Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; SP1: 2033-2036

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ITK based pest management module for shoot and fruit borer (*Leucinodes orbonalis*) on Brinjal (*Solanummelongena* L.) Under terai agro-ecological system of West Bengal

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Abstract
Brinjal, *Solanum melongena* L.(Eggplant) is one of the most important vegetable crops in Asia, where more than 90% of the world's eggplant production occurs. Among different biotic and abiotic stresses, insect pest is one of the most important limiting factors for successful cultivation of brinjal. For protecting the crops, farmers usually rely upon chemical pesticides those gradually hampering non-target organisms, increasing cost of production as well as leaving hazardous residues in the produce (Prempong *et al*., 1977).

Among the non-chemical alternate technologies, indigenous technology may play important role in bringing sustainability in brinjal cultivation. From time immemorial, the farming communities of northern tract of West Bengal that comprises many aboriginal populations earlier used a number of indigenous techniques in managing pest menaces on brinjal. A good number of them are still in use on brinjal at different corners of the region. A number of indigenous knowledge based pest management module for brinjal have been formulated and tested in the agro-ecosystem under consideration during rabi season of 2015 and 2016. Inspiring results obtained in field trial from two years of study. Insect pest population observed lowest in chemical based pest management module but natural enemy complex found drastically low. On the contrary in indigenous knowledge based pest management module moderate pest population were recorded with higher natural enemy population. Thus, production cost reduced, non-target arthropod faunal complex less hampered and reasonable harvest recorded in indigenous knowledge based management module where almost all the indigenous technology were accommodated including use of sieve ash, cow urine, cow dung slurry and cow urine+cow dung slurry (Karkar *et al*., 2014). Hence, considering the ill effects of pesticidal application in agro- ecosystem and increasing cost of production, the indigenous technical knowledge based pest management technologies may be recommended to protect brinjal from pest menace. However, it may not be the only option but may be accommodated as one of the most viable as well as effective tools of IPM under northern parts of West Bengal.

Keywords: management module, shoot and fruit borer, agro-ecological system

Introduction
Vegetables play a pivotal role in strengthening the agrarian economy of developing countries like India by way of creating employment opportunity vis-à-vis providing raw materials to the agro industries. In addition to that, vegetables play an important role in providing balanced nutrition to the human beings as these are the highly valuable sources of carbohydrates, proteins, minerals and vitamins etc. Brinjal fruit contains 93% water, 40% carbohydrate, 1.4% protein, 0.3% minerals, 1.3% fibres, potassium, sulphur and phosphorous as well as vitamin A and C. Majority of Indian populations are vegetarian and they depend mainly upon vegetables to fulfill their dietary requirements. Almost all kinds of vegetables are cultivated in India in different corners of the country. Per capita consumption of vegetable in India is about 135 g per day as against the recommended 300 g per day (Dhandapani *et al*., 2003).

It is used in ayurveda as appetizer, aphrodisiac and cardio-tonic etc. (Chadha, 1993), whereas, white Brinjal is believed to be good for diabetic patients with its medicinal values (Chouhan, 1981). Apart from these, brinjal is a good source of ascorbic acid and phenolics, both of which are powerful antioxidants. It has also been recommended as an excellent remedy for those suffering from liver complaints (Shukla and Naik, 1993).

There are several constraints in Brinjal production which are responsible both qualitative as well as quantitative deterioration in yield. Among several biotic and abiotic stresses one of the most important limiting factors is the devastation caused by pest menace.

Insect pest is one of the most important factors among them. It suffers intense insect-pest attack due to favourable conditions available for their reproduction and multiplication. Brinjal crop has been damaged by one hundred forty (140) species of insect pests at different stages of the crop growth (Prempong *et al*., 1977).

A good number of them have also been documented and analyzed as well as refined by Laskar (2015). Again it is needless to state that, ITKs are community based functional knowledge system, developed, preserved and refined by generations of people through continuous interaction and observation with their surrounding environment. It is a dynamic system, ever charming, adopting and adjusting to the local situations and has close links with the culture, civilization and religious practices of the communities (Anon. 2002). These technologies are of low cost, easily available and above all eco-friendly.

Materials and methods

1. Technical Programmes to be undertaken

1.1. Experimental details

Variety	:	Local (Salta)
Season	:	Rabi
Year	:	2015-16 and 2016-17
Date of sowing	:	10.11.2015 and 10.11.2016
Design	:	RBD
Replications	:	5
Observation units	:	10 plants per replication
Plot size	:	5m X 5m
Spacing	:	60cm X 60cm
NPK	:	100:50:50
Plant Protection measures	:	One week interval
Number of treatments	:	6

1.2. Materials used in the indigenous technology

a) Cow dung slurry
b) Cow urine
c) Fresh cow dung
d) Wood ash

In addition to those, Carbosulfan 25% EC (Manufactured by FMC India Pvt. Ltd.) was taken as an insecticide for chemical based pest management module of Brinjal. Other material required to conduct the study were measuring balance, knapsack sprayer, bamboo sticks, ropes etc.

1.3. Evaluation of different ITK based pest management module

Four ITK based pest management modules have been formulated. One chemical based management module and another one control was there. Thus, altogether the efficacies of six treatments were evaluated in field condition. The Brinjal seedlings were transplanted during the second week of November for every two years i.e., during 2015-16 and 2016-17.

Table 1: Treatment details of the study

Treatments	Particulars	Remarks
T1	Application of wood ash	Sprinkling on leaves @ 50g/plant at 10 days interval.
T2	Application of Cow urine	Spraying of Cow urine and water (1:10) at 10 days interval.
T3	Application of Cow dung slurry	Spraying of Cow dung slurry and water (1:10) at 10 days interval.
T4	Application of Cow dung slurry + Cow urine	Spraying of Cow dung slurry and Cow urine (1:1) then the mixed with water (1:5) at 10 days interval.
T5	Application of *Carbosulfan 25% EC*	Spraying of Carbosulfan 25% EC@1ml/lit. At 10 days interval.
T6	Control (without adopting any pest management tactic).	Spraying only with tap water at 10 days interval.

First top dressing was given after 30 days of transplanting @ 5g Urea per plant and second top dressing was given after 60 days of transplanting @ 10g Urea and 5g MOP as the source of nitrogen and potassium per plant respectively.Recording of observation was started immediately after first top dressing. All other agronomic practices for raising the crop were as per the recommendation of Brinjalfor terai region of West Bengal.

2. Recording observation

2.1. Shoot and fruit borer

Observations on shoot and fruit infestation were recorded soon after noticing the damaged shoot and/or fruits. The shoot and fruit infestation was judged by counting healthy shoot and fruit and plants having damaged shoots and fruits infested by shoot and fruit borer on 10 randomly selected plants/plot. Percentage of shoot as well as fruit infestation determined as follows:

$$\% \text{ shoot / fruit infestation} = \frac{\text{Number of shoots / fruits damaged}}{\text{Total number of shoots / fruits observed}} \times 100$$

Results and discussion

Brinjal is one of the most important vegetable crops grown commercially under northern tract of West Bengal and is infested by a number of insect pests during its growing season. Brinjal is cultivated round the year in the agro-ecological region under consideration and insects pests cause irrepairable crop losses all round the year. However, only a few cause havoc damage of the crop in field condition and affect production both from qualitative and quantitative aspects. Farmers apply conventional toxic chemical insecticides indiscriminately to protect their crops from pest menace. This practice not only causing faunal destabilisation in the agro-ecosystem but also leaving toxic residue in the produce.

Indigenous technical knowledge (ITK), which the aboriginal

farming communities of northern West Bengal are using in agriculture since time immemorial may take pivotal role in minimising pesticidal load on brinjal. Considering this perspectives, in the present investigation four ITK based pest management modules have been formulated and evaluated against the pest complex of brinjal during rabi seasons of 2015-16 and 2016-17. One chemical based management module and another one control were also there with a view to compare the efficacy of ITK based management modules. Thus, altogether six treatments were evaluated in field condition in the present study. The crop i.e. brinjal were transplanted during second week of February every year during 2016 and 2017. First top dressing was applied at 21 days after transplanting. All other agronomic practices for raising the crop were as per recommendation of brinjal in terai region of West Bengal. Observation were recorded weekly and continued till harvest.

Data thus obtained from the study were stabilized and statistically analyzed by Microsoft Excel and INDOSTAT presented in tabular as well as graphical form as follows.

3. Shoot and Fruit feeding pest on brinjal

Fruit feeders are the most important pests of any crop because they cause damage to ultimate economic parts of the crop. In brinjal, there is only one pest viz. Fruit and shoot borer, *Leucinodesorbonalis* Guen. that feed on fruit directly causing considerable qualitative as well as quantitaive loss in production. In addition to cause damage to fruits it also infest shoots leading to partial wilting of the plant in vegetative as well as reproductive stage.

3.1. Fruitand shoot borer, *Leucinodesorbonalis* Guen. (Lepidoptera: Pyralidae)

In the present investigation it has been detected that the pest only appeared in the field during reproductive stage. No shoot infestation was noted in vegetative as well as reproductive stages of the crop during both the years of study i.e. 2015-16 and 2016-17. It only found to caused fruit damage during reproductive stage. Observation was recorded during harvesting of the crop. Percentage infestation was determined and cumulative % infestation was analysed and presented in the table.

From the presentation in table-2 it appeared that relatively low fruit damage was recorded in the treatment that comprises indigenous techniques than the control. However, the chemical management was the best in terms of reducing insect pest infestation but that also involved extra cost for the chemical which is nearly zero in case of ITKs. During rabi season of 2015-16 significantly higher percent damage of fruits (37.28%) have been detected control (T-6). Minimum infestation (17.93%) of fruits by the pest was noted in chemical based pest management module (T-5). Among the ITK based pest management modules intermediate infestation was recorded that varies from 24.03 to 25.94%. Significantly lowest percentage of fruit infestation was noted on T-4. However, no T-1, T-2 and T-3 are statistically at par with each other.

Table 2: Incidence offruit and shoot borer, *Leucinodesorbonalis* Guen. (Lepidoptera: Pyralidae), in different ITK based pest management module of brinjal.

Treatment	% infestation by fruit and shoot borer					
	2015-16		2016-17		Pooled mean	
	Fruit	Shoot	Fruit	Shoot	Fruit	Shoot
T-1	25.76^{c} (25.76)	0.00	20.23^{c} (20.22)	0.00	22.99^{c} (22.99)	0.00
T-2	25.63^{c} (25.53)	0.00	20.38^{c} (20.00)	0.00	23.00^{c} (22.76)	0.00
T-3	25.95^{c} (25.94)	0.00	20.28^{c} (20.28)	0.00	23.12^{c} (23.11)	0.00
T-4	24.03^{b} (24.03)	0.00	18.34^{b} (18.32)	0.00	21.17^{b} (21.17)	0.00
T-5	17.94^{a} (17.93)	0.00	13.27^{a} (13.27)	0.00	15.62^{a} (15.60)	0.00
T-6	37.29^{d} (37.28)	0.00	28.08^{d} (28.09)	0.00	32.86^{d} (32.68)	0.00
SEM (±)	0.159	--	0.153	--	0.156	--
CD at 0.05%	0.444	--	0.426	--	0.417	--

* Figures followed by same alphabet are not statistically different.

** Figures within parenthesis are square root transformed values.

[T1: Sprinkling of wood ash @ 50 gm/plant at 10 days interval, T2:Spraying of Cow urine and water (1:10) at 10 days interval, T3:Spraying of Cow dung slurry and water (1:10) at 10 days interval, T4:Spraying of cow dung slurry and Cow urine (1:1) then the mixed with water (1:5) at 10 days interval, T5:Spraying of Carbosulfan 25% EC@1ml/litre at 10 days interval, T6: Control (Spraying only with tap water at 10 days interval)]

During rabi season of 2016-17 significantly higher damage of fruits (28.09%) have also been detected control (T-6). In chemical based pest management module (T-5), minimum infestation (13.27%) of fruits by the pest was noted. Among the ITK based pest management modules intermediate infestation was recorded that varies from 18.32 to 20.28%. Here also, significantly lowest percentage of fruit infestation was noted on T-4 (18.32%). However, no T-1 (20.22%), T-2 (20.00%) and T-3 (20.28%) are statistically at par with each other.

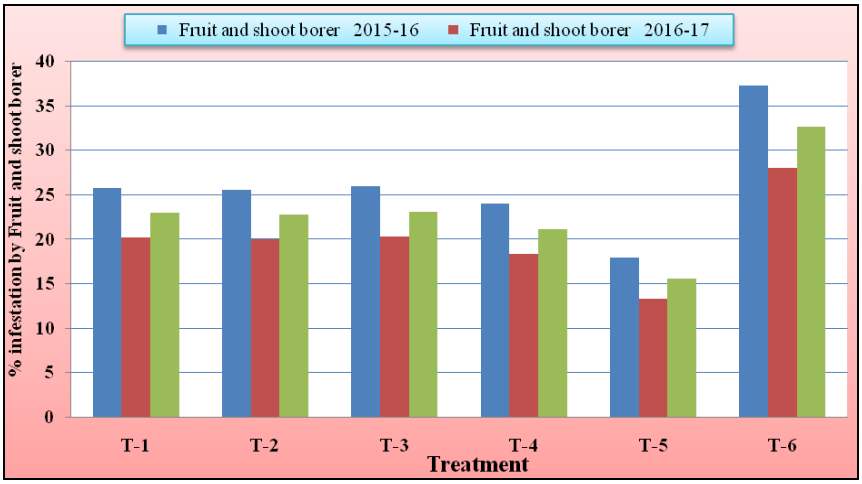

Fig 1: Incidence of fruit and shoot borer in different ITK based pest management moduleon brinjal.

When two years observation were pooled together significantly lowest fruit damage (15.60%) was noted in chemical based pest management module (T-5) whereas highest fruit damage (32.68%) was observed in control (T-6). Among ITK based pest management module T-4 appeared as the best treatment in lowering down percent fruit infestation (21.17%). All other ITK based pest management modules reduces pest infestation as compared to control but are statistically at par with each other.

Summary and conclusion

In the agro-ecological situation under consideration, the crop have to pass through several biotic and abiotic stresses. Among the stresses insect pest is one of the most important limiting factors for realizing optimum yeild potentiality of the crop. To protect the crop farmers are usually rely upon chemical pesticides that gradually hampering non-target organisms, developing resistance in the pest species. Resurgence of pest population also happening in addition to increasing cost of production.

With a view to lessen pesticidal load in brinjalagro-ecosystem, the alternate ways of crop protection may take important role. Among the alternate non-pesticidal technologies, indigenous technology may play pivotal role in bringing sustainability in agriculture. Indigenous technical knowledge (ITK) is the accumulated skill, technology of a locality or a community and has been passed from one generation to another generation. From time immemorial, the farming communities of northern tract of West Bengal that comprises many aboriginal populations used a number of indigenous techniques in managing pest menaces on brinjal. A good number of them are still in use on rabibrinjal at different corners of the region. Some of the indigenous technologies used in cultivation by the farmers have been documented through exhaustive snow ball survey methodology by Laskar *et al.* (2015). In the present study a number of indigenous knowledge based pest management module for rabibrinjal have been formulated and tested in the agro-ecosystem under consideration during rabi season of 2015-16 and 2016-17. Inspiring results obtained in field trial from two years of study.

The salient findings of the study are stated as follows:

- Production cost reduced, non-target arthropod faunal complex less hampered and reasonable harvest recorded.
- Insect pest population was noted lowest in chemical based module (T-5). Recommended chemical module included Carbosulfan 25% EC@1ml/lit. at 10 days interval. In respect of benefit cost ratio T-5 have also been appeared as the best pest management module.
- Among the ITK based pest management module T-4, i.e. application of cow dung slurry and cow urine mixture at an interval appeared as the most effective treatment.
- Brinjal without pest management practice suffer intense arthropod stress and thereby give lower yeild as observed in control plot (T-6) in the present investigation.

Thus, it may be inferred that application of indigenous techniques like cow dung slurry, wood ash and cow urine may be included in the present day IPM of brinjal under northern tract of West Bengal along with indigenous cultivars because these indigenous techniques show their best efficacy under the cultivation of local cultivars.

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