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Management of brinjal shoot and fruit borer through farmer's participatory approach

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Abstract
Field trails were conducted at 5 different villages in Gopalganj district of Bihar to evaluated beneficiary of botanicals and bio-pesticides for the management of brinjal shoot and fruit borer through farmers participatory approach. All the tested IPM modules were fanel to be statistically superior over the farmer practice and control. The IPM modules comprising with neem oil 0.4% + Pongamia oil 0.1% + Installation of pheromone traps was most effective in minimizing of shoot and fruit infestation of 86.82, 87.74% respectively. The aforesaid module gene maximum marketable fruit yield 225.76 q/ha with maximum percentage of increase yield our control 48.78 q/ha and also proved profitable as per maximum cost benefit ratio of 1:2.58 followed by neem oil (0.4%) + Pongamia oil (0.1%), *Beauveria bassiana*, farmers practice, mechanical measures with benefit cost ratio of 1:2.43, 1:2.06, 1:1.74 and 1:1.61, respectively.

Keywords: Brinjal, *Leucinodes orbonalis* farmers' participatory approach, IPM modules

Introduction
Brinjal (*Solanum melongena* L.) cosmopolitan and popular vegetable available throughout the year in India and also called poor man's crop in the country. Brinjal is one of the most common and popular vegetable crops grown in Bihar and other parts of India and the World. The brinjal crop is attacked by about 142 species of insects, 4 species of mites and 3 species of nematodes in different countries of the World (Sohi, 1966) [12]. Amongst these pests, brinjal shoot and fruit borer is the most serious and destructive one (Butani and Jotwani, 1984; Nair, 1986; Chattopadhyay, 1987) [3]. Although no information exists on the pest in terms of origin and diversity, it was concluded that brinjal shoot and fruit borer is also native to India due to its monophagous nature. The incidence of the pest is sporadic and outbreaks every year throughout the country as well as in the Indian sub-continent (Dhankar, 1988) [4]. The intensity of infestation may go over 90% in case of heavy infestation (Ali *et al*., 1980; Kalloo, 1988) [2, 8] and yield loss in certain cases may go up to 63% (Dhankar *et al*., 1977) [5] for which farmers mainly use Among the various insect pests that attack brinjal, the shoot and fruit borer, *Leucinodes orbonalis* (Maench) is the most important insect pests, causing damage to shoots in early vegetative stage and fruits in the reproductive stage. Shoot and fruit borer is also known as tissue borer, as they infest the crop in its early stage of growth. Larvae bone into the young growing shoots and as a result shoot drop down and wither away. Attack of this pest causes considerable damage to brinjal crop each year, affecting the quality and yield of the crop. The Larvae of this pest cause 12-16% damage to shoots and 20-60% damage to fruits Alum *et al* (1970; Maureal AM *et al*.1982) [9]. Later as they bone the developing fruit which become unfit for human consumption. Several IPM trials have been conducted all over the World and found that integration of all these control measures along with the application of pesticides reduces the pest problem to a great extent (Islam *et al*. 1999; Patnaik and Singh, 1997) [7, 10]. The incorporation of biopesticides and IPM technology is also gaining importance in recent years (Prabhat, and Johnsen, 2000; Bajpai *et al*. 2005) Hence it was thought to evaluate the different IPM modulus through farmer's participatory approach against *L.* orbonalis for developing economically viable control strategies of brinjal.

Materials and Methods
The present on farm trails were carried out by Krishi Vigyan Kendra Sipaya Gopalganj at Khem mathinia, Baraepatti, Bisanpura, Durgmathinia and Sallepur village in Gopalganj

district of Bihar during rain 2016-17 and 2017-18. Bio efficacy of botanicals and bio-pesticides had been taken for the management of *L. orbonalis* were evaluated a CV. Pusa purple round in the farmer's field. Pusa purple round is a round variety of brinjal. The plant is very tall with a thick stem of greenish purple, highly lobed with green coloured leaves. The round brinjal has an average weight of 137 gram with fruits per plant up to six. It is a shoot borer and a little leaf disease resistant plant. A model of IPM demonstration block of 40 hectare of brinjal crop involving 20 farmers was identified to establish bio-intensive IPM model in selected villages to demonstrate the effectiveness of IPM practices. The details of IPM modules were given below:

M_1- Neem oil (0.4%) + Pongamia oil (0.1%)
M_2- *Beauveria bassiana* @ 2.0 gm/l of water.
M_3- Neem oil (0.4%) + Pongamia oil (0.1%) + installation of pheromone traps (10 traps/ha)
M_4- Mechanical measure (collection and destruction of shoot and fruits)

The borer infestation was recorded on randomly selected 50 plants from each replication. The percentage data for the damaged shoot and fruits were converted into its angular transformation and data was subjected for statistical analysis using ANOVA for test of significance.

Table 1: Performance of IPM modules in management of brinjal shoot and fruit borer (Pooled data of 2017 and 2018)

IPM Modules	Shoot Damage (%)	Protection over control (%)	Fruit damage (%)	Protection over control (%)	Yield (q/ha)	Increased over control (%)
M_1	2.84 (9.63)	82.76 (65.50)	9.23 (17.64)	76.53 (61.00)	205.40	43.70 (41.38)
M2	6.36 (14.65)	61.38 (51.59)	22.41 (28.25)	43.00 (49.98)	165.25	30.02 (33.21)
M_3	2.17 (8.53)	86.82 (68.78)	4.82 (12.66)	87.74 (69.47)	225.76	48.78 (43.74)
M_4	10.52 (18.51)	36.13 m(36.93)	27.50 (31.63)	30.06 (33.27)	135.48	14.64 (22.46)
F.P	3.65 (10.62)	77.84(61.89)	13.65 (21.72)	65.28 (53.91)	138.52	16.52 (23.97)
Control	16.47 (23.95)	0.00	39.32 (38.82)	0.00	115.64	0.00
Sem (±)	0.341	1.042	1.047	2.238	5.280	0.709
CD (P=0.05)	1.024	3.125	3.142	6.714	15.841	2.126

Average of 25 farmers with 50 acres of land.
Figures in parentheses are angular transformed values.

Table 2: Effect of IPM modules on fruit yield and economics of brinjal (Pooled data of 2017 and 2018

IPM Modules	Yield (q/ha)	Gross return (Rs/ha)	Cost of cultivation	Benefits (Rs/ha)	C:B ratio
M_1	205.40	164320.00	67400.00	96920.00	1:2.43
M2	165.25	132200.00	63925.00	68275.00	1:2.06
M_3	225.76	180608.00	71436.00	109172.00	1:2.58
M_4	135.48	108384.00	67175.00	41209.00	1:1.61
F.P	138.52	110816.00	75450.00	35366.00	1:1.46
Control	115.64	92512.00	63315.00	30197.00	1:1.48
Sem (±)	5.280	-	-	-	-
CD (P=0.05)	15.841	-	-	-	-

Market price of brinjal fruits @ Rs 800.00/quintal
F.P.- Farmer's practice (15 times different insecticide sprays) Control-Untreated check.

Results and Discussion

The results revealed that all the IPM modules were effective in reducing the infestation of *L. orbonalis* in comparison to farmer's practice and control. (Table 1). Data showed that among the IPM modules, neem oil 0.4% + Pongamia oil (0.1%) + Pheromone traps (to traps/ha) was the most effective in reducing of shoot infestation (86.82%) and fruit infestation (87.74%) our control. This was followed by neem oil 0.4% + Pongamia oil (0.1%), farmers practice and entomopathogen fungi (*B. bassiana*) with reduction of shoot infestation by 82.26, 77.84 and 61.38%, respectively and fruit infestation by 76.53, 65.28 and 43.00% protection our control, respectively. The lowest efficacy was recorded in mechanical measure (Removal of shoots and fruits) 36.13% of shoot infestation and fruit damage 30.06% protection. Similar results and management of shoot and fruit borer of brinjal was observed by Tiwani *et al*. (2011). Whenever Pareet and Basavanagond (2012) [11] reported that microbial insecticides as *B. bassiana* was effective only at early stage of plant growth.

The pooled data of 2017 and 2018 of highest fruit yield showed that neem oil 0.4% + Pongamia oil 0.1% + Pheromone traps/ha (225.76 cs/ha) and neem oil 0.4% + Pongamia oil 0.1% (205.40 cs/ha) had high CB ration of 1:2.58 and 1:2.43, respectively. Farmer's practice recorded with lower yield of 138.52 cs/ha with less CB ratio of 1:1.46 due to high cost of synthetic insecticides. Pruent finding with corroborated earlier observations of sardana *et al*. (2004) [13]. Singh and Pandita (2009) [14], Gautam *et al*. (2008) [6] and Nagendra *et al*. (2013).

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