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Ecological Engineering as an Emerging Technology for the Management of Insect-Pests

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Abstract

Ecological engineering is a human activity that modifies the environment based on ecological principles. It is a useful conceptual framework for considering the practice of habitat manipulation for pest management. The form of ecological engineering presents an attractive option for the design of sustainable agro-ecosystems and it is also less risky. Ecological engineering can be complemented by other methods and should not be promoted as a standalone method. Commonly these will employ biological control agents that have been released in classical or augmentative manners. In such instances habitat management holds considerable potential for enhancing the success rates of classical agents, and to maximize the persistence and impact on pest population of augmentative agents. In the near future, these formerly separate branches of biological control will be merged to synergistic effect in "integrated biological control".

Introduction

Ecological engineering is a kind of habitat manipulation, in which the ecosystem is engineered and makes it more attractive for natural enemies and to improve natural enemies' population and thereby manage the population of insects and ultimately minimize the pest pressure. Recently, Mitsch (1989) defined ecological engineering as "the design of human society with its natural environment for the benefit of both." Nowadays habitat manipulation practices are used more frequently and come in the trend because it is an eco-friendly approach and has become a part of integrated pest management (IPM). The final goal of ecological engineering is to make a suitable ecological infrastructure in the agricultural landscape to provide shelter to the natural enemies under adverse conditions, food resources for adult natural enemies and alternative host/ prey. This habitat manipulation is a type of cultural practice where it is based on low input of energy materials; it is based on natural processes (*e.g.*, natural enemies or the response of herbivores to vegetation diversity). Shelters such as overwintering sites, moderate microclimate *etc*., alternate hosts when primary hosts are not present and food in the form of pollen and nectar for adult natural enemies.

Strategies used in Ecological Engineering

Push-Pull Strategy

It involves the behavioural manipulation of insect pests and their natural enemies, where those types of resources are used which act as a lure and attractive sources (pull) for natural enemies and another side those resources are used which are unattractive or unsuitable to the pests (push). In this way, one can manage the insects without using any chemical pesticides.

Chocolate-Box Ecology

Habitat manipulation for enhanced pest control has been referred to by critics as 'chocolate-box ecology'. Floristically diverse vegetation is added in order to provide adequate nectar, pollen and nutritious diet for natural enemies, this crude approach of habitat manipulation researchers now more commonly screen plant species to determine optimal species or use a range of selection criteria to determine appropriate botanical composition. These approaches reflect that the quality not the quantity of diversity that is important (Polasezek *et al*., 1999) and requires the selection of 'right kind' of diversity. A wide range of approaches are being developed by researchers and employed by practitioners to ensure that appropriate forms of diversity are deployed for pest management *via* ecological engineering (Gurr *et al*., 2004).

Broadly it has two mechanisms.

1. Enemies hypothesis, also called top-down, in which diverse habitats provide a diversity of prey. In this case, the third tropic level called natural enemies suppressed the population of the second tropic level that includes the insect pests.

2. The second hypothesis is based on the 'resource concentration' idea ('bottom-up'). In this approach the crop is manipulated by using green mulches, cover crops (first trophic level). This type of approach is seen in habitat manipulation of 'Conservation biological control'.

There has been extensive research done in ecological engineering like in Vietnam, Thailand and China, where rice farmers have started to use rice bunds to sow sesame, *Sesamum indicum* L. (Pedaliaceae) to improve the biological control of the rice brown planthopper, *Nilaparvata lugens* (Hemiptera: Delphacidae) as it attracts *Anagrus* spp. The combined planting of *S. indicum* and the vetiver grass, *Vetiveria zizanioodes* L., on a rice bund increased the parasitism rate of rice stem borers (Lepidoptera: Pyralidae).

How Natural Enemy's Population Enhanced Structural and Cultural Diversity

Landscape designing is very important for attracting natural enemies, flowering, vegetation and different floral trees can provide the vertical structure needed for predators like spiders and birds. The Flowering shrubs, herbs and annual and perennial plants can provide shelter, Overwintering sites, food, nectar and pollen for parasitic syrphids. It is also found that most of the lady bird beetles feed upon the aphids present on the succulent plants.

Banker Plant System

Now a new technique was used like in green house *Carica papaya* is used as a banker plant for the parasitoid *Encarsia sophia* against *Bemisia tabaci*, another example is that in greenhouse tomato production the *Zea mays* crop was grown to support the predatory midge *Feltiella acarisuga* against *Tetranychus urticae*.

Future Prospects

There is a foremost strengthen required to done research on tritopic interaction and other eco-friendly approaches, use more border crops, coloured flower to attract natural enemies, insectaries plants are also important like a flower that provide flower, nectar, pollen and shelter to the predators and parasitoids. These approaches are very much useful in integrated pest management because in this no chemical is used everything is natural.

Conclusion

Without execution of any natural practices, which is eco-friendly, causing no harm to the environment and are effective to manage the population of insect pest and increase the high food demand, these all possible ways are fulfilled by ecological engineering, so in-depth, one should go for a natural method of managing insects to eliminate possible dual uses, ecological engineering is the best technique as no pesticides were used to manage the insects, completely based on natural ways to manipulate the habitat and provide a better path for the natural enemies and the most important thing is that it is completely a human activity.

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