**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 climatic condition. This crop is cultivated 2-3 times in a year. The fruit is the edible part and contains higher nutrition value and may compare with the fruits of tomato. 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* (Lepidoptera: Pyralidae) is an oligophagous insect observed many areas in Asia including Indian. It feeds mainly on brinjal and often on some other solanaceae vegetables, viz. potato tomato, and chilli. Stem borer is sometimes reported as a severe pest in India. Tiruchirapalli district of Tamil Nadu and some areas of West Bengal it is treated as an important pest. The caterpillars mainly cause damage by feeding inside the stem. Top shoots of young aged plants drop and dry. Old plant becomes stunted. Fruit bearing is affected. The insect is active form March to October when the temperature is high enough. Different types of procedures are effective for management of the pest. The pest may be controlled through IPM which contains cultural, mechanical, physical, behavioural, microbial, biological, genetical method etc. Finally, small amount of pesticides should be used f its damage is very high.

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

**I. INTRODUCTION**

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

The origin of brinjal (*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 8.140 % area under cultivation of vegetables. Economically it is very important vegetable crop and cultivated about 1.70 million ha throughout the world having a production of 29.460 million tones. Its average productivity is about 17.430 tons/ hectare in the year 2004-2005. In India, brinjal is grown of an area of 0.510 million ha and annual production of 8.200 million tones. Productivity of brinjal in India is about 16.080 tons/ hectare during 2005-2006. The eggplant is included to the family Solanaceae and its genus *Solanum*, spp *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 S-E Asia (Nath *et al*., 1987). The brinjal crop was well known to Indians from ancient time (Decando Le, 1986). The real centre of origin is India and China is treated as secondary centre of origin (Thompson and Kelly, 1957). Its cultivation is widely done in both temperate and tropical areas of the world (Rai *et al*., 1995). It is grown throughout the year in many parts of India including W. B. (Ghosh, 1999) & Bangladesh (Singh, 1967).

Pest constraints of this crop are enough high in West Bengal including in N. Bengal, and causes enough damage as well as hamper yield and their management is difficult (Ghosh and Senapati, 2002, Ghosh, *et.al*. 2003). Pests management by application of chemical synthetic insecticides is not recommended as causing many 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 defenders of the pest like spider (Ghosh *et.al.*, 2006a), *Menochilus* (Ghosh *et.al.*, 2007), *Coccinella* (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 major pest as well as an alarming insect pest in eggplant cultivation regions including West Bengal (Banerjee and Basu, 1955 &1956 ; Ghosh and Senapati,2001a; Ghosh and Senapati,2009; Ghosh,2014) Therefore, shoot and fruit borer ranks 1st as a key pest that affects directly the fruit yield and its fruit quality. The other important Lepidopteran pests where larva causes heavy damage in West Bengal areleaf roller (*Eublema olivacea* Walk.) and stem borer *(Euzophera particella*) (Ghosh, 1999). The harmful Hemipterous pests that cause enough damage areAphid (Ghosh *et.al*., 2004a, Ghosh,2019), leaf hopper (Ghosh, and Senapati 2003), Thrips (Ghosh *et.al*., 2005) and Whitefly (Ghosh *et.al*., 2004b). The harmful Coleopterous pests that cause heavy damage areHadda beetle (Ghosh, and Senapati 2001b), Flea beetle (Ghosh *et.al*., 2006b) and Blister beetle (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 an important plant pathogen, which affect world's food production (Sasser, 1980). Alternate hosts of nematodes are cereals, other vegetables, oilseed crops, pulses, fibre crops, fruits, ornamentals, plantations etc. grown in various regions of the world. They are also damaged by nematodes but vegetable crops including brinjal are seemed as their preferable 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 many insects and non-insect pests to emerge as devastating form. Insect pests provide the main limiting factors in the proper cultivation of eggplant. 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 harmed by many serious pests:

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| --- | --- | --- | --- |
| Common name  | Scientific name | Systematic position | Attacked plant parts |
| Shoot & fruit borer | *Leucinides orbonalis* (Guen.) | Family: PyralidaeOrder: Lepidoptera | Shoot& fruit |
| Hadda / epilachna beetle | *Henosepilachna vigintioctopunctata* Fabr. | Fam. : CoccinellidaeOrder: Coleoptera | Leaf |
| Brinjal leaf roller | *Eublema olivacea* Walk. | Fam.: NoctuidaeOrder: Lepidoptera | Leaf |
| Brinjal stem borer | *Euzophera particella* Rag. | Fam.: PhycitidaeOrder: Lepidoptera | Shoot |
| Lace-wing bug | *Urentius sentis* Dist. | Fam.: TingidaeOrder: Hemiptera | Leaf-area |
| Aphid | *Aphis gossypii* Glov. | Fam. AphididaeOrder: Hemiptera | Leaf |
| Leaf hopper | *Amrasca biguttula biguttula*  | Fam. CicadellidaeOrder: Hemiptera | Leaf |
| Thrips | *Thrips tabaci* Lin. | Fam. ThripidaeOrder: Thysanoptera | Leaf |
| Whitefly | *Bemisia tabaci* Genn. | Fam. AleyrodidaeOrder: Hemiptera | Leaf |
| Flea beetle | *Phyllotreta* spp. | Fam.: ChrysomelidaeOrder: Coleoptera | Leaf |
| Mite | *Tetranychus urticae* Boisd.*T. neocaledonicus* Andre | Fam.: TetranychidaeOrder: Acarina | Leaf |
| Root-knot nematode | *Meloydogyne incognita* White | Fam.: HeteroderidaeOrder: Tylenchida | Roots |

**II. COMMON NAME**

The Brinjal Stem Borer or Egg plant Boring Caterpillar

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

**IV. TAXONOMIC TREE**

 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* has been considered as an oligophagous insect pest. This pest causes damage mainly in India. The damage of the pest on brinjal plant was first recorded from Hyderabad by Rizvi and Sanyal (1977). It feeds and causes damage mainly on brinjal. Often it also attacks on many crops like tomato, potato and chilli. This pest is usually seemed 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). Often this pest is found to be a serious pest in India 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 certain damage intensity of the borerof eggplant and its defenders.

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

Moths are medium sized, forewings are pale yellow having distinct vertical black lines (transverse line) in the middle of the wing and hind wings are white 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, W.B , 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 pest starts their activity from March to October and its larva hibernates inside the stem of the crop from Nov. 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 lay 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 to be seen elongate & 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 emerged larvae start feeding for a few minutes on on the open plant parts 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 whitish or yellowish white in color having several bristly hairs and its head is orange-brown or red. The measurement of full-grown larva is 1.50 to 2.0 cm long. The larval lasts about 4-8 weeks and this variation takes place due to the temperature.

**3. Pupa:** Larva pupates in the silken cocoons inside the feeding tunnel ofthe stem of the brinjal plant. It sometimes pupates in the soil. Pupa is dark brown and 12 mm in length. The life span of pupa is about 1-2 weeks.

**4 . Adult:** Moth generally emerges in six to eight days. The life-cycle is completed within 35-76 days. It has 5-6 overlapping generations per year.

**5. Life history described by Halder *et al.* (2017):** The neonate larva of stem boreris slight yellowish green. There are 4 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 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. Just after hatching, the larvae bore inside the stem at the ground level. In most cases, the larvae bore in the branching portion and in leaf axils and they seal the opening holes with excreta. There is a thickening of stem in the entry portion. Larvae move by feeding downward along the length of the main stem. This feeding result in stunted growth or wilting and drying of the total plant and fruits bearing capacity is also reduced. The plant growth at the later stages is most vulnerable for attacking of the pest. The upper shoots of young plants drop and dry. Old plant becomes stunted. Fruit bearing capacity of the crops is severely affected.

**1. Damage described by Halder *et al.,* (2017):** Hundred % plants are infested by this stem borer insect pest During June–July. This infestation leads to discart attack of the aged plants and re-sown the new plant. Reports come from many farmers about this type of problem. Initially infected plants turn light yellow with stunted growth. Also reports that patches are found on the plot. Later on the infested plants are completely drooped, dried and wilted with stunted growth. Plant vigour is reduced and fruiting capacity of the plants are affected and lowered. Larvae of this stem borer, damage the stem of brinjal by feeding the pith and so translocation of fluid or water through the xylem are reduced. The affected plants are detected by the symptom of drooping nature. They may be uprooted and bring to bio-control laboratory for examinatiom. Proper observations prove that distinct larval galleries filled with faecal matters are found inside the stem and its underneath. Larval tunnels may vary from 3-11 / plant and an average of 7.92±0.69 tunnels per plant. Lunnel length may vary from 8.40 – 21.30 cm and an average of 12.80 cm. On deep observation, it is observed that majority of the larvae (84.61%) exhibit (+ ) geotropic movement towards root region, except few (15.39%) showing opposite direction. The larval movement is observed by comparing the dia of the tunnel on which they feed. Pupation takes place usually inside the stem. They remain within brown fibrous cocoon. Exit points of adults are found adjacent to the branch or any injured portion of stem. Often many borer larvae generally use one exit point.

**XI. SEASONAL FLUCTUATION**

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 Feb with 13.50% damage stem and branches and step by step increase coinciding with increase the temperature during summer. The damage of the stem during March, April, May and June are 29.75, 51.50, 76.50 & 89.70%, respectively. About all plants are infested by the stem borer in July. In June–July, about 100 % plants are infested by the stem borer and that lead to discontinuation of aged plants and re-sown new plants. The lower temp during winter limits its growth and the larva goes to hibernation. This results as is evident from no incidence or very little incidence of the stem borer insect during Nov to mid of Feb, at Varanasi, India. In a case study, it is observed that infestation of this borer was found generally in later stage of brinjal plant (Anonymous 2008). Sathe *et al*. (2016) observed that incidence of brinjal stem borer, appeared during Oct to March in Kolhapur areas of Maharashtra, India. Satpathy *et al*. (2006) reported that in July, 15 to 34% brinjal crops were damaged, whereas in August the intensity of damage increased and average crop infestation was 49.45% showing 3 times increases in damage within one month.

**XII. MANAGEMENT OF THE PEST**

**1. Management practices in brief:**

* Collection and destruction of the infested, dried &dead plants.
* Use 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.* minimum use of the chemical insecticides may increase the activities of the 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.
* Use of neem cake in the soil may reduce the heavy incidence of stem borer.
* Spraying neem oil @ 2.50 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 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 action 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 1962 knocked the people referring the forceful account of dangerous effect of chemical pesticides to the nature. Today the environmental pollution is a great problem. The chemicals are accumulated to the environment by being transported from one system to another. These contaminate every system like air, soil, water, plants animals etc. Although pesticides are protecting the Agri-horti crops from insect and other pests for increasing up the agri-horti production but introduce ecological misbalance and environmental pollution. A large number of chemical pesticides viz BHC, dieldrin, aldrin, 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 pesticide residues by many plants 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 fishes and many aquatic animals (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 plants, vegetables and fruit are observed to be affected with indiscriminate use of chemical insecticides from germination to harvest. High dose application of chemical insecticides may create resurgence of harmful pests against applied pesticides, the outbreak of many unimportant pests. The chemical insecticides are also harmful to beneficial insects such as honey bees and defenders like parasites, predators and pathogens of the pests etc. As a result of pesticide pollution, the living beings are affected in several ways. Human beings and domestic animals are infected by a number of diseases 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 seperated from *E. perticella*. The length of adult female is 7.50 to 8.0 mm (excluding ovipositor). The body colour is pale yellow. It has mandibular apices, claws, antennal flagellum. The bases of all gastral segments are black. The mesothorax has 3 black patches. Head and thorax are punctuate. The gastral segment I and II are aciculate. Wings have hyaline colour, All the veins and stigma of the wings are dark. Fore and middle legs are found pale yellow in colour. Black patches are found on hind legs, and hind femur consists of a distinct spine. The parasitization by *P. euzopherae* is observed first in 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 step by step increased and the highest level of parasitization (12.48%) is found in July followed by June (7.73%). This is the first record of *P. euzopherae* as an endoparasitoid of this stem borer from Varanasi areas. The adult female parasitoid begins oviposition from the first day. During oviposition, the female inserts her abdomen to penetrate its ovipositor into the host larvae remaining inside the stem to lay eggs. The lifespan of *P. euzopherae* females varies from 7.50-13.75 days and an average of 10.63 days in lab conditions. Jiménez *et al*. (2000) reported that the first generation of *P. spinator* females (F1) is a parasitoid of the potato tuber moth (*Pthorimaea operculella*) and its mean lifespan is 33.50 days .The 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 measures 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 cultivated in both temperate and tropical areas of the world. 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 better 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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