



FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES

Lecture 7- Ecological management of crop environment

Ecological Engineering for Pest Management

Introduction:

Ecological Engineering (EE) for pest management is a new paradigm to 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 and enhance biological control.

Concept:

Ecological Engineering emerged as a paradigm for considering pest management approaches that are based on cultural practices and informed by ecological knowledge rather than on high technology approaches such as synthetic pesticides and genetically engineered crops.

Objectives:

The primary objective in Ecological engineering is to make environment of the Agro-ecosystem suitable for the better survival of natural enemies of pests.

Habitat manipulation aims to provide natural enemies of pests with nectar, pollen, physical refuge, alternate prey, alternate hosts and living sites. This can be 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. The main emphasis is to improve the soil health below ground by developing soils

rich 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

- Focus is on making the habitat less suitable for pests and more attractive to natural enemies.
- Raising 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 provide nectar/pollen as food for various bio-control agents. Trap crops and repelling crops for pests are also grown as intercrop along with the main crop.
- Not uprooting weed plants which are growing naturally like *Tridax procumbens*, *Ageratum* sp, *Alternanthera* sp etc. as they act as a nectar source for natural enemies.
- Not applying chemical pesticides, when the P: D ratio is favorable. 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.

Management of aphid in Cole crops through ecological engineering During a demonstration of ecological engineering in Cole crops conducted by the Directorate of Plant Protection, Quarantine & Storage, Cole crops were bordered by Sunflower, Mustard, Marigold and Coriander crops. 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 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 BCA 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
- Garlic repels beetles, aphids, weevils, spider mites, carrot fly
- Radish deter cucumber beetle • Mint repel cabbage moth

- Marigold repels 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.

Ecological engineering (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.
- Reducing tillage intensity so that hibernating natural enemies can be saved.
- Applying balanced dose of nutrients using biofertilizers.
- Applying mycorrhiza and plant growth promoting rhizobacteria (PGPR)
- Applying *Trichoderma* spp. and *Pseudomonas fluorescens* as seed/seedling/planting material, nursery treatment and soil application.

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. Integrating AESA (Agro-Eco System Analysis) based IPM and Principles of Ecological Engineering There is a need to integrate AESA based IPM and principles of ecological engineering for pest management to help farmers maintain biodiversity and keep pests under control while at the same time maintain the eco-system.