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Role of Ecological Engineering in Pest Management

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SUMMARY

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. Environmental 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 favoring Natural enemies and enhancing biological control in agricultural systems. The ultimate goal of habitat management is to create a suitable ecological Infrastructure within the farm landscape to provide food resources for adult natural enemies, alternative hosts/prey, and shelter under adverse Conditions. It focuses on reducing the mortality of natural enemies, providing 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 to integrate the goal of ecological engineering into the Conservation of Nature and natural enemies is discussed here.

INTRODUCTION

Ecological engineering can be defined as 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," Recently Mitsch and Jorgensen (1989) Defined ecological engineering as "the design of human society with its natural environment for the benefit of both". Environmental engineering is a conscious human activity. It is an emerging technology to enhance biological control in an agro-system by preserving or enhancing plant diversity or providing adequate Refugia for the pest's natural enemies.

Ecosystem Services

Farmers increasingly raise awareness about the ecosystem services in agricultural Biodiversity. It includes pest suppression, Conservation of natural enemies, pollinators and wildlife, fixation of Atmospheric nitrogen, nutrient cycling, and so on (Costanza et al. 1997). Indigenous and peasant farmers have always relied on Biodiversity for agroecosystem function in the developing world. Alternative strategies, i.e. hedgerows, agroforestry, polycultures, herbal strips within crops, appropriate field margins, and small fields surrounded by hedgerows could be readily incorporated into conventional farming systems are essential. These practices used in ecological engineering are inexorably Entwined with the pragmatic use of Biodiversity to perform the ecosystem Service for pest suppression. Consequently, the pursuit of this practical Outcome (i.e. reduced crop losses) may simultaneously lead to other benefits Such as Conservation of pollinators, wildlife, and nitrogen fixation and so on. The discipline of ecological engineering is in the process of moving from a 'first approximation' is the simplistic assumption that diversity is undeniably A powerful tool for pest management. Combining statistics for annual and Perennial crop systems, lowered pest densities were apparent in 63 per cent of monophagous pests species but in only 23 per cent of polyphagous pests (Gurr et al. 2004).

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).

1. It involves relatively low inputs of energy or materials,
2. It relies on natural processes (e.g., natural enemies or the response of herbivores to vegetational diversity)
3. Developed to be consistent with ecological principles are refined by Applied ecological experimentation
4. Contribute to Knowledge of theoretical and applied ecology.

5. Natural enemies may require Food in the form of pollen and nectar for adult natural enemies Shelters such as overwintering sites, moderate microclimate etc.
6. Alternate hosts when primary hosts are not present.

Habitat Requirements

As a general rule, to be useful for pest management, any area maintained. For beneficial insect habitat must result in a net gain in beneficial insects and A net reduction in pest insects.

1. It must attract beneficial insect populations.
2. It must improve the health or reproduction of beneficials so they Can be more effective.
3. It must allow beneficials to move from the habitat to the crop of Interest. The beneficials must eat or parasitize an increasing number Of pest insects once they have into the crop.
4.The activity of the beneficials must lead to an economic reduction In pest populations. Preferably, their activity would prevent Economic damage to the crop the bottom line for habitat and any Other pest management tactic (Landis et al. 2000).

Habitat Manipulation Approaches

Top down Control (Augmentative biological control): Here herbivores (second trophic level) are suppressed by the natural bio-agents (third trophic Level).

Bottom up Control (Conservation biological control): Pest habitat Manipulation strategies such as cover crops and green mulches (first trophic Level) can also act on pests directly, providing 'bottom-up' control. He Termed pest suppression resulting from such non-natural enemy effects as 'resource concentration hypothesis', reflecting the fact that the resource (crop) was effectively 'diluted' by cues from other plant species (Root, 1973).

Ecological Engineering Techniques

1. Limited and Selective use of pesticides
2. Alternate food source
3. Right diversity
4. Refugia
5. Microclimate
6. Alternate host /Prey insect
7. Behavioural manipulation
8. Host plant resistance
9. Other cultural practices.

Ecological engineering-Above Ground

Focus is on making the habitat less suitable for pests and more attractive to Natural enemics. Mixed cropping, Intercropping. Not applying chemical pesticides. 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.

Not to uproot weed plants those are growing naturally like ***Tridax Procumbens, Ageratum spp., Alternanthera spp. E*****tc.** which act as Nectar source for natural enemies,

Ecological Engineering -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.

Trap cropping

Cotton and.chilli ficld- Castor –Controls Tobacco caterpillar.

Marigold- Cotton-***Helicoverpa armigera***
Marigold – Garlic -Thrips

Repellants

Garlic repels beetles, aphids, weevils, spider mites.
Marigold- cucumber beetles, nematodes.
Mint- cabbage moth
Marigold- cucumber beetles, nematodes

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).

Eg.Push pull strategy in control of stem borers in maize and sorghum

Stem borers are repelled from the crops by repellent non host intercrops, particularly molasses grass *(M. Minutiflora*), silverleaf desmodium (D. *uncinatum*), or Greenleaf desmodium *(D. intortum*) (push), and are concentrated on attractive trap plants, primarily Napier grass (*Pennisetum purpureum)* or Sudan grass (*Sorghum vulgare Sudanense*) (pull). Molasses grass, when intercropped with maize, not only Reduced stem borer infestation, but also increased parasitism by *Cotesia Sesamiae*

Barrier crops

- Two rows of mustard to attract Chrysopcrla and Lady Bird Bectle.
- Coriander crop attracts different natural enemies of main crop pests.
- The Sunflower -tallest crop-attracts Helicoverpapest

Blackgram

- Blackgram + cowpea border cropping system.
- Pest defender ratio(PDR) of1:2.4 ,BC ratio (1:4.35)

Paddy

- Blackgram bund cropping.
- ***Sesamum îndicum***-BPH

Banker plant

Carica papaya is used as a banker plant for the parasitoid ***Encarsia sophi*** Against ***Bemisia tabaci*** in greenhouse tomato production.

Windbreak Design

Windbreak design is another method of manipulating natural enemy Abundance, and diversity. In North Dakota, carabids and staphylinids (Coleoptera) that feed on crop pests were more abundant at the edge of Multi-row wind breaks than in the interior of the windbreak. In single-row Elm windbreaks carabid and staphylinid abundance should be relatively Constant across the windbreak (Frye et al.1988).

CONCLUSION

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’’.

REFERENCES

Ecological Engineering for Pest Management: Advances in Habitat Manipulation. Edited by Geoff M Gurr, Steve D Wratten, Miguel A Altieri

Ecologically Sustainable Strategies for Pest Management Published by Director General on behalf of the National Institute of Agricultural Extension Management (MANAGE), Rajendranagar, Hyderabad – 500030, Telangana

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