



Ecological Engineering Approaches in Insect Pest Management

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Abstract

A successful pest management is based on a thorough knowledge of the target pest's life cycle, and its ecological and behavioural interactions with its environment and natural controlling factors. Ecological engineering has recently emerged as a paradigm for considering pest management approaches based on cultural practices and informed by ecological knowledge. Ecological engineering is also referred to as 'Habitat manipulation'. Habitat manipulation is another form of conservation biological control is an ecologically based approach aimed at favouring natural enemies and enhancing biological control in agricultural systems. The ultimate goal of habitat management is to create a suitable ecological infrastructure within the agricultural landscape is to provide food resources for adult natural enemies, alternative host/prey, and shelter under adverse conditions. It focuses on reducing mortality of natural enemies, providing the supplementary resources and manipulating host plant attributes for the benefit of natural bio-agents, which increases the efficacy of conservation of natural enemies, inoculative and augmentative biological control. The potential is to integrate the goal of ecological engineering to conservation of nature and natural enemies are discussed here under.

Keywords: Ecological engineering, approaches, pest, management, natural enemies

Introduction

Ecological engineering can be defined as the practice of joining the economy of society to the environment symbiotically by fitting technological design with ecological self-design. Odum was the first person to use the term "ecological engineering", which can be described as environmental manipulation by man using small amounts of supplementary energy to control systems in which the main energy drives are still coming from natural sources (Odum, 1962). Recently Mitsch and Jorgensen (1989) defined ecological engineering as "the design of human society with its natural environment for the benefit of both"

Ecological Engineering

Pest management approaches are forms of ecological engineering, irrespective of whether they act on the physical environment (e.g. via tillage), chemical environment (e.g. via pesticide use) or biotic environment (e.g. via the use of novel crop varieties). It is however the use of cultural techniques to effect habitat manipulation and enhance biological control that most readily fit the philosophy of ecological engineering. These cultural techniques typically:

Ecological Engineering Techniques

Limited and Selective use of pesticides

- Alternate food source

- Right diversity
- Refugia
- Microclimate
- Alternate host /Prey insect
- Behavioural manipulation
- Host plant resistance
- Other cultural practices.

Ecological Engineering for pest Management-Above Ground

- Raise the flowering plants/compatible cash crops along the orchard 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
- Grow flowering plants on the internal bunds inside the orchard
- Not to uproot weed plants those are growing naturally like *Tridax procumbens*, *Ageratum* spp., *Alternanthera* spp. etc. which act as nectar source for natural enemies,
- Don't apply broad spectrum chemical pesticides. The plant compensation ability should also be considered before applying chemical pesticides.

Ecological Engineering for Pest Management-Below Ground

- Keep soils covered year-round with living vegetation and/or crop residue.
- Add organic matter in the form of farm yard manure (FYM), vermicompost, crop residue which enhance below ground biodiversity
- Reduce tillage intensity so that hibernating natural enemies can be saved.
- Apply balanced dose of nutrients using bio-fertilizers.
- Apply mycorrhiza and plant growth promoting rhizo-bacteria (PGPR)
- Apply *Trichoderma* spp. and *Pseudomonas fluorescens* as seed/seedling/planting material, nursery treatment and soil application.

Push-Pull Strategy

Push-pull strategies involve the behavioural manipulation of insect pests and their natural enemies via the integration of stimuli that act to make the protected resource unattractive or unsuitable to the pests (push) while luring them toward an attractive source (pull) from where the pests are subsequently removed (Cook et al. 2007).

Principles of the Push-Pull Strategy

Push-pull strategies use a combination of behaviour modifying stimuli to manipulate the distribution and abundance of pest and/or beneficial insects for pest management. Strategies targeted against pests try to reduce their abundance on the protected resource, for example, a crop or farm animal. The pests are repelled or deterred away from this resource (push) by using stimuli that mask host apparency or are repellent or deterrent. The pests are simultaneously attracted (pull), using highly apparent and attractive stimuli, to other areas such as traps or trap crops where they are concentrated, facilitating their elimination (Cook et al. 2007).

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