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Ecological Engineering for Pest Management

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Abstract

Ecological Engineering (EE) , a sustainable pest management tool is a modified tritrophic interaction, which enhance the natural enemies of pests and modify the crop micro environment has been emphasized in recent times due to lesser adversities. This approach relies on use of cultural techniques to bring out habitat manipulation by altering plant composition and enhance biological control by manipulating the third trophic level. It is emphasized more on ecological knowledge rather than on high technology approaches such as synthetic pesticides and genetically engineered crops. Thus, in the era of IPM this tool can be used for the pest management purposes to obtain highest profit without hampering the environment.

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Introduction

Ecological Engineering (EE) for pest management is a modified tritrophic interaction, which enhance the natural enemies of pests in an agro ecosystem and is being considered an important strategy for promoting Bio intensive Integrated Pest Management (BIPM). This approach relies on use of cultural techniques to bring about habitat manipulation by altering plant composition and enhance biological control by manipulating the third trophic level. It is emphasized more on ecological knowledge rather than on high technology approaches such as synthetic pesticides and genetically engineered crops. (Altieri, 1991). The primary objective in Ecological engineering is to create an amenable environment for the natural enemies by manipulating the habitat. Habitat manipulation aims to provide natural enemies of pests with nectar, pollen, physical refuge, alternate prey, alternate hosts and living sites. This canbe through plantation of appropriate companion plants like floral trap crops and repellent crops, through which the population of pollinators, predators and parasitoids can be enhanced to manage the herbivorous insect pests.

Ecological Engineering (EE) strategies focus on pest management both below ground and above ground (Hossain *et al.,* 2001). The main emphasis is to improve the soil health below ground by developing soilsrich in organic matter and microbial activity and above ground plant health by habitat manipulation to increase the biodiversity of beneficial natural enemies.

EE for Pest Management – Above Ground

It is more focussed on making the habitat less suitable for pests and more attractive to natural enemies. Raising of flowering plants along the border by arranging shorter

plants towards main crop and taller plants towards the border to attract natural enemies as well as to avoid immigrating pest population. Inter-cropping, border-cropping and mix cropping of the flowering plants are done to provide nectar/ pollenas food for various bio-control agents. Trap crops and repelling crops for pests are also grown as intercrop along with the main crop. No uprooting of weed plants which are growing naturally like *Tridax procumbens*, *Ageratum sp.*, *Alternanthera sp.* etc. as they act as a nectar source for natural enemies. Application of chemical pesticides is avoided when the Pest: Defender ratio is favourable. The compensation ability of the plant should also be considered before applying chemical pesticides.

Different Types of Plants Used In Ecological Engineering

These can be classified into 4 categories.

1. Attractant Plants - Attract the Natural Enemies of pests

2. Trap plants - Trap the crop pests

3. Repellent plants - Repel the crop pests

4. Barrier/Border plants - Prevent the entry of pests

1. Plants which attract natural enemies of pests

These include Mustard, sunflower, buckwheat, carrot, marigold, French bean, maize/corn, cowpea, spearmint. The actual selection of flowering plants could be based on availability, agro-climatic conditions and soil types. Due to enhancement of biodiversity by the flowering plants, the number of parasitoids and predators (natural enemies) also increase due to availability of nectar, pollen, fruits, insects, etc. The major predators are a wide variety of spiders, ladybird beetles, long horned grasshoppers, *Chrysoperla*, earwigs, etc. Cole crops were bordered by Sunflower, Mustard, Marigold and Coriander crops for management of aphids. The Sunflower was the tallest crop to attract the *Helicoverpa* pest, it was surrounded by two rows of mustard to attract *Chrysoperla* and Lady Bird Beetle. Coriander crop attracts different natural enemies of main crop pests. Marigold was the preferable crop for egg laying of *Helicoverpa.* It was observed that the cabbage and cauliflower crops found affected with aphid and the aphid population on Cole crops was found parasitized by *Aphidius*, a potential parasite of aphid. This parasite was able to manage the aphid population on Cole crops.

2. Trap plants

A trap crop is a crop that is planted to lure insect pests away from the main crop. Basil and marigold act as a border crop (main crop- Garlic) controls Thrips. Castor plant as a border crop in Cotton and chilli field, controls Tobacco caterpillar. Legume as inter / alternate crops in sugarcane enhances the population of fungal and bacterial bio control agent for the management of nematodes & other soil borne diseases. Inter crop rows of *Tridax procumbens* in paddy crop enhances the natural parasite and predator populations.

3. Repellant plants which repel harmful insect-pests

Grown either as border crop or main crop, these repel the pests away from the crop mainly due to the release of volatile repellent plant chemicals. Basil repels flies, mosquito, tomato borer whereas, garlic repels beetles, aphids, weevils, spider mites, carrot fly. Similarly, radish deter cucumber beetle and mint repel cabbage moth. Furthermore, marigold has been reported to repel beetles, cucumber beetles, nematodes.

4. Barrier/ border plants which attract insect-pests and reduce pest population on main crop

These protect the main crop against small soft bodied flying insects which migrate from one field to other field such as whiteflies, hoppers, aphids, mealybugs, thrips etc. Eg. Maize, Sorghum, Bajra, Redgram etc. as barrier crops.

EE for Pest Management – Below Ground

This focuses on improvement of soil health**.** Keeping soils covered round the year with living vegetation and/or crop residue, adding organic matter in the form of farm yard manure (FYM), vermicompost, crop residue which enhance below ground biodiversity can be helpful in improving soil health. Moreover, reducing tillage intensity so that hibernating natural enemies can be saved and applying balanced dose of nutrients using biofertilizers enhance existing biodiversity. Applying mycorrhiza and plant growth promoting rhizobacteria (PGPR) and application of *Trichoderma* spp. and *Pseudomonas fluorescens* as seed/seedling/planting material, nursery treatment and soil application can also be helpful in this regard. These practices strengthen the ability of crops to withstand pests and also help improve soil fertility and crop productivity. Thus Biodiversity is crucial to crop defenses: the more diverse the plants, animals and soil-borne organisms in a farming system, the more diverse are the pest fighting beneficial organisms on the farm (Thomas and Sotherton, 1992).

Conclusion

Adding biodiversity, through ecological engineering, can alter or manipulate the tritrophic interaction, which can be ecologically and economically feasible alternative to manage the pest population. Considering, the non-use or lesser use of chemicals this approach can be a viable option, to divert the pest to non-host crops.

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