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Impact of various treatments against brinjal shoot and fruit borer

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Abstract
Brinjal (*Solanum melongena)* is one of the main vegetable of Pakistan. It is also known as an aubergine belongs to Solanaceae family. The present study was conducted at Medicinal Garden, newly Developed Malakandir Farm, University of Agriculture Peshawar-Pakistan during summer, 2015. Main plot was divided into 24 sub-plots in which 15 plants of Brinjal variety Neelam were transplanted with 0.44m & 0.55m distance kept in plant to plant & row to row, respectively. The results showed that estimated high yield (1641.41 kg ha^{-1}) and less mean no. of infested shoots (4.43) and fruits (0.76) were recorded in Cypermethrin + Neem oil + Physical control, followed by Cypermethrin + Neem oil (6.15, 1.13) and Cypermethrin (7.28, 1.42). Similarly less yield (275.48 kg ha^{-1}) and high mean no. of shoots and fruits infestation, 12.2 & 2.94, respectively were recorded in Control, followed by Physical control measure viz., 10.48 & 2.48 and in Neem oil recorded 9.44 & 2.19, respectively. Thus, the results revealed that T_7 showed highly significant differences in management of *L. orbonalis* among all treatments by registering high yield and less no. of infested shoots & fruits of brinjal.

Keywords: Brinjal, no. of infested shoots & fruits, Brinjal shoot & fruit borer, yield, botanical extract, Integrated Pest Management (IPM)

1. Introduction
Brinjal (*Solanum melongena)* is one of the main vegetable of Pakistan and especially of Khyber Pakhtunkhwa. It is also known as an aubergine belongs to Solanaceae family. It is grown in all parts of the world. The Brinjal family comprises more than 95 genera and 2450 species [11]. Brinjal is one of the most delicious vegetable and fruit therefore it has been grown fairly on a wide range throughout the world [10]. Brinjal comprises 92.7 per cent water, 1.1 per cent proteins and 0.2 per cent carbohydrates. It also contains a rich of vitamin A and B [19]. Brinjal is a source to produce antioxidants, vitamins, nutrients, dietary fiber, minerals, proteins and factors that build the body [14]. A hundred grams comprise 12 mg calcium, 13 mg sodium, 0.7 mg iron, and 213 mg potassium [16]. The cultivation of Brinjal worldwide exceeded than 1,600,000 hectares and the production of yield was 50 million tons [5]. The Subcontinent of Indo and Pak was concluded the land of Brinjal (Dunlop, 2006). The Brinjal cultivation in Pakistan was 9,000 hectares while the yield production was 87,000 tons per annum [6].

Brinjal crop flourishes in a warm seasonal area where 80 to 90 °F and 70 to 80°F temperatures existed in day and night respectively. It is an iron rich base nourishing summer crop. In Khyber Pakhtunkhwa area under cultivation of this crop was 1033 hectares with the total production 11982 tons with an average yield of 20831 kg/ha [15]. Brinjal crop is capable of high yields in hot wet environment, high rainfall and high temperature among few vegetables [7].

Brinjal crop can be attacked by different insect pests from planting till harvesting. Some of them are Brinjal borer (*Leucinodes. orbonalis*), coccinelide beetle (*E. vigintioctopunctata*), jassid (*A. bigutulla*), aphid (*A. gossyppii*) and white fly (*B. tabaci*) [9]. *Leucinodes orbonalis* is one of the key insect pest of Brinjal crop [8, 2, 17] and is found throughout the world [4].

Brinjal borer *L. orbonalis* Guenee was a serious insect pest. In autumn season damage to the fruits are very severe and it is not common to see the whole of the crop destroyed by the borers. Cotton whiteflies and mites also suck cell sap especially found on the underneath of the leaves. They lower down the strength of the plant through loss of cell sap and inhibit photosynthesis owing to the growth of sooty mold on the honeydews secreted by insects [1].

Brinjal Shoot and Fruit Borer has turned into a harmful against Brinjal in all growing fields.

The regions of Khyber Pakhtunkhwa, insecticides are applied once a week to control Brinjal borer. Now days, this practice is common in farmers. The application of these predictable insecticides decreases the effectiveness in contradiction of *L. orbonalis* while upsurges the production cost. Since insecticide have frequent health hazardous effects, there is a need to use harmless insecticides and less doses of insecticides.

Keeping in view the aforementioned problems, Integrated Pest Management (IPM) research was undertaken with an aim to find out the best combination of control measurment for the management of Brinjal Shoot and Fruit Borer (FSB) and to investigate yield and mean no. of infested shoots & fruits after the application of various treatments.

2. Materials and Methods

The present study was conducted on the management of Brinjal Shoot and Fruit Borer (BSFB), *Leucinodes orbonalis* Guenee. For this purpose a plot size 116.16 m^2 was prepared in Medicinal Garden newly developed Malakandir Farm, The University of Agriculture Peshawar Pakistan during summer 2015. The main plot was divided into 24 sub-plots; each sub-plot size was kept 4.84 m^2. The study was carried out in Randomized Complete Block Design (RCBD). Seedlings of the Brinjal variety "Neelam" were obtained from the farmers of Swabi, Khyber Pakhtunkhwa, Pakistan. These seedlings were transplanted into each sub-plot with a plant to plant and row to row distance 0.44m and 0.55m respectively. There were 8 treatments in this experiment. Each treatment was replicated 3 times. All agronomic practices were kept constant for all sub-plots. The treatments were as following,

T_1= Cypermethrin 10 EC
T_2= Neem Oil
T_3= Physical Control
T_4= Cypermethrin 10 EC and Neem Oil (T_1+T_2)
T_5= Cypermethrin 10 EC and Physical Control (T_1+T_3)
T_6= Neem Oil and Physical Control (T_2+T_3)
T_7= Cypermethrin10 EC, Neem Oil and Physical Control (T_1+T_2+T_3)
T_8= Control (Check)

2.1 Field Layout

Randomized Complete Block (RCB) design was used for 8 treatments which were replicated 3 times.

Block 1	Block 2	Block 3
T_6	T_2	T_5
T_5	T_8	T_2
T_1	T_6	T_7
T_8	T_3	T_1
T_4	T_7	T_3
T_7	T_5	T_4
T_3	T_1	T_6
T_2	T_4	T_8

Plot size = 116.16m^2 (width=6.6m and length=17.6m)
Sub-Plot Size = 4.84 m^2 (width=2.2m and length=2.2m)

2.2 Chemicals (Treartment$_1$ + Treatment$_2$)

Cypermethrin 10 EC @ 2ml per liter water and Neem Oil @ 3ml per liter water were sprayed 3 times in whole season depending upon the Economic Threshold Level of Brinjal crop. The application of initial chemicals sprayed in the month of June 2015 at 6:30am early in the morning with knap sack sprayer at 25 days interval when 10% infestation of shoots occurred in the field (Economic Threshold Level).

2.2.1 Treartment$_3$

Physical control was done thrice times a week throughout the Brinjal season. Uprooting of weeds with the help of hands, Khurpa or saddle and picking of damaged fruits were done in this experiment.

2.2.2 Treatments Combination

Treatment$_4$ (T_1+T_2) Cypermethrin and Neem oil @ 2ml and 3ml per liter water, respectively sprayed combined, Treatment$_5$ (T_1+T_3) physical control was done with Cypermethrin spray, Treatment$_6$ (T_2+T_3) Neem oil and physical control done combined and treatment$_7$ (T_1+T_2+T_3) Cypermethrin, Neem oil and physical control combined, were used in this experiment to check the best combination treatments against Brinjal borer (FSB), L. orbonalis.

2.3 Chemicals preparation

Selected chemicals shown in the table below were tested against Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis*). The formulated chemicals were prepared on the basis of recommended dose in tap water.

Table: Chemicals with its Common Name, Manufacturer Name, Trade Name and Recommended Dose per Liter water

Common Name	Manufacturer Name	Trade Name	Recommended Dose per Liter Water
Cypermethrin 10% EC	Swat Agro insecticides Pakistan	TRYCORD ™	2ml / L Water
Neem Oil	Haque Planters Pakistan	---------	3ml / L water

2.4 Application

Chemicals were sprayed after 10% infestation of the shoots occurred. Data were recorded at interval of 1, 7, 14, and 21 days after each spray. Data was also recorded on damage fruits and shoots as well as undamaged fruits and shoots.

2.5 Statistical Anaylsis

Data obtained was subjected to analysis of variance by using STATISTIX (8.1) software. Significant difference among the means was differentiated by using Least Significant Difference (LSD) test.

3 Results and Discussion

3.1 Effect of various control measures on shoots infestation in Brinjal (June, 2015)

The effects of different treatments on BSFB are presented in Table (1). Significantly low infestation was recorded in T_7 (Cypermethrin + Neem oil + Physical Control), followed by T_4 (Cypermethrin & Neem oil) and T_1 (Cypermethrin). While highly significant infestation was observed in T_8 (Control), followed by T_3 (Physical control) & T_2 (Neem oil).

It is shown in the results that statistically significant differences observed in the data recorded at weekly intervals. Significantly lowest infestation was recorded in first week (0.60) followed by second (1.03) and third (1.62) week while fourth week (2.39) recorded highest number of shoots infestation.

Table 1: Effect of various treatments on means number of Brinjal shoots infestation by *L. orbonalis* after 1st spray.

Treatments	Time Interval (June, 2015)				Mean
	Weeks				
	1st	2nd	3rd	4th	
Cypermethrin (T_1)	0.58 lmno	0.95 jk	1.41 fghi	1.95 d	1.22 e
Neem oil (T_2)	0.58 lmno	1.12 ij	1.75 def	2.75 b	1.55 c
Physical control (T_3)	0.87 jkl	1.37 ghi	1.91 d	3.16 a	1.83 b
Cypermethrin + Neem oil (T_4)	0.37 nop	0.70 klmn	1.12 ij	1.75 def	0.98 f
Cypermethrin + Physical control (T_5)	0.33 op	0.87 jkl	1.70 defg	2.33 c	1.31 de
Neem oil + Physical control (T_6)	0.41 mnop	0.95 jk	1.79 de	2.58 bc	1.43 cd
Cypermethrin + Neem oil + Physical control (T_7)	0.20 p	0.37 nop	0.75 klm	1.20 hij	0.63 g
Control (T_8)	1.5 efgh	1.91 d	2.54 bc	3.37 a	2.33 a
Mean	0.60 d	1.03 c	1.62 b	2.39 a	

(LSD 0.05 for Treatment, Intervals, & Treatments/Intervals are 0.1753, 0.1239, & 0.3505, respectively). Means followed by different letter(s) are significantly different from each other (LSD's test, $P<0.05$)

3.2 Effect of various control measures on shoots infestation in Brinjal (July, 2015)

The data revealed that significant differences were examined between treatments. Significantly high number of shoots infestation were recorded in T_8 (Control) followed by T_3 (Physical control) and T_2 (Neem oil). While lower significant infestation was examined in T_7 (Cypermethrin + Neem oil + Physical Control) followed by T_4 (Cypermethrin & Neem oil) and T_1 (Cypermethrin). Similarly T_5 (Cypermethrin & Physical control) and T_6 (Neem oil and Physical control) showed statistically least differences over T_8 in Table (2).

On the basis of time interval, data recorded in first week was highly significant different from second, third and fourth week. Lowest shoots infestation (2.64) was observed in 1st week followed by 2nd (3.52), 3rd (4.41) and 4th (5.31) week.

Table 2: Effect of various treatments on means number of Brinjal shoots infestation by L. orbonalis after 2nd spray

Treatments	Time Interval (July, 2015)				Mean
	Weeks				
	1st	2nd	3rd	4th	
Cypermethrin (T_1)	2.12 mno	3 jkl	3.87 fghi	4.95 de	3.48 e
Neem oil (T_2)	2.83 kl	3.95 fgh	5 de	5.79 c	4.39 c
Physical control (T_3)	3.33 ijk	4.41 ef	5.45 cd	6.5 b	4.92 b
Cypermethrin + Neem oil (T_4)	2.08 mno	2.62 lm	3.5 hij	4.20 fg	3.10 f
Cypermethrin + Physical control (T_5)	2.62 lm	3.33 ijk	4.12 fg	5.12 d	3.80 d
Neem oil + Physical control (T_6)	2.75 kl	3.91 fghi	4. 41 ef	5.20 cd	4.07 d
Cypermethrin + Neem oil + Physical control (T_7)	1.58 o	1.91 no	2.5 lmn	2.79 kl	2.19 g
Control (T_8)	3.79 ghi	5.04 d	6.41 b	7.91 a	5.79 a
Mean	2.64 d	3.52 c	4.41 b	5.31 a	

(LSD 0.05 for Treatment, Intervals, & Treatments/Intervals are 0.3056, 0.2161, & 0.6111, respectively). Means followed by different letter(s) are significantly different from each other (LSD's test, $P<0.05$)

3.3 Effect of various control measures on shoots infestation in Brinjal (August, 2015)

The effects of different treatments on BSFB are presented in Table (3). Significantly low infestation was recorded in T_7 (Cypermethrin + Neem oil + Physical Control), followed by T_4 (Cypermethrin & Neem oil) and T_1 (Cypermethrin). While highly significant infestation was observed in T_8 (Control), followed by T_3 (Physical control) & T_2 (Neem oil). However, T_5 (Cypermethrin and Physical control) and T_6 (Neem oil and Physical control) showed least significant differences as compared to T_8 (Control).

It is shown in the results that statistically significant differences observed in the data recorded at weekly intervals. Significantly lowest infestation was recorded in first week (1.97) followed by second (2.60) and third (3.31) week while fourth week (4.02) recorded highest number of shoots infestation.

Table 3: Effect of various treatments on means number of Brinjal shoots infestation by *L. orbonalis* after 3rd spray.

Treatments	Time Interval (August, 2015)				Mean
	Weeks				
	1st	2nd	3rd	4th	
Cypermethrin (T_1)	1.70 pqr	2.20 mno	2.87 ijk	3.54 efg	2.58 f
Neem oil (T_2)	2.33 lmn	3.04 hij	3.87 de	4.75 b	3.5 c
Physical control (T_3)	2.5 klm	3.16 ghi	4.12 cd	5.16 a	3.73 b
Cypermethrin + Neem oil (T_4)	1.33 r	1.79 pq	2.33 lmn	2.83 ijk	2.07 g
Cypermethrin + Physical control (T_5)	2.04 nop	2.70 jkl	3.37 fgh	3.83 de	2.98 e
Neem oil + Physical control (T_6)	2.29 mn	2.87 ijk	3.70 ef	4.16 cd	3.26 d
Cypermethrin + Neem oil + Physical control (T_7)	0.83s	1.41 qr	1.83 op	2.37 lmn	1.61 h
Control (T_8)	2.79 ijk	3.62 ef	4.41 bc	5.5 a	4.08 a
Mean	1.97 d	2.60 c	3.31 b	4.02 a	

(LSD 0.05 for Treatment, Intervals, & Treatments/Intervals are 0.1902, 0.1345, & 0.3803, respectively). Means followed by different letter(s) are significantly different from each other (LSD's test, $P<0.05$)

3.4 Effect of various control measures on fruits infestation in Brinjal (June, 2015)

Different treatments showed effectiveness on Brinjal borer in Table (4). T_7 (Cypermethrin + Neem oil + Physical Control) showed significantly lowest infestation, followed by T_4 (Cypermethrin & Neem oil) and T_1 (Cypermethrin). While T_8 (Control) recorded highly significant infestation of fruits, followed by T_3 (Physical control) & T_2 (Neem oil). Moreover, T_5 and T_6 examined no significant differences between each other.

It is shown in the results that statistically significant differences observed in the data recorded at weekly intervals. Significantly lowest infestation was recorded in first week (0.22) followed by second (0.42) and third (0.65) week while fourth week (0.94) recorded highest number of fruits infestation.

Table 4: Effect of various treatments on means number of Brinjal fruit infestation by *L. orbonalis* after 1st spray.

Treatments	Time Interval (June, 2015)				Mean
	Weeks				
	1st	2nd	3rd	4th	
Cypermethrin (T_1)	1.70 pqr	2.20 mno	2.87 ijk	3.54 efg	2.58 f
Neem oil (T_2)	2.33 lmn	3.04 hij	3.87 de	4.75 b	3.5 c
Physical control (T_3)	2.5 klm	3.16 ghi	4.12 cd	5.16 a	3.73 b
Cypermethrin + Neem oil (T_4)	1.33 r	1.79 pq	2.33 lmn	2.83 ijk	2.07 g
Cypermethrin + Physical control (T_5)	2.04 nop	2.70 jkl	3.37 fgh	3.83 de	2.98 e
Neem oil + Physical control (T_6)	2.29 mn	2.87 ijk	3.70 ef	4.16 cd	3.26 d
Cypermethrin + Neem oil + Physical control (T_7)	0.83s	1.41 qr	1.83 op	2.37 lmn	1.61 h
Control (T_8)	2.79 ijk	3.62 ef	4.41 bc	5.5 a	4.08 a
Mean	1.97 d	2.60 c	3.31 b	4.02 a	

(LSD 0.05 for Treatment, Intervals, & Treatments/Intervals are 0.0978, 0.0691, & 0.1956, respectively). Means followed by different letter(s) are significantly different from each other (LSD's test, $P<0.05$)

3.5 Effect of various control measures on fruits infestation in Brinjal (July, 2015)

The results showed significant differences between treatments in Table (5). Significantly high number of fruits infestation were recorded in T_8 (Control) followed by T_3 (Physical control), T_2 (Neem oil), T_6 (Neem oil and Physical control) and T_5 (Cypermethrin & Physical control). While low significant infestation was examined in T_7 (Cypermethrin + Neem oil + Physical Control) followed by T_4 (Cypermethrin & Neem oil) and T_1 (Cypermethrin).

On the basis of time interval, data recorded in first week was highly significant different from second, third and fourth week. Lowest fruits infestation (0.38) was observed in 1st week followed by 2nd (0.60), 3rd (0.79) and 4th (1.06) week respectively.

Table 5: Effect of various treatments on means number of Brinjal fruit infestation by *L. orbonalis* after 2nd spray.

Treatments	Time Interval (July, 2015)				Mean
	Weeks				
	1st	2nd	3rd	4th	
Cypermethrin (T_1)	0.33 op	0.41 mno	0.62 jkl	0.79 ghi	0.54 f
Neem oil (T_2)	0.5 lmn	0.79 ghi	0.95 ef	1.20 c	0.86 c
Physical control (T_3)	0.58 kl	0.91efg	1 ef	1.37 b	0.96 b
Cypermethrin + Neem oil (T_4)	0.20 pqr	0.29 opq	0.54 klm	0.75 hij	0.44 g
Cypermethrin + Physical control (T_5)	0.29 opq	0.54 klm	0.75 hij	0.91 efg	0.62 e
Neem oil + Physical control (T_6)	0.37 no	0.66 ijk	0.87 fgh	1.16 cd	0.77 d
Cypermethrin + Neem oil + Physical control (T_7)	0.12 r	0.16 qr	0.37 no	0.58 kl	0.31 h
Control (T_8)	0.66 ijk	1.04 de	1.25 bc	1.75 a	1.17 a
Mean	0.38 d	0.60 c	0.79 b	1.06 a	

LSD 0.05 for Treatment, Intervals, & Treatments/Intervals are 0.0775, 0.0548, & 0.1551, respectively). Means followed by different letter(s) are significantly different from each other (LSD's test, $P<0.05$)

3.6 Effect of various control measures on fruits infestation in Brinjal (August, 2015)

The results in Table (6) showed significantly lowest number of fruits infestation in T_7 (Cypermethrin + Neem oil + Physical Control), followed by T_4 (Cypermethrin & Neem oil), T_1 (Cypermethrin) T_5 (Cypermethrin and Physical control) and T_6 (Neem oil and Physical control). While significantly high infestation was recorded in T_8 (Control), followed by T_3 (Physical control) & T_2 (Neem oil).

Statistically the results were shown significant differences in the recorded data at weekly intervals. First week (0.32) was recorded significantly low infestation followed by second (0.43) and third (0.60) week while fourth week (0.88) recorded statistically high number of fruits infestation.

Table 6: Effect of various treatments on means number of Brinjal fruit infestation by *L. orbonalis* after 3rd spray.

Treatments	Time Interval (August, 2015)				Mean
	Weeks				
	1st	2nd	3rd	4th	
Cypermethrin (T_1)	0.29 kl	0.37 ijkl	0.54 fgh	0.70 de	0.47 e
Neem oil (T_2)	0.45 ghij	0.5 fghi	0.58 efg	1.04 b	0.64 c
Physical control (T_3)	0.41 hijk	0.62 ef	0.79 cd	1.12 b	0.73 b
Cypermethrin + Neem oil (T_4)	0.25 lm	0.25 lm	0.45 ghij	0.62 ef	0.39 f
Cypermethrin + Physical control (T_5)	0.29 kl	0.37 ijkl	0.58 efg	0.83 cd	0.52 de
Neem oil + Physical control (T_6)	0.33 jkl	0.5 fghi	0.70 de	0.83 cd	0.59 cd
Cypermethrin + Neem oil + Physical control (T_7)	0.12 m	0.12 m	0.33 jkl	0.45 ghij	0.26 g
Control (T_8)	0.45 ghij	0.70 de	0.87 c	1.41 a	0.86 a
Mean	0.32 d	0.43 c	0.60 b	0.88 a	

(LSD 0.05 for Treatment, Intervals, & Treatments/Intervals are 0.0773, 0.0547, & 0.1547, respectively). Means followed by different letter(s) are significantly different from each other (LSD's test, $P<0.05$)

3.7 Effect of various control measures on yield (kg ha^{-1}) in Brinjal (June, July and August, 2015)

Highest yield (1641.41 kg ha^{-1}) was obtained from Cypermethrin + Neem oil + Physical Control, which is significantly higher in all treatments. This was followed by Cypermethrin + Neem oil, Cypermethrin, Cypermethrin + Physical Control and Neem oil + Physical Control, respectively. On the other hand lowest yield (275.48 kg ha^{-1}) was recorded from Control (untreated), followed by Physical Control measure and Neem oil measure in Table (7). The total yield (6923.78 kg ha^{-1}) was obtained during three months.

Table 7: Effect of Brinjal Shoot and Fruit Borer on Yield (kg ha^{-1}) recorded in various treatments during three months

Treatments	Yield (Kg ha^{-1})
Cypermethrin (T_1)	1081.26
Neem Oil (T_2)	550.96
Physical Control (T_3)	459.13
Cypermethrin + Neem Oil (T_4)	1377.41
Cypermethrin + Physical Control (T_5)	918.27
Neem Oil + Physical Control (T_6)	619.83
Cypermethrin + Neem Oil + Physical Control (T_7)	1641.41
Control (T_8)	275.48
Total	6923.78

Significantly high yield was recorded in T_7 (1641.41 kg ha^{-1}) followed by T_4 (1377.41 kg ha^{-1}) which is statistically on a par to T_1 (1081.26 kg ha^{-1}) and T_5 (918.27 kg ha^{-1}). However, T_8 was recorded significantly lower yield (275.48 kg ha^{-1}) followed by T_3 (459.13 kg ha^{-1}), T_2 (550.96 kg ha^{-1}) and T_6 (619.83 kg ha^{-1}), respectively.

Our findings relating to Cypermethrin are in agreement with Maleque MA. (1998) [12] who recorded that Cypermethrin combined with mechanical control produced high yield. However, the report of Srinivasan R. (2008) [22] regarding neem oil deviated from our findings who reported that neem based product showed high yield. The findings of Shahinoor R. (2014) [18] are in conformity with our finding who reported that treatment Ripcord (Cypermethrin 10EC) @ 1ml / l of water recorded significantly high marketable yield (30.55 t/ha).

Treatment$_7$ evaluated statistically higher shoots number against Brinjal Shoot and Fruit borer (BSFB) followed by T_4 and T_1, while T_8 showed significantly lower number of shoots followed by T_3, T_2, T_6 and T_5. Similarly, T_7 registered high fruits number followed by T_4 and T_1, while T_8 recorded significantly lower fruits number followed by T_3, T_2, T_5 and T_6.

The results of our findings regarding Cypermethrin + neem oil + physical control are conformity with Sharma *et al.*, (2012) [20] who reported that Cypermethrin + chlorpyriphos @ 0.01% at 15 days interval was found the most significant, while the report of Mathur *et al.*, (2012) [13] relating neem oil deviating from our findings who concluded that iluppai oil showed significant results than neem oil against BSFB. The findings of Chakraborti & Sarkar (2011) [2] are in conformity with our findings who reported that triazophos 40% + Cypermethrin 4% recorded good results against Brinjal Shoot and Fruit borer. Our findings relating to neem oil are conformity with Dutta *et al.*, (2011) [4] concluded that neem oil showed least economical regarding number of shoots and fruits infestation.

4. Conclusion

Among all treatments, T_7 (Cypermethrin + Neem oil + Physical control) was found comparatively the best by recording lowest mean number of shoots & fruits infestation. It is also obtained high yield production (Kg ha^{-1}) and is recommended as Integrated Pest Management (IPM) tool.

Peak infestation of *Leucinodes orbonalis* was recorded in second month (July) regarding shoots and fruits infestation in almost all interactions of treatments and time intervals.

A critical period for yield production by *L. orbonalis* was examined and need to be focused during this month (July). The recorded response of treatments towards *L. orbonalis* showed less or no adverse effect on environment.

5. References

1. Atwal. 1976. Agricultural pests of India and South-East Asia. https://books.google.com.pk/books/about/agricultural_pests_of_India_and_South_Ea.html?id.
2. Chakraborti S, Sarkar PK. Management of *Leucinodes orbonalis* Guenee on eggplant during the rainy season in India. J Protect. Res. 2011; 51:325- 328.
3. Dunlop F. Revolutionary Chinese cookbook. Recipes from Hunan Province. Ebury Press. 2006, 202.
4. Dutta P, Singha AK, Das P, Kalita S. Management of Brinjal Shoot and Fruit borer, *Leucinodes orbonalis* in agro-ecological conditions of West Tripura. Scholarly J. agric. Sci. 2011; 1:16-19.
5. FAO, 2012. FAOSTAT. (Available at: http://www.fao.org.)
6. FAO, 2014. FAOSTAT. (Available at: http://www.fao.org.)
7. Hanson PM, Yang RY, Tsou SCS, Ledesma D, Englea L, Lee TC. Diversity in eggplant (Solanum melongena) for superoxide scavenging activity, total phenolics, and ascorbic acid. J of Food Composition and Analysis. 2006; 19: 594-600

8. Latif MA, Rahman MM, Alam MZ. Efficacy of nine insecticides against shoot and fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) in eggplant. J Pestic. Sci. 2010; 83:391-397.
9. Latif AM, Mahbubar RM, Zinnatul AM, Mufazzal HM. Evaluation of flubendiamide as an IPM component for the management of Brinjal Shoot and Fruit Borer, *Leucinodes orbonalis* Guenee Mun. Entomol. Zool. 2009; 4:1.
10. Lohar MK. Applied Entomology, 2nd Edition. Kashif Publications Hyderabad Sindh. 2001, 31-34.
11. Mabberley DJ. Mabberley's Plant-Book. Third edition, Cambridge University Press. 2008, 1-1021.
12. Maleque MA. Judicious use of insecticides for the management of the Brinjal Shoot and Fruit Borer. Bang. J. Entomol. 1998; 8:97-107.
13. Mathur A, Swaroop S, Singh NP, Mahesh M. Field evaluation of plant products and microbial formulations against Brinjal Shoot and Fruit Borer, *Leucinodes orbonalis* Guenee under semi-arid conditions of Rajasthan. J. Bio-pest. 2012; 1:71-74
14. Matsubara K, Kaneyuki T, Miyake T, Mori M. Antiangiogenic activity of nasunin, an antioxidant anthocyanin in eggplant peels. J Agric. Fd. Chem. 2005; 53:6272- 6275.
15. Ministry of Food and Agricultur Paksitan, Fruits, Vegetables and Condiments Statistics, Economic Wing of Pakistan, 2009.
16. Nonnecke IBL. Vegetable production. *Van Nostrand Reinhold, NY,* 1989, 729
17. Saimandir J, Gopal M. Evaluation of synthetic and natural insecticides for the management of insect pest control of eggplant (*Solanum melongena* L.) and pesticide residue dissipation pattern. Am J Pl. Sci. 2012; 3:214-227.
18. Shahinoor R. Development of an effective dose of cypermethrin for managing Eggplant Fruit and Shoot Borer (*Leucinodes orbonalis*). Inter. J of Bio-science. 2014; 5:354-359.
19. Shanmugavelu KG. Production Technology of Vegetable Crops. Agri. Res. J Karala, India. 1989; 3:321-345.
20. Sharma DK, Haseeb M, Qamar M. Comparative Potential of Different Botanicals and Synthetic Insecticides and Their Economics against *Leucinodes Orbonalis* In Eggplant. J Pl. Prot. Res. 2012; 52:1.
21. Sharma AK, Chhibber RC. Effect of exposure periods and insecticides on *Leucinodes orbonalis* in Brinjal. Indian J. Entomol. 1999; 61(3):242-251.
22. Srinivasan R. Integrated Pest Management for eggplant Fruit and Shoot Borer (*Leucinodes orbonalis*) in south and South East Asia: Past, Present and Future. J Bio-pest. 2008; 2:105-112.