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

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**Abstract**

Eggplant/brinjal (*Solanum melongena* L.) is a hardy crop and does best in worm and moist climate. The crop is generally grown twice or thrice in a year. The edible part, fruit is of high nutritive value and can well be compared with tomatoes. Insect pest constitute the major limiting factors in the successful production of eggplant/brinjal. Pest complex of eggplantl is very high and create severe problem to the farmers for its cultivation. Eggplant/Brinjal stem borer *Euzophera perticella* Ragonot (Lepidoptera: Pyralidae) is an oligophagous insect pest found mostly in the Indian subcontinent. It feeds mainly on brinjal but sometimes on other solanaceous plants, viz. tomato, potato and chilli. Occasionally stem borer is reported to be a severe pest in this subcontinent. Tiruchirapalli district of Tamil Nadu and parts of West Bengal it is considered as a major pest. Damage is caused by the caterpillars 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 can be managed through Integrated Pest Management (IPM) comprising cultural, mechanical, physical, behavioural, biological, microbial, genetical method etc. Lastly a little amount of pesticides may be used f it is difficult to control.

***Keywords:*** Seasonal fluctuation, bio-pesticides, life cycle, organic farming, sustainability

**I. INTRODUCTION**

Vegetables rank next to cereals and occupy a very important place in human diet and serve as supplementary source of nutrients like carbohydrates, proteins, vitamins, minerals and energy for all (N.R.C., 1978). Besides nutrition, vegetables act as an important source of dietary fiber comprised of inassimilable cellulose, hemicelluloses, protein and lignin. These dietary fibers provide the roughage and have an important effect on gut functioning due to their bulk, their ability to absorb water and their being substrates for normal bacterial flora of the gut (Jones, 1978).

The brinjal (also popularly known as eggplant) (*Solanum melongena* L) is originated in India, and to be known to have been cultivated for over 4000 years. Second only to the potato in terms of total quantity produced, the eggplant continues to be an important domestic crop cultivated across the country accounting for 9% of total vegetable production and covering 8.14% of the land under vegetable cultivation. It is an economically important vegetable grown over 1.7 million hectare worldwide with a production of 29.46 million tones with an average productivity of 17.43 tons per hectare during 2004-05. In India, eggplant occupies an area of 0.51 million hectares with an estimated annual production of 8.20 million tones and the productivity stands at 16.08 tons per hectare during 2005-06. The eggplant/brinjal belongs to the family Solanaceous and to the genus Solanum, species melongena. The egg plant, Guinea squash are some synonyms to brinjal. Brinjal is a native to India. It shows the secondary diversity in China and South East Asia (Nath *et al*., 1987). The brinjal was well known to India since ancient time (Decando Le, 1986). The centre of origin for brinjal is India with China as a secondary centre (Thompson and Kelly, 1957). However, it is widely cultivated in both temperate and tropical regions of the globe (Rai *et al*., 1995). It is grown year round throughout most part of India including West Bengal (Ghosh, 1999) and Bangladesh (Singh, 1967).

Pest complex of brinjal is very high in West Bengal particularly in North Bengal, India causes heavy yield loss and their control is very difficult (Ghosh and Senapati, 2002, Ghosh, *et.al*. 2003). Pests control by using pesticides is very harmful causing environmental abnormality, health hazards etc. It also causes damage to the natural suppression of the pests by killing 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 various insect pests causing limitations, shoot and fruit borer, *Leucinodes orbonalis* Guen has treated as an alarming insect pest in eggplant/brinjal growing areas including West Bengal (Banerjee and Basu, 1955 &1956 ; Ghosh and Senapati,2001a; Ghosh and Senapati,2009; Ghosh,2014) and ranks first as a key pest directly affecting the fruit yield as well as its fruit quality. The other important Lepidopteran pests in West Bengal areBrinjal leaf roller (*Eublema olivacea* Walk.) and Brinjal stem borer *(Euzophera particella* Rag) (Ghosh, 1999). The important Hemipteran pests causes 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 important Coleopteran pests 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). Mite (*Tetranychus cinnabarinus* Boisd.) also causes heavy damage to eggplant (Ghosh and Chakraborty, 2014, Ghosh, 2019). Root-knot nematodes are recognized as one of the major group of plant pathogens affecting world's food production (Sasser, 1980). Vegetables, cereals, pulses, oilseed crops, fibre-yielding crops, ornamentals, fruit trees, plantation crops etc. grown in different parts of the world are affected by these nematodes but vegetables are considered as their preferred host crops. They cause quantitative as well as qualitative damage to the crops.

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 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 or spotted leaf 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 cinnabarinus* Boisd.  *T. neocaledonicus* Andre | Fam.: Tetranychidae  Order: Acarina | Leaf |
| Root-knot nematode | *Meloydogyne incognita* White | Fam.: Heteroderidae  Order: Tylenchida | Root |

**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/Brinjal stem borer *Euzophera perticella* Ragonot (Lepidoptera: Pyralidae) is an oligophagous insect pest found mostly in the Indian subcontinent. The first infestation of this pest in eggplant was reported from Hyderabad by Rizvi and Sanyal (1977). It feeds mainly on brinjal but sometimes on other solanaceous plants, viz. tomato, potato and chilli. It is generally considered as a minor pest of eggplant (Swamy and Satpathy 2007, Rai *et al*., 2014) but occasionally its infestation is reported to be severe (Yadav and Kumawat 2013, Anonymous, 2014). Occasionally stem borer is reported to be a severe pest in this subcontinent (Akhtar and Khawaja 1973, Anonymous 2014). In India, viz. Tiruchirapalli district of Tamil Nadu (David *et al*., 2001) and parts of West Bengal it is considered as a major pest (Anonymous 2006). Literature on biology, seasonal incidence and periodical damage of the *E. perticella* on eggplant and its potential parasitoid(s) are very scanty.

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

Moths are medium sized, forewings are pale straw yellow with distinct dentate 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**

This oligophagous insect feeds mainly on eggplant, and sometimes on other solanaceous plants such as tomato, potato, and chilies. Although it is not a serious pest, infestations occasionally can be severe.

**IX. BIOLOGY AND LIFE CYCLE**

The insect is active form March to October and hibernates as larva in 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. Soon 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. A single 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 white or yellowish white in color with several bristly hairs and an orange-brown or red head. The full-grown larva is 1.5 to 2 cm long. The larval period is about four to eight weeks depending on the temperature.

**3. Pupa:** Larvae pupate within silken cocoons inside the feeding tunnel in the stem or in the soil. Pupae are dark brown and 12 mm in length. The pupal period is about one to two weeks.

**4 . Adult:** Moth emerged in 6-8 days. The insect completes its life-cycle in 35-76 days and has 5-6 overlapping generations in a year.

**5. Life history described by Halder *et al.* (2017):** The neonate larvae of *E. perticella* were light yellowish green in colour. There were four larval instars. Larval period varied from 29 to 47 days having mean duration of 38.40 days. The third instar larvae were whitish in colour with blackish hairs on its body, whereas fourth instar larvae were bigger in size (14.5–19.25 mm in length) with brown sclerotized head capsule, sparsely clothed with white minute hairs and brown spotted dorsal area and clearly segmented body. Pupation took place mostly in feeding galleries inside the stems or sometime in cracks and crevices in the soil. The obtect pupae were light brown in colour with spindle shaped fibrous cocoon. The pupal period ranged from 7 to 14 days, with an average of 10.10 days. Adult was medium sized moth whose forewings were pale straw yellow with prominent dentate vertical black lines beyond middle of the wing and hindwings were whitish in colour. Adult longevity varied from 4 to 13 days. The adult female survived longer (average 8.68 days) than the male (6.08 days). Mating took place mostly during night hours and gravid females laid eggs singly on the young leaves, petioles and tender stems. Freshly laid eggs were oval in shape, light yellowish colour which turned to yellowish brown before hatching. The oviposition period ranged from 4 to 11 days. Egg viability ranged from 79-90% with average 83.90%, whereas incubation period varied from 3-9 days. The insect is active from February to October and hibernates as larva in the stem of old plant from November to February under Varanasi, Uttar Pradesh, India condition. Swamy *et al*. (2006) reported that the incubation period ranged from 3-10 days, moths emerged in 6-8 days and insect completes its total life cycle in 35- 75 days.

**X. NATURE OF SYMPTOMS AND DAMAGE**

Damage is caused by the caterpillars by feeding inside the stem. Newly emerged caterpillars bore in to the stem and move down ward by making a tunnel inside the stem. Soon after hatching, the larva starts boring into the stem near ground level. Mostly they bore in the branching area or in leaf axils, and seal the entry holes with excretory materials. There is a distinct thickening of stem at the entry point. Larvae feed downward along the length of the main stem, which results 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 this insect. Top shoots of young plants drop and wither. Old plant becomes stunted. Fruit bearing is affected.

**1. Damage described by Halder *et al.,* (2017):** During June–July, cent percent plants were affected by this borer pest which led to discontinuation of the old crops and re-sow the new crop. Several local farmers also reported about the same problem. Initially infested plants became light yellow in colour with stunted growth and detected in patches across the plot. Later on the infested plants were completely drooped, withered and wilted with stunted growth, reduced plant vigour and lowered fruit bearing capacity. Larvae of stem borer, *E. perticella* damaged the stem portion of the eggplant by feeding the pith portion thereby reducing the translocation activity of the plants. The affected plants as visualized by their drooping nature were uprooted and brought to the biocontrol laboratory. Close observations revealed that prominent larval galleries/tunnels filled with frassy excreta were observed inside the stem and its underneath. Number of larval tunnels were varied from 3-11 per plant with an average of 7.92±0.69 tunnels/plant. Larval feeding tunnel length varied from 8.4 – 21.3 cm with an average of 12.8 cm. On critical examination, it was found that most of the larvae (84.61%) exhibited positive geotropic movement i.e.*,* moving from stem towards root region, except few (15.39%) following reverse direction. Movement of the larvae was clearly visualized by comparing the diameter of the feeding tunnel. Pupation was generally inside the stem with brown coloured fibrous cocoon. Adult exit points were quite often adjacent to the branch or any weak or injured point on the stem. A single exit point was 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 larva in the stem of old plant 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):** Field incidence of the stem borer was observed from second fortnight of February with 13.5% stem damage and gradually increased coinciding with increase in atmospheric temperature during summer months. The stem damage during March, April, May and June were 29.75, 51.5, 76.5 and 89.7%, respectively. Almost all the plants were affected by this borer during July. During June–July, cent percent plants were affected by this borer pest which led to discontinuation of the old crops and re-sow the new crop. The lower temperature restricts its normal growth and development resulting as was evident from no incidence of this borer pest during November to first fortnight of February, i.e*.* winter at Varanasi. In another study it was confirmed that infestation of stem borer was seen usually in the later stage of crop (Anonymous 2008). In contrast, Sathe *et al*. (2016) reported that infestation eggplant stem borer, *E. perticella* occurred during October to March under Kolhapur region of Maharashtra, India. Satpathy *et al*. (2006) documented that during the July, 15-34% plants were infested, whereas during August the severity of damage increased and the mean plant infestation was 49.45% indicating three fold increases in infestation during one month.

**XII. MANAGEMENT OF THE PEST**

**1. Management practices in brief:**

* Collection and destruction of the damaged and dead plants.
* Installation of light trap @ 10-12/Ha to attract and kill 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 synthetic pesticides may enhance the activities of these natural enemies. 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 to reduce the incidence of stem borer.
* Spraying neem oil @ 2.5 ml/L.
* Application of recommended pesticide, if situation demands so.
* Apply a pesticide in the soil in consultation with the local extension staff, if absolutely 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 planting 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 awakened the people referring the forceful account of the dangerous effect of pesticides to the environment. Today the environmental pollution is a great problem and may be of everybody’s concern. The pesticides are accumulated in the environment and contaminate all the systems i.e. air, water, soil, plants animals etc. by being transported from one system to another. Although pesticides are protecting the Agri-horti crops from insect and other pests for increasing up the agricultural production but bring out ecological disturbance and environmental pollution. A variety of insecticides like BHC, aldrin, dieldrin, heptachlor, chlordane, toxaphene, methyl parathion, phorate etc. are being used in our country for the control of termite, white grub, cutworm, root borer etc. It is found that the pesticides disturb the microbial activity of the soil, adverse effect on the earth worm and may harm the predatory mites and carabid beetles. They may have adverse effect on some invertebrates that were responsible soil fertility. The uptake of insecticide residues by some crops adversely affects our health. The people around vicinity of pesticide factories even upto 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 raised 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 insecticide residues which killed the fishes and 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. Commonly cultivated crops, vegetables and fruit plants have been found to be affected with injudicious use of pesticides right from germination through growth to harvest. The application of pesticides may bring the resurgence of the target pests against which the chemicals are applied, the outbreak of some unimportant pests. The 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, several diseases may develop in human beings and domestic animals.

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

*Pristomerus euzopherae* Viereck (Hymenoptera: Ichneumonidae) an endoparasitoid was recovered from *E. perticella*. The adult female is 7.5 to 8 mm long (excluding ovipositor). The body is pale yellow with mandibular apices, claws, antennal flagellum and bases of all gastral segments black, mesothorax with three black patches. Head and thorax punctuate, gastral segment I and II aciculate. Wings are hyaline, all veins and stigma are dark. Antenna was extending to almost apex of post petiole. Fore and mid legs are pale yellow, hind legs with black patches, hind femur with a distinct spine. The parasitization by *P. euzopherae* was recorded first during the second fortnight of April when only 1.91% *E. perticella* larvae were parasitized. From April onwards, rate of parasitization gradually increased and the highest parasitization (12.48%) was recorded during July followed by June (7.73%).This is the first comprehensive report of *P. euzopherae* as an endoparasitoid of brinjal stem borer, *E. perticella* which has become a serious pest in near maturing and ratoon brinjal in and around Varanasi. The adult female parasitoid began to oviposit from the first day onwards. In the act of oviposition, the female arched her abdomen to penetrate its ovipositor into the host larvae residing inside the stem for egg laying. The lifespan of *P. euzopherae* females ranged from 7.5-13.75 days with an average of 10.63 days under 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*), had a mean lifespan of 33.5 days and second generation females (F2) lived 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 an everlasting solution to the pest problems of crop. With the rapid advancement of science and technology and constantly changing dynamic nature in production 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 manipulating interaction between crop phenology and insect phenology to avoid synchronization between peak period in pest infestation 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 population dynamics 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 grown year round throughout most part of India including West Bengal 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 devised once cannot be an everlasting solution to the pest problems of crop. With the rapid advancement of science and technology and constantly changing dynamic nature in production system, pest management strategy is likely to go on changing from time to time.

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