**Environmentally sound management of brinjal stem borer (*Euzophera perticella* Ragonot) for safe food production**

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**Abstract**

Brinjal (*Solanum melongena* Lin.) is a seasonal vegetable crop and grows best in arid and semi-arid climate. This crop is generally cultivated twice or thrice in a year. The fruit is the edible part and contains high nutritive value and may be compared with the fruits of tomatoes. Insect and non-insect (mite, nematode etc) pests are responsible to limit in the successful production of its fruits. Large number of pests attack to eggplant/brinjal crop and reduce its yield which is a great problem to the farmers. Eggplant/Brinjal stem borer *Euzophera perticella* Ragonot (Lepidoptera: Pyralidae) is an oligophagous insect pest found many areas in Asia including Indian. It feeds mainly on brinjal and often on some other solanaceous vegetables, viz. tomato, potato and chilli. Stem borer is sometimes reported as a severe pest in India. Tiruchirapalli district of Tamil Nadu and parts of West Bengal it is treated as an important pest. The caterpillars mainly cause damage by feeding inside the stem. Top shoots of young plants drop and wither. Old plant becomes stunted. Fruit bearing is affected. The insect is active form March to October when the temperature is high enough. Only a single procedure is not effective for controlling of the pest. The pest may be controlled through Integrated Pest Management (IPM) which contains cultural, mechanical, physical, behavioural, biological, microbial, genetical method etc. Finally, small amount of pesticides should be used f its damage is very high.

***Keywords:*** Seasonal fluctuation, bio-control, life-cycle, organic cultivation, sustainable management

**I. INTRODUCTION**

Vegetables rank an important place as food just next to cereals and serve as source of many nutrients viz carbohydrates, proteins, vitamins, minerals and energy (N.R.C., 1978). Besides nutrition, vegetables also supply to human body the dietary fibers contained of cellulose, hemicelluloses, protein and lignin. These dietary fibers and along with their roughage play an important role on gut function due to their bulk, having ability to absorption of water and their substrates for normal bacterial flora of the gut (Jones, 1978).

The origin of brinjal (also popularly known as eggplant) (*Solanum melongena* Lin.) is India, and it is cultivated for over 4000 years. It ranks second in total production just after potato, the brinjal cultivation continues as a major domestic crop across the country. Its cultivation accounts about nine per cent of total vegetable production with coverage of 8.14% land under vegetable cultivation. Economically it is very important vegetable crop and cultivated about 1.7 million hectare worldwide with a production of 29.46 million tones. Its average productivity is about 17.43 tons per hectare during 2004-05. In India, brinjal is grown of an area of 0.51 million hectares with annual production of 8.20 million tones. The productivity of brinjal in India is about 16.08 tons per hectare during 2005-06. The eggplant/brinjal belongs to the family Solanaceae and its genus *Solanum*, species *melongena*. Some synonyms to brinjal is egg plant, Guinea squash are. This vegetable crop is a native of India. Its secondary origin is China and South East Asia (Nath *et al*., 1987). The brinjal crop was well known to Indians since ancient time (Decando Le, 1986). The main centre of origin for brinjal is India with China as a secondary centre of origin (Thompson and Kelly, 1957). However, its cultivation is widely done in both temperate and tropical regions of the world (Rai *et al*., 1995). It is grown throughout the year in the most part of India including West Bengal (Ghosh, 1999) and Bangladesh (Singh, 1967).

Pest constraints of brinjal are very high in West Bengal including in North Bengal, India and causes heavy damage as well as yield loss and their management is very difficult (Ghosh and Senapati, 2002, Ghosh, *et.al*. 2003). Pests management by application of chemical synthetic pesticides is very harmful causing different abnormalities, viz environmental pollution, health hazards killing of different micro flora and micro fauna etc. It also lifts natural control of the pests by destroying parasites and predators like spider (Ghosh *et.al.*, 2006a), *Menochilus sexmaculatus* Berliner (Ghosh *et.al.*, 2007), *Coccinella septempunctata* (Chakraborty and Ghosh,2010; Ghosh, 2016). Among the harmful insect pests of brinjal which cause limits of production, shoot and fruit borer, *Leucinodes orbonalis* Guen is declared as the key pest as well as an alarming insect pest in brinjal growing regions including West Bengal (Banerjee and Basu, 1955 &1956 ; Ghosh and Senapati,2001a; Ghosh and Senapati,2009; Ghosh,2014) So and So shoot and fruit borer ranks first as a key pest that affects directly the fruit yield as well as its fruit quality. The other important Lepidopteran pests where larva causes heavy damage in West Bengal areBrinjal leaf roller (*Eublema olivacea* Walk.) and Brinjal stem borer *(Euzophera particella* Rag) (Ghosh, 1999). The harmful Hemipteran pests that cause heavy damage areAphid (*Aphis gossypii* Glov.) (Ghosh *et.al*., 2004a, Ghosh,2019), Jassid (*Amrasca biguttula biguttula* Ishida) (Ghosh, and Senapati 2003), Thrips (*Thrips tabaci* Lin.) (Ghosh *et.al*., 2005) and Whitefly (*Bemisia tabaci* Genn) (Ghosh *et.al*., 2004b). The harmful Coleopteran pests that cause heavy damage areHadda or spotted leaf beetle (*Henosepilachna vigintioctopunctata* Fabr.) (Ghosh, and Senapati 2001b), Flea beetle (*Phyllotreta* spp.) (Ghosh *et.al*., 2006b) and Blister beetle (*Mylabris pustulata)* (Ghosh,2020). Among the non-insect pest, mite pest (*Tetranychus cinnabarinus* Boisd.) is treated as very harmful to brinjal (Ghosh and Chakraborty, 2014, Ghosh, 2019). Other non-insect pest root-knot nematodes are designated as one of the major group of plant pathogens, which affect world's food production (Sasser, 1980). Alternate hosts of nematodes are cereals, other vegetables, oilseed crops, pulses, fibre-yielding crops, fruit trees, ornamentals, plantation crops etc. grown in various parts of the world. They are also damaged by these nematodes but vegetables including brinjal are considered as their preferred host crops. Quantitative as well as qualitative damage to the crops are done by this nematode.

Favourable climatic condition, presence of large number alternate host plants particularly some crops of solanaceous family and a number of weeds make a number of insect and non-insect pests to emerge as devastating form. Insect pests provide the major limiting factors in the successful cultivation of brinjal. Successful cultivation of the crops calls for an adequate knowledge of insect pest. Least work is done, and many spending in preparing land, manuring, transplantation and buying good seeds may all be undone by the ravages of insect pest. The damage of crop is done by direct feeding on the plants or by dissemination of harmful organisms from diseased plants to healthy plants. The crop is attacked by a number of serious pests:

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| --- | --- | --- | --- |
| Common name | Scientific name | Systematic position | Attacked plant parts |
| Shoot & fruit borer | *Leucinides orbonalis* (Guen.) | Family: Pyralidae  Order: Lepidoptera | Shoot& fruit |
| Hadda / epilachna beetle | *Henosepilachna vigintioctopunctata* Fabr. | Fam. : Coccinellidae  Order: Coleoptera | Leaf |
| Brinjal leaf roller | *Eublema olivacea* Walk. | Fam.: Noctuidae  Order: Lepidoptera | Leaf |
| Brinjal stem borer | *Euzophera particella* Rag. | Fam.: Phycitidae  Order: Lepidoptera | Shoot |
| Lace-wing bug | *Urentius sentis* Dist. | Fam.: Tingidae  Order: Hemiptera | Leaf |
| Aphid | *Aphis gossypii* Glov. | Fam. Aphididae  Order: Hemiptera | Leaf |
| Jassid | *Amrasca biguttula biguttula* Ishida | Fam. Cicadellidae  Order: Hemiptera | Leaf |
| Thrips | *Thrips tabaci* Lin. | Fam. Thripidae  Order: Thysanoptera | Leaf |
| Whitefly | *Bemisia tabaci* Genn. | Fam. Aleyrodidae  Order: Hemiptera | Leaf |
| Flea beetle | *Phyllotreta* spp. | Fam.: Chrysomelidae  Order: Coleoptera | Leaf |
| Mite | *Tetranychus urticae* Boisd.  *T. neocaledonicus* Andre | Fam.: Tetranychidae  Order: Acarina | Leaf |
| Root-knot nematode | *Meloydogyne incognita* White | Fam.: Heteroderidae  Order: Tylenchida | Roots |

**II. COMMON NAME**

The Brinjal Stem Borer or Egg plant Boring Caterpillar

**III. SCIENTIFIC NAME**  *Euzophera perticella* Rag.

**IV. TAXONOMIC TREE**

 Kingdom : [Animalia](https://gd.eppo.int/taxon/1ANIMK)

 Phylum : [Arthropoda](https://gd.eppo.int/taxon/1ARTHP)

 Subphylum : [Hexapoda](https://gd.eppo.int/taxon/1HEXAQ)

 Class : [Insecta](https://gd.eppo.int/taxon/1INSEC)

 Order : [Lepidoptera](https://gd.eppo.int/taxon/1LEPIO)

 Family : [Pyralidae](https://gd.eppo.int/taxon/1PYRAF)

 Genus : [Euzophera](https://gd.eppo.int/taxon/1EOZOG)

 Species : [*Euzophera perticella*](https://gd.eppo.int/taxon/EUZOPE)

**V. STATUS OF *EUZOPHERA PERTICELLA* AS PEST**

Eggplant stem borer *Euzophera perticella* Ragonot (Lepidoptera: Pyralidae) has been considered as an oligophagous insect pest. This pest causes damage mostly in the Indian subcontinent. The infestation of the pest on brinjal plant was first reported from Hyderabad by Rizvi and Sanyal (1977). It feeds and causes damage mainly on brinjal. Sometimes it also attacks on other solanaceous plants, viz. tomato, potato and chilli. This pest is generally considered as a minor pest of brinjal (Swamy and Satpathy 2007, Rai *et al*., 2014) but sometimes it attacks severely infestation becomes very high (Yadav and Kumawat 2013, Anonymous, 2014). Occasionally stem borer is found to be a serious pest in this subcontinent and causes heavy damage (Akhtar and Khawaja 1973, Anonymous 2014). In India, Tiruchirapalli district of Tamil Nadu (David *et al*., 2001) and some areas of West Bengal it is declared as a major pest (Anonymous 2006). Details Literatures of attack of stem borer on brinjal plant are very scanty, particularly its biology, population dynamics and periodical damage intensity of the borerof eggplant and its potential parasitoid(s).

**VI. APPEARANCE / MORPHOLOGY /** **MARKS OF IDENTIFICATION**

Moths are medium sized, forewings are pale straw yellow with distinct vertical black lines (transverse line) beyond middle of the wing and hind wings are whitish in colour and have pale-yellow abdomens. Wing expanse is 26 and 32 mm in male and female, respectively. Eggs are cream, scale-like. Fully grown larvae are creamy white.

**VII. DISTRIBUTION**

This insect is limited in distribution. The stem-borer is a minor pest of brinjal and is widely distributed in India and Sri Lanka. It is a major pest in Tamil Nadu, West Bengal , Uttar Pradesh etc province of India

**VIII. HOST RANGE**

The host range of this borer pest is very high. This insect mainly attacks and feeds on brinjal plant. It is reported that this pest also attack other solanaceous crops like potato, tomato, and chilies. Though this is not a serious pest, but sometimes infestations become serious.

**IX. BIOLOGY AND LIFE CYCLE**

The insect is active form March to October and its larva hibernates inside the stem of old plant from November to the beginning of March. The Overwintered larvae pupate at the beginning of March and emerge as moths in the second half of the month. Immediately after mating the females start laying eggs.

**1. Egg:** The eggs are cream coloured scale-like and are laid singly or in batches on tender leaves, petiole, and branches. The eggs are elongate and flat. One female may lay 104-363 eggs in its life span of about 7 days. The incubation period is 3-10 days.

**2. Larva:** The young larvae feed for a few minutes on exposed parts of plants and then bore into the stem making longitudinal tunnels. The larvae are full-fed in 26-58 days after passing four or five stages. The larva is looking like white or yellowish white in color having several bristly hairs and its head is orange-brown or red. The measurement of full-grown larva is 1.5 to 2 cm long. The larval lasts about 4-8 weeks and this variation takes place due to the temperature.

**3. Pupa:** Larva pupates within silken cocoons inside the feeding tunnel in the stem of the brinjal plant. It sometimes pupates in the soil. Pupae are dark brown and 12 mm in length. The pupal period is about 1-2 weeks.

**4 . Adult:** Moth generally emerges in six to eight days. The borer completes its life-cycle in 35-76 days. It has five to six overlapping generations in a year.

**5. Life history described by Halder *et al.* (2017):** The neonate larvae of stem borerare light yellowish green in colour. There are four instars of larvae. Larval period may vary from 29 to 47 days. Average larval period is 38.40 days. The third instar larvae are whitish in colour and having blackish hairs on its body.The fourth instar larvae are larger in size (14.5–19.25 mm in length). The head capsule is sclerotized and brown in colour, sparsely clothed with white minute hairs. The dorsal area of the body is brown spotted. The whole body is clearly segmented. In most cases pupation takes place in feeding galleries inside the stems of the brinjal plant. Sometimes pupation takes place in cracks and crevices in the soil. The obtect pupae are light brown in colour and having spindle shaped fibrous cocoon. The pupal period varied from 7 to 14 days. The average pupal period is 10.10 days. Adults are medium sized moth and its forewings are pale straw yellow and prominent dentate vertical black lines are found beyond middle of the wing. The hindwings are whitish in colour. Adult longevity ranges from 4 to 13 days. The adult female survives longer (average 8.68 days) than the adult male (6.08 days). Mating takes place mostly during night hours. The gravid females lay eggs singly on the young leaves, petioles and tender stems. Freshly laid eggs are oval in shape, light yellowish colour and it turns to yellowish brown before hatching. The oviposition period varies from 4 to 11 days. Egg viability ranges from 79-90% and an average of 83.90%. The incubation period varies from three to nine days. The insect becomes active from February to October and hibernates in the stem of old plant as larva from November to February in Varanasi areas, Uttar Pradesh, India condition. Swamy *et al*. (2006) reported that the incubation period varied from three to ten days, moths emerged in six to eight days and the pest completed its total life cycle in 35- 75 days.

**X. NATURE OF SYMPTOMS AND DAMAGE**

The caterpillars cause damage by feeding inside the stem. Newly emerged caterpillars bore in to the stem and move down ward by making a tunnel inside the stem. Just after hatching, the larvae bore into the stem near ground level. In most cases, the larvae bore in the branching area or in leaf axils and they seal the entry holes with excretory materials. There is a distinct thickening of stem at the entry point. Larvae move by feeding downward along the length of the main stem. This feeding result in stunted growth or wilting and withering of the whole plant and fruits bearing capacity is also reduced. The later stages of plant growth are most vulnerable to attack of this insect. Top shoots of young plants drop and wither. Old plant becomes stunted. Fruit bearing capacity of the plants is severely affected.

**1. Damage described by Halder *et al.,* (2017):** Hundred percent plants are affected by this stem borer pest During June–July. This infestation leads to discontinuation of the old crops and re-sown the new crop. Many farmers also report about the same problem. Initially infested plants turn light yellow in colour with stunted growth and patches across the plot are detected. Later on the infested plants are completely drooped, withered and wilted with stunted growth. Plant vigour is reduced and fruit bearing capacity of the plants are affected and lowered. Larvae of this stem borer, damage the stem portion of brinjal by feeding the pith portion and so translocation activity of the plants are reduced. The affected plants as visualized by their drooping nature. They may be uprooted and bring to the bio-control laboratory for examinatiom. Close observations prove that prominent larval galleries/tunnels filled with frassy excreta are found inside the stem and its underneath. Number of larval tunnels may vary from 3-11 per plant and an average of 7.92±0.69 tunnels/plant. Larval feeding tunnel length may vary from 8.4 – 21.3 cm and an average of 12.8 cm. On deep observation, it is found that most of the larvae (84.61%) exhibit positive geotropic movement i.e.*,* moving from stem towards root region, except few (15.39%) following reverse direction. Movement of the larvae is clearly visualized by comparing the diameter of the feeding tunnel. Pupation takes place generally inside the stem with brown coloured fibrous cocoon. Adult exit points are quite often adjacent to the branch or any weak or injured point on the stem. A single exit point is often used by many borer larvae by interconnecting their feeding tunnel.

**XI. SEASONAL INCIDENCE**

The insect is active form March to October when the temperature is high enough. They hibernate as larvae inside the old plant stem during winter from November to the beginning of March. The pests emerge as moths in the second half of March.

1. **Incidence described by Halder *et al.* (2017):** Population dynamics of the stem borer at field level is observed from beginning of third week of February with 13.5% damage stem and branches and gradually increase coinciding with increase in atmospheric temperature during summer months. The damage of the stem during March, April, May and June are 29.75, 51.5, 76.5 and 89.7%, respectively. Almost all the plants are infested by this stem borer during July. During June–July, about cent percent plants are infested by this stem borer pest and that lead to discontinuation of the old crops and re-sown the new crop. The lower temperature during winter restricts its normal growth and development and the larva goes to hibernation. This results as is evident from no incidence or very little incidence of this stem borer pest during November to mid of February, i.e*.* winter at Varanasi, India. In a study, it is observed that infestation of stem borer was found usually in the later stage of brinjal crop (Anonymous 2008). In contrast, Sathe *et al*. (2016) reported that infestation of eggplant stem borer, occurred during October to March under Kolhapur region of Maharashtra, India. Satpathy *et al*. (2006) reported that during July, 15-34% brinjal plants were infested, whereas during August the severity of damage increased and the average plant infestation was 49.45% indicating three times increases in infestation during one month.

**XII. MANAGEMENT OF THE PEST**

**1. Management practices in brief:**

* Collection and destruction of the damaged, dried and dead plants.
* Installation of light traps @ 10-12/ha for attracting and killing the adults.
* Ratoon cropping should be avoided. When the attack of this borer is serious, the rationing of brinjal plants should be discontinued. The withered plants should be up rooted and burnt.
* Protecting the population of the parasitoids such as *Pristomerus.* Reduced use of the chemical synthetic pesticides may increase the activities of these natural defenders of stem borer. The larvae are parasitized by *Pristomerus testaceus* Mori. And *P. euzopherae* Vier.
* Avoid the use of synthetic pyrethroids which may cause resurgence of the pest.
* Application of neem cake in the soil may reduce the heavy incidence of stem borer.
* Spraying neem oil @ 2.5 ml/L.
* Application of recommended pesticide, if situation demands so.
* Application of safe pesticides in the soil in consultation with the local extension staff, if necessary.
* Four sprays 315 ml of dichlorvos (DDVP)76 EC, in 625 litres of water/ha should be given at 15 days intervals.
* Spray any one of the following insecticides starting from one month after transplanting at 15 days interval; NSKE 5%, Azadirachtin 1.0% or  Fenpropathrin 30 EC or  Thiodicarb 75 WP spray should be repeat at 15 days interval.

**2 . Harmful effect of chemical insecticides:**

Since the discovery of insecticide properties of DDT in 1939 by Dr. Paul Muller, there had been a great expansion in the use of chemicals for pest control. Pesticides during manufacturing, transportation, storage and actual use enter in the abiotic and biotic components of the environment through air, water and soil and disturb the ecosystem, causing great disaster sometimes. Miss Rachel Carson in her book “Silent Spring” in the year 1962 knocked the people referring the forceful account of the dangerous effect of chemical pesticides to the environment. Today the environmental pollution is a great problem and may be of everybody’s concern. The chemical pesticides are accumulated to the environment by being transported from one system to another. These contaminate all the systems i.e. air, water, soil, plants animals etc. Although pesticides are protecting the Agri-horti crops from insect and other pests for increasing up the agri-horti production but bring out ecological disturbance and environmental pollution. A large number of chemical insecticides like BHC, aldrin, dieldrin, toxaphene, methyl parathion, heptachlor, chlordane, phorate etc. are being used in India for the management of termite, white grub, cutworm, root borer etc. It is found that the pesticides disturb the microbial activity in the soil, adversely affect the earth worm and may be harmful to the predatory mites and carabid beetles. They may adversely affect some invertebrate animals that were responsible soil fertility. The uptake of chemical insecticide residues by some crops has adverse effect on our health. The people around vicinity of pesticide factories even up to 5-7 km area badly feel off flavor and such suffocated environment ultimately results in different kind of diseases among the residents. The contamination of air during pesticide application may also take place which could pose serious health hazards, if the concentration in air rose above the thresh hold values. Different doses of pesticides at different dose levels are being used on the different types of crops against noxious pest all over the country for the last four decades. Saxena *et al*., (1990) reported that the residue of malathion was found more than the permissible limits in tomato, okra, cauliflower, brinjal and beans. Gupta et al., (1987-88) reported that above 60% samples of potato, brinjal, cabbage, cauliflower okra and cucurbits were containing the residues of organophosphatic insecticides more than the permissible level. Water has been found contaminated with pesticides by different ways. Many great rivers of the world have been found to contain large amount of chemical insecticide residues which kill the fishes and many other aquatic animals living there (Srivastava and Saxena, 1989). In order to destroy unwanted plants, insects and fishes etc. the deliberate use of pesticide is being done due to which water is contaminated. Water has also been found to be contaminated with pesticides through run off from fields, through sewage disposal, through the effluents of industries using pesticides, through dead and decayed plants treated with pesticides. In UK the presence of insecticides was reported in rain water. Fresh rain water on the mountain top of the Himalaya was found possessing pesticide residues. Some common cultivated crops, vegetables and fruit plants are found to be affected with indiscriminate and injudicious use of chemical pesticides right from germination through growth to harvest. The high dose application of chemical pesticides may create resurgence of the target harmful pests against applied pesticides, the outbreak of some unimportant pests. The chemical pesticides are also harmful to beneficial fauna such as honey bees and natural enemies like parasites, predators and pathogens of the pests etc. As a result of pesticide pollution, the living beings are affected in several ways. Many diseases may develop in human beings and domestic animals if chemical pesticides are applied.

**3. Details study of predators and parasitoids of brinjal stem borer (Halder *et.al.,* 2017):**

*Pristomerus euzopherae* Viereck (Hymenoptera: Ichneumonidae) an endoparasitoid was recovered from *E. perticella*. The length of adult female is 7.5 to 8 mm (excluding ovipositor). The body colour is pale yellow with mandibular apices, claws, antennal flagellum. The bases of all gastral segments black, mesothorax with three black patches. Head and thorax are punctuate, gastral segment I and II aciculate. Wings are hyaline in colour, all veins and stigma of the wings are dark. Antenna is extending to almost apex of post petiole. Fore and mid legs are pale yellow in colour. The hind legs consist of black patches, and hind femur consist of a distinct spine. The parasitization by *P. euzopherae* is recorded first during the 3rd and 4th week of April when only 1.91% stem borerlarvae are parasitized. From the month of April onwards, rate of parasitization is gradually increased and the highest parasitization (12.48%) is recorded during July followed by June (7.73%). This is the first comprehensive report of *P. euzopherae* as an endoparasitoid of brinjal stem borer from Varanasi areas. The adult female parasitoid begins to oviposit from the first day onwards. In the act of oviposition, the female arches her abdomen to penetrate its ovipositor into the host larvae remaining inside the stem for egg laying. The lifespan of *P. euzopherae* females varies from 7.5-13.75 days and an average of 10.63 days in laboratory conditions. According to Jiménez *et al*. (2000), the first generation of *P. spinator* females (F1), a parasite of the potato tuber moth (*Pthorimaea operculella*), has a mean lifespan of 33.5 days and second generation females (F2) lives 10 days less than F1.

# 4. IPM (Integrated Pest Management) on brinjal: IPM on brinjal/eggplant and other vegetable crops is in a different stage of development in different countries but is becoming increasingly more important with the problems such as resurgence of pests. IPM usually involves using pest threshold for treatment, decision, appropriate cultural practices and giving priority to microbial and other selective insecticides to protect i natural enemies. Some countries also employ additional elements such as light trapping, use of sticky traps, and physical barriers using netting. On implementation emphasis is given to understanding farmers’ knowledge, attitude and practices in pest control and in guiding them to think IPM through participatory training and field demonstration.

**5. Future IPM Strategy for terai region:** The constantly changing dynamic nature of agro-ecosystem results in equally dynamic changes in pests and the problem they pose. The values of control techniques in time and with such variable like bio-ecological understanding of the phenomena, development of technological and differences in economic threshold levels. Thus IPM programme devised once cannot be a permanent solution to the pest problems of crop. With the rapid change of science and technology and constantly changing dynamic nature in cultivation system, pest management strategy is likely to go on changing from time to time. In perspective of this situation more and more programme for research to be conducted to formulate IPM modules of various crops under different agro-ecological situation and subsequent field testing through direct involvement of farmers to be organized to the following areas.

* Development of surveillance and monitoring programme at last for key pests of vegetable crops in order to develop a forecasting system through interaction between crop phenology and insect phenology to avoid synchronization between peak period in pest attack and vulnerable stage of crop growth.
* Identification of ecological barriers for both pests and natural enemies.
* Development of cultivars/germplasms against harmful insect-pests.
* Exploiting non-chemical control of insect-pests such as physical, cultural, mechanical and biological control methods on different crops.
* Testing of bio-pesticides like microbials and botanicals in the laboratory and subsequently in the field under different crop eco-system.
* Mass production of bio-agents under IPM.
* Judicious / need based application of pesticides at a minimum dose.
* Testing of IPM technologies in different crops whenever developed.

Failures of IPM are generally occurred because of lack of direct involvement of farmers. Farmers’ acceptance of IPM is related to their initiative understanding of the eco-system and to their perception/experiences. Thus training which provides the motivation and confident decision making capabilities give better results. Following training programme for IPM can be drawn for vegetable crops in pesticide intense system.

* Crop growth oriented agro-ecosystem analysis on the basis of seaspnal incidence of pests and beneficial organisms.
* Understanding the role of naturally occurring beneficial organisms.
* Economic threshold level (ETL) and Economic injury level (EIL) of pest population.
* Resistant varieties.
* Harmful effects of pesticides on beneficial organisms that includes parasites, predators, frogs, fishes and honeybees.

Lastly, for evolving IPM strategies that would be appropriate and suitable in different agro-ecological zones for different crops expanded research and adequate investment are necessary. Success in crop production sustainability is largely dependent on availability of dedicated plant protection personnel, a pragmatic public policy and a determined political will in the coming years.

**XIII. CONCLUSION**

Brinjal is widely cultivated in both temperate and tropical regions of the globe. It is cultivated throughout the year in the most part of India including and Bangladesh. Favourable climatic condition, presence of large number alternate host plants particularly other solanaceous crops and weeds make a number of pests to emerge as devastating ones. Insect pest provide the major limiting factors in the successful cultivation of brinjal. Successful cultivation of the crops calls for an adequate knowledge of insect pest. Least work is done, and many spending in preparing land, manuring, transplantation and buying good seeds may all be undone by the ravages of insect pest. The damage of crop is done by direct feeding on the plants or by dissemination of harmful organisms from diseased to healthy plants. The constantly changing dynamic nature of agro-ecosystem results in equally dynamic changes in pests and the problem they pose. The values of control techniques in time and with such variable like bio-ecological understanding of the phenomena, development of technological and differences in economic threshold levels. Thus IPM programme cannot be a permanent solution to the pest problems of crop. With the rapid changing of science and technology and constantly changing dynamic nature in cultivation system, pest management strategy is likely to go on changing from time to time.

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