the number of spray applications for its management. Keeping in view the economic importance of the crop, quantum of damage caused by the shoot and fruit borer, the present study regarding the effect of different dates of transplanting on the incidence of brinjal shoot and fruit borer was carried out.

MATERIAL AND METHODS

The experiment was laid out in RBD in uniformly sized plots measuring 3.60x3.15m at spacing of 60x45 cm. The brinjal variety Nisha was used for the experiment. Seedlings of brinjal (Nisha) were raised in three different nursery beds for different dates of transplanting. There were six replications and three treatments in the trial. Ten plants were randomly selected and tagged in each plot. The first transplanting was done on May 15, 2020 and subsequently another two transplanting were done at 15 and 30 days after the first transplanting. Weekly observations were taken from ten randomly selected plants/plot for brinjal shoot and fruit borer infestation on shoot from each planting. For fruit infestation, total number of fruits and infested fruits were recorded per plot during each harvesting from each replication. The per cent age of infested shoot/fruit was recorded and data recorded were analyzed by using OPSTAT online software and two factor ANOVA was performed in Randomised Block Design to compute CD value. The treatments with significant difference were also separated using Tukey's honestly significant difference post Hoc test using IBM SPSS software.

RESULTS AND DISCUSSION

Shoot infestation: The weekly data on shoot infestation (per cent) by *Leucinodes orbonalis* at three different dates of transplanting viz. 15th May, 30th May and 15th June, 2020 are presented in Table 1. During the first week after transplanting there was no shoot infestation (%) in all the treatments and it started after the second week of transplanting and the crop transplanted on 15th June recorded the highest shoot infestation of 4.19 per cent. The present investigations on the initiation of shoot infestation by brinjal shoot and fruit borer is in close agreement with that of Jat et al (2002) who reported that the infestation of brinjal shoot borer commenced on shoots one week after transplantation. Salve et al (2021) reported that the infestation of *L. orbonalis* on developing shoots commenced from four weeks after transplantation and ranged from 2.25 (31st SMW) to 0.45 per cent (43th SMW) with peak being 10 per cent at 37th SMW.

From the second week onwards, the shoot infestation in all the three treatments showed an increasing trend. In case of the crop transplanted on 15th of May (T_1), the peak (highest) shoot infestation of 24.85 per cent was observed on the 8th week after transplanting whereas in case of crop transplanted on 30th of May (T_2), the highest shoot infestation of 39.66 per cent was observed on 9th week after transplanting. Treatment (T_3) recorded the peak (highest) shoot infestation of 43.80 per cent on the 7th week after the transplanting. After attaining a peak, shoot infestation showed a decreasing trend in all the treatments. No shoot infestation due to *L. orbonalis* attack was observed after 17th weeks after transplanting in T_1 and 16th weeks after transplanting in T_2, respectively. However, shoot infestation ceased at 15th weeks after transplanting in T_3. Infestation in shoots decreased after fruit setting. On comparing the mean shoot infestation observed in the three treatments, the highest mean shoot infestation was observed in T_3 (13.33 per cent) followed by T_2 (12.78 per cent) and then T_1 (9.87%). The treatments T_3 and T_2 were statistically at par ($p > 0.05$), however, T_1 was found to be statistically different from T_2 and T_3 ($p < 0.05$) at 0.05 significance level. Interaction between the transplanting date and the duration of crop was significant at 0.05 level of significance. The results thus revealed that among the three different dates of transplanting, the brinjal crop transplanted on 15th of May (T_1) showed the lowest shoot infestation, while the crop transplanted on 15th of June (T_3) recorded the highest shoot infestation.

The finding on peak infestation of brinjal shoot and fruit borer are in conformity to those of Nandi et al (2017) who reported that peak shoot infestation by *L. orbonalis* was around 8 weeks after transplantation during *Kharif* season. Singh et al (2000) reported that shoot infestation was started at the end of August and reached peak in the third week of September. Bharadiya and Patel (2005) also reported that the damage of shoot & fruit borer on shoot was the highest during fourth week of September.

Fruit infestation (on number basis): The weekly data on fruit infestation on number basis (per cent) by *L. orbonalis* at three different dates of transplanting viz. 15th May, 30th May and 15th June are presented in Table 2. It is evident from the table 2 that in the initial days of the crop growth i.e. from the first to fifth weeks after transplanting, only vegetative phase of crop is there and no fruit was formed. After the initiation of reproductive phase, the fruit infestation (per cent) in all the treatments started on 6th week after transplanting, highest number of fruits infestation (28.13%) were observed in T_3 however, a very less number of infested fruits were recorded in T_1 (3.0%) and T_2 (2.5%). Similar to the trend followed in shoot infestation, fruits infestation also showed an increasing trend. The peak fruit infestation of 26.17 per cent was observed on 12th week after transplanting in T_1, however peak number of fruits infestation of 36.61 and 53.36 per cent was

observed in 11th and 10th week after transplanting in T_2 and T_3, respectively. After attaining a peak, a reduction in fruit infestation was observed. The fruit infestation was observed till the 19th week after transplanting in all the treatments. The mean number of fruits infested was highest in T_3 (21.71 per cent), however, in T_1 and T_2, fruit infestation was 9.66 and 10.21 per cent, respectively. All the mean number of fruit infested were statistically different at 0.05 level of significance ($p<0.05$). Interaction between the date of transplanting and duration of crop growth was found to be significant 0.05 level of significance.

Fruit infestation (weight basis): The data on fruit infestation on weight basis (%) by *L. orbonalis* at three different dates of transplanting viz. 15th May, 30th May and 15th June are presented in table 2. As reported earlier also there was no fruit infestation up to 5 weeks after each transplanting and the fruit infestation started in the later stage. The fruit infestation commenced from 6th week after the transplanting of the crop and the highest fruit infestation of 25.37 per cent (on weight basis) was observed in T_3, however, a very less infested fruits on weight basis were recorded in T_1 (2.3 per cent) and T_2 (2.65 per cent). Similar to the trend followed in

Table 1. Shoot Infestation level of *L. orbonalis at* different date of transplanting

Crop duration (WAT)	Shoot infestation (%)			
	T_1 (TD=15th May)	T_2 (TD=30th May)	T_3 (TD=15th June)	Mean
1	0±0* (0)	0±0 (0)	0±0 (0)	0 (0)
2	1.12±1.28 (4.195)	1.80±1.98 (5.401)	4.19±0.97 (11.73)	2.37 (7.11)
3	2.48±1.17 (8.39)	5.91±0.93 (14.02)	9.47±0.84 (17.90)	5.95 (13.44)
4	7.49±1.11 (15.83)	9.09±0.90 (17.52)	14.29±1.00 (22.19)	10.29 18.51)
5	19.2±2.55 (25.93)	14.59±0.72 (22.44)	18.83±1.01 (25.70)	17.54 (24.69)
6	20.50±1.63 (26.89)	19.68±1.38 (26.31)	26.27±1.39 (30.81)	22.15 (28.00)
7	22.51±2.31 (28.28)	25.60±1.06 (30.38)	43.80±1.09 (41.42)	30.64 (33.36)
8	24.85±2.13 (29.87)	35.86±1.47 (36.77)	42.10±11.45 (40.15)	34.27 (35.60)
9	21.14±0.78 (27.36)	39.66±21.72 (39.28)	40.40±1.45 (39.44)	33.73 (35.36)
10	16.42±1.08 (23.88)	25.96±2.92 (30.58)	22.58±1.30 (28.35))	21.65 (27.61)
11	11.63±1.49 (19.89)	21.06±2.16 (27.28)	17.49±0.74 (24.71)	16.72 (23.96)
12	11.63±0.91 (19.92)	17.67±2.19 (24.81)	11.78±1.75 (21.58)	13.69 (21.58)
13	9.44±0.59 (17.88)	12.07±0.69 (20.31)	9.33±0.74 (17.76)	10.28 (18.65)
14	9.37±0.50 (17.81)	10.92±1.36 (19.26)	6.04±4.22 (13.57)	8.78 (16.88)
15	8.71±0.77 (17.14)	9±0.76 (17.44)	0±0 (0)	5.90 (11.53)
16	7.39±0.76 (15.75)	6.65±0.95 (14.90)	0±0 (0)	4.68 (10.22)
17	3.43±1.04 (10.55)	0±0 (0)	0±0 (0)	1.14 (3.52)
18	0±0 (0)	0±0 (0)	0±0 (0)	0 (0)
Mean	9.87[a]	12.78[b]	13.33[b]	

*Mean ± SE (value in the parentheses are arc sin transformation values); WAT = Week after transplanting, TD=Transplanting date
Mean followed by different letters are significantly different at α = 0.05 (p-value < 0.05) according to Tukey HSD
CD (α = 0.05)
Date of transplanting (Factor A) = 0.94 (0.69)
Crop Duration (Factor B) = 2.43 (1.77)
Factor A X B = 4.22 (3.07)

shoot infestation, fruit infestation on weight basis also showed an increasing trend. The peak fruit infestation on weight basis (24.13%) was observed in 12th week after the transplanting in T_1, however peak fruits infested on weight basis (32.57 and 50.01 per cent) were observed in 11th and 10th week after the transplanting in T_2 and T_3, respectively. After attaining a peak, a reduction in fruit infestation was observed. The fruit infestation was observed till the 19th week after the transplanting in all the treatments. The mean fruits infested on weight basis was highest in T_3 (19.91 per cent) which was statistically different from T_1 and T_2, with the fruit infestation of 8.83 and 9.01 per cent, respectively, at 0.05 level of significance ($p<0.05$). Interaction between the date of transplanting and duration of crop growth was found to be significant 0.05 level of significance.

The results thus revealed that among the three different dates of transplanting, the brinjal crop transplanted on 15th of May (T_1) showed the lowest fruit infestation (both number and weight basis) while the crop transplanted on 15th of June (T_3) recorded the highest fruit infestation (both number and

Table 2. Fruit Infestation level of *L. orbonalis* at different date of transplanting (on number and weight basis)

Crop duration (WAT)	Transplanting date = 15th May (T_1)		Transplanting date = 30th May (T_2)		Transplanting date = 15th June (T_3)		Mean (on number basis)	Mean (on weight basis)
	FI on number basis (%)	FI on weight basis (%)	FI on number basis (%)	FI on weight basis (%)	FI on number basis (%)	FI on weight basis (%)		
5	0±0 (0)	0±0 (0)	0±0 (0)	0±0 (0)	0±0 (0)	0±0 (0)	0 (0)	0 (0)
6	3±2.37 (8.15)	2.3±0.34 (8.70)	2.5±2.74 (6.46)	2.65±0.45 (9.34)	28.13±1.34 (32.01)	25.37±1.44 (30.23)	11.21 (15.54)	10.11 (16.09)
7	10.11±0.75 (18.52)	8.7±0.60 (17.14)	6.58±2.01 (14.73)	4.34±0.60 (12.00)	32.42±1.33 (34.69)	29.7±1.82 (33.00)	16.37 (22.65)	14.25 (20.72)
8	13.89±1.39 (21.85)	13.48±0.84 (21.52)	9.98±1.16 (18.38)	8.04±1.46 (16.41)	39.38±1.24 (38.85)	37.614.40 (37.79)	21.08 (26.36)	19.71 (25.24)
9	16.28±1.16 (23.77)	15.21±0.64 (22.94)	14.41±2.99 (22.21)	12.05±1.52 (20.28)	46.5±0.99 (42.98)	43.19±1.69 (41.07)	25.73 (29.65)	23.49 (28.10)
10	19.9±1.05 (26.47)	18.01±0.82 (25.10)	18.67±0.75 (25.58)	16.56±0.84 (24.00)	53.36±1.70 (46.91)	50.01±1.76 (44.99)	30.64 (32.99)	28.19 (31.36)
11	23.41±1.32 (28.92)	22.96±1.17 (28.62)	36.61±1.51 (37.22)	32.57±1.92 (34.78)	46.33±0.76 (42.88)	45.1±1.68 (42.17)	35.46 (36.34)	33.54 (35.19)
12	26.17±1.81 (30.74)	24.13±1.35 (29.40)	28.67±1.33 (32.35)	26.4±0.75 (30.90)	42.99±0.96 (40.95)	40.03±1.79 (39.23)	32.6 (34.68)	30.19 (33.18)
13	20.89±0.95 (27.18)	19.34±1.02 (26.08)	23.65±1.64 (29.08)	22.7±1.54 (28.43)	38.74±1.43 (38.48)	35.01±1.87 (36.26)	27.76 (31.58)	25.69 (30.26)
14	19±0.92 (25.83)	17.72±1.10 (24.88)	21.67±2.52 (27.67)	20.08±2.15 (26.59)	36.21±3.39 (36.16)	31.23±1.64 (33.96)	25.63 (30.17)	23.01 (28.47)
15	15.53±0.40 (23.02)	13.27±0.94 (21.34)	17.08±2.38 (24.36)	14.16±0.96 (22.08)	24.62±1.10 (29.73)	22.68±1.39 (28.42)	19.08 (25.76)	16.7 (23.95)
16	11.63±0.77 (19.92)	11.03±0.71 (19.38)	12.28±1.97 (20.45)	10.83±1.36 (19.18)	20.9±0.91 (27.15)	18.36±0.98 (25.36)	14.92 (22.51)	13.41 (21.30)
17	8.58±0.80 (17.01)	8.46±0.73 (16.89)	8.3±0.42 (16.68)	6.98±0.81 (15.29)	13±1.55 (21.10)	11.88±1.33 (20.13)	9.94 (18.27)	9.1 (17.44)
18	4±0.89 (11.47)	1.59±1.39 (5.86)	3.17±1.17 (10.11)	2.49±1.56 (8.17)	8.2±0.69 (16.62)	6.2±0.78 (14.39)	5.12 (12.73)	3.43 (9.47)
19	0.83±0.98 (3.67)	0.35±0.65 (1.89)	0.67±0.82 (3.27)	0.43±0.52 (2.63)	3.42±1.02 (10.55)	1.73±1.25 (6.73)	1.64 (5.83)	0.84 (3.75)
20	0±0 (0)	0±0 (0)	0±0 (0)	0±0 (0)	0±0 (0)	0±0 (0)	0 (0)	0 (0)
Mean	9.661[a]	8.83[a]	10.21[b]	9.01[a]	21.708[c]	19.91[b]		

*Mean ± SE (value in the parentheses are arc sin transformation values); WAT = Weeks after transplanting, FI= Fruit infestation
Mean followed by different letters are significantly different at α = 0.05 (p-value < 0.05) according to Tukey HSD
CD (α = 0.05)
For fruit infestation on number basis
Date of transplanting (Factor A) = 0.32 (0.42)
Crop duration (Factor B) = 0.83 (1.09)
Factor A X B = 1.43 (1.89)
For fruit infestation on weight basis
Date of transplanting (Factor A) = 0.28 (0.33)
Crop duration (Factor B) = 0.72 (0.85)
Factor A X B = 1.25 (1.47)

weight basis). The present finding are in agreement to those of Nandi et al (2017) who reported that fruit infestation reached its maximum at 12 weeks after transplantation during *Kharif* season. These findings also in agreement to those of Tripura et al (2017) who reported that peak infestation of shoot & fruit borer on shoot and fruits were in the first week of August (34.20 per cent) and in the third week of August (46.75 per cent), respectively.

The result obtained from the present study thus revealed that among the three different dates of transplanting of brinjal, the crop transplanted 15th of May recorded the lowest mean shoot infestation (9.87 per cent) and fruit infestation on number (9.66 per cent) and weight basis (8.83 per cent) as compared to the crop transplanted on 15th of June which recorded mean shoot infestation of 13.33 per cent and mean fruit infestation of 21.70 per cent on number basis and 19.91 per cent on weight basis. This can be attributed to the less population build up of L. *orbonalis* on the crop transplanted on 15th of May as compared to the crop transplanted on 15th of June.

The present results find support from the studies of Tripura et al (2017) carried out at Meghalaya who reported that first transplanting (done on 15th of April, 2015) showed lowest shoots and fruit damage followed by the second transplanting (done on 30th April, 2015). They further reported that the third transplanting (done on 15th of May) showed the highest shoot and fruit infestation. The peak shoot infestation was 25.25, 32.60 and 34.20 per cent in the first, second and third transplanting, respectively. Whereas the peak fruit infestations were recorded to be 16.25, 44.75 and 46.75 per cent in the respective transplanting. However, Singh et al (2017) on the basis of the experiments conducted during *Kharif* (July 2016 to February, 2017) reported that brinjal crop transplanted during August 2016 (third transplanting) recorded relatively higher shoot damage with a mean of 18.01 per cent followed by that in first and second transplanted crop (crop transplanted during July, 2016) with a mean of 16.07 and 16.17 per cent shoot damage. Similarly the third transplantation crop recorded the highest mean fruit damage (17.65 per cent) on number basis and 15.70 percent on weight basis followed by first and second transplanted crop with a mean fruit damage of 15.95 per cent on number basis and 14.64 per cent on weight basis and 17.62 per cent on number basis and 14.97 per cent on weight basis, respectively.

The present findings are in partial agreement with reports of Rashid et al (2003) who revealed that the highest level of shoot & fruit infestation was found from June to September. Radhakishore et al (2009) observed that infestation of *L. orbonalis* on brinjal crop started from early vegetative stage and continued up to crop maturity. First infestation appeared on shoots from the second week of April and peaked in the second week of June and third week of May during two consecutive years.

REFERENCES

Alam SN, Hossain MI, Rouf, FMA, Jhala RC, Patel MG, Rath LK, Sengupta A, Baral K, Shylesha AN, Satpathy S, Shivalingaswamy TM, Cork A and Taleka NS 2006. Implementation and promotion of an IPM strategy for control of eggplant fruit and shoot borer in south Asia. *Technical Buletin 36. AVRDC* publication number 06-672, AVRDC- The World Vegetable Center, Shanhua, Taiwan.74p.

Alpuerto AB 1994. Ecological studies and management of brinjal fruit and shoot borer, *Leucinodes orbonalis* Guenee. *Indian Journal of Agricultural Science* **52**: 391-395.

Baral K, Roy BC, Rahim KMB, Chatterjee H, Mondal P, Mondal D, Ghosh D and Talekar NS 2006. Socio-economic parameters of pesticide use and assessment of impact of an IPM strategy for the control of eggplant fruit and shoot borer in west Bengal, India. *Technical Bulletin 37*, AVRDC Publications number 06-673, AVRDC- The World Vegetable Centre, Shanhua, Taiwan, 36pp.

Bharadiya AM and Patel BR 2005. Study on the efficacy of certain insecticides against brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. *Journal of Plant Protection and Environment* **2**(2): 113-115.

Bhargava MC, Choudhary RK and Jain PC 2008. Genetic engineering of plants for insect resistance. In: P.C Jain and M.C Bhargava (eds.). *Novel App. Roaches*. New India Publishing. New Delhi, India, pp.133-144.

CABI 2007. *Crop protection compendium.* CAB International. (Available at: http://www.cabicompendium.org/cpc).

Chakraborti S and Sarkar PK 2011. Management of *Leucinodes orbonalis* Guenee on eggplant during the rainy season. *Indian Journal of Plant Protection* **51**: 325-328.

Dhandapani N, Shelkar UR, Murugan M 2003. Bio-intensive pest management in major vegetable crops: An Indian perspective. *Journal of food Agriculture and Environment* **1**(2): 330-339.

Dutta P, Singha AK, Das P and Kalita S 2011. Management of brinjal fruit and shoot borer, *Leucinodes orbonalis* in agro-ecological conditions of West Tripura. *Scholarly Journal of Agricultural Sciences* **1**: 16-19.

Indian Horticulture database 2019. National Horticultural Board, Ministry of Agriculture, Govt. of India, pp.127-135.

Jat KL and Pareek BL 2001. Field evaluation of ecofriendly insecticides against brinjal shoot and fuit borer *Leucinodes orbonalis* Guenee. *Indian Journal of Plant Protection* **29**(1-2): 53-56.

Jayaraj J and Manisegaran S 2010. *Management of fruit and shoot borer in brinjal*. The Hindu Science Technology Agricultural College and Research Institute, Madurai.

Kumar S and Dharmendra S 2013. Seasonal incidence and economic losses of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. *Agricultural Science Digest* **33:** 98-103.

Latif MA, Rahmah MM, Islam MR and Nuruddin M 2009. Survey of arthropod biodiversity in the brinjal field. *Journal of Entomology* **6**: 28-34

Latif MA, Rahman MM and Alam MZ 2010. Efficacy of nine insecticides against shoot and fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) in eggplant. *Journal of Pesticidal Science* **83**: 391-397.

Nandi C, Narabenchi H, Jakatimath S and Praful Kumar M V 2017. Seasonal incidence of brinjal shoot and fruit borer, *Leucinodes orbonalis Guene,* (*Lepidoptera: Crambidae)* during *Kharif* season. *International Journal of current Microbiology and Applied Science* **6**(12): 1088-1093

Nayak US, Baral K, Mandal P and Chatterjee S 2014. Seasonal variation in the larval population of brinjal shoot and fuit borer *Leucinodes orbonalis* Guenee with respect to different ecological parameters. *International Journal of Bio-Resource & Stress Management* **5**(3): 409-412

Neupane FP 2001. *Crop Pest and Their Management* (4th ed.) (Nepali language) Sajha Prakashan, Pulchwok, Lalitpur, Nepal. 582p.

Naqui AR, Pareek BL and Mitherwal BS 2009. Seasonal incidence of shoot and fruit borer (*Leucinodes orbonalis* Guenee) infesting brinjal in hyper arid region of Rajasthan. *Journal of Insect Science* **22**(2):195-198.

Radhakishore RK, Devjani P and Singh TK 2009. Population dyanamics of *Leucinodes orbonalis. Annals of Plant Protection Sciences* **17**(2): 459-529.

Rashid M A., Alam SN, Rouf FMA and Talekar NS 2003. Socio economic parameters of brinjal pest control in Jessore district of Bangladesh. *Technical Bulletin No. 29*. Shanbua, Taiwan. AVRDC-The world vegetable centre. AVRDC publication No. 03. 29p.

Saimandir J and Gopal M 2012. Evaluation of synthetic and natural insecticides for the management of insect pest control of egg plkant (*Solanum melongena* L.) and pesticide residue dissipation pattern. *American Journal of Plant Sciences* **3**(2): 214-227.

Salve RS, Sonkamble MM and Patil SK 2021. Population dynamics of major insect pests of brinjal. *Indian Journal of Entomology* **83**(1): 16-20.

Sharma DR 2002. *Bioefficacy of certain insecticide and biopesticides against major pest of brinjal under field condition*. M.Sc. thesis. Indian Agricultural Research Institute, New Delhi, India, 160p.

Singh B Rana BS, Kumar R and Prasad B 2017. Effect of different dates of transplanting on the incidence of brinjal shoot & fruit borer. *Journal of Entomology and Zoology Studies* **5**(5): 564-573.

Singh SV, Singh KS and Malik YP 2000. Seasonal abundance and economic losses of shoot and fruit borer, *Leucinodes orbonalis* on brinjal. *Indian Journal of Entomology* **62**(3): 247-252.

Tripura A, Lal R, Chatterjee ML and Patra S 2017. Seasonal incidence of shoot and fruit borer (*Leucinodes orbonalis* Guence) on brinjal in mid hills of Meghalaya. *Indian Journal of Hill Farming* **30**(2): 335-340.

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