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Importance of Ecological Engineering in Pest Management and its Recent Outlook

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Summary

Ecology together with engineering results in ecological engineering which may restore the disturbed ecosystems. Selective pesticides, intercropping, alternate food supply & refugia strategy primarily produce property ecological engineering. environment manipulation is another kind of augmentation and conservation of natural enemies' necessary a part of ecological engineering. Integration of

entice plants, repellent plants, barrier plants square measure making favourable surroundings for effective ecological engineering. Most of the experiments on the ecological engineering restricted to some crops solely, within the coming years plans square measure on to introduce this technique in alternative crops like cole crops, healthful crops and fiber crops.

Introduction

Plants aren't capable of deed from their enemies, i.e., the herbivores which will eat them. Plants will have faith in the natural enemies for defense. The management of insect pests is critical to confirm food security. Insect pests results in 2 hundredth to half-hour loss of yield from each field and storage. Indiscriminate use of chemical pesticides light-emitting diode to pollution and ecological imbalance, that caused insect powder resistance, pesterer betterment and chemical residues to be found in food and also the surroundings. Most predators and parasitoids of hymenopterans full of pesticides. Therefore, immediate concern of reducing these cytotoxic substances and serving to individuals eat a lot of organic crops that square measure freed from chemicals, that is why want for alternate measures to guard crops is incredibly necessary.

Overview

Ecological engineering is that the integration of ecology with engineering. it's almost like alternative disciplines of engineering during which general, quantitative techniques for style and problem-solving square measure applied in a very specific field. for instance, chemical engineering is that the discipline during which engineering principles and practices square measure utilized in chemistry applications. during this same sense, ecological engineering is that the discipline during which ecosystems square measure designed, made, and operated for applications or sensible functions. to form styles and solve issues, a chemical engineer should have an intensive understanding of chemistry. Similarly, associate ecological engineer should have an intensive understanding of ecology. (Kangas and Adey, 2008). The goals of ecological engineering, as represented by Mitsch and Jorgensen (2004) one. The restoration of ecosystems that are well disturbed by human activities like environmental pollution or land disturbance and a couple of. the event of latest property ecosystems that have each human and ecological values.

Techniques concerned in Ecological Engineering

1. **Restricted and Selective use of pesticides:** once pesticides and natural enemies square measure used in a very crop, conflicts will be reduced by use of following property principles of pesticides. These property pesticides are going to be required particularly in a very crop management system. To spare the natural enemies, insecticidal application ought to be supported property principles like physiologically property, ecologically property, behavioural property and property

through improved application (Menasch,1997).

2. **Right diversity:**
   a. **Intercropping:** Intercropping chickpea with coriander was found to extend the activity of Campoletis chloridae and reduce the population Helicoverpa armigera (Shanthakumari, 2003).
   b. **Non-crop Vegetation:** it's been ascertained that Coleomeglla maculata lays a lot of eggs on a weed, rosid dicot genus ostryaefolia than the sweet corn (Zea mays), although the plant supports a couple of preys.
3. **Alternate food source**: Some parasitoids square measure ready to acquire required resources from hosts others need access to non-host foods (Jervis et al. 1986). Floral nectar is taken by several species, and might lead to redoubled rates of mutuality (Powell, 1986). Extra-floral nectar is created by varied plants like faba bean (Vicia faba) and cotton (Gossypium hirsutum) and is a vital food supply for adult parasitoids (Bugg, 1989).
4. **Microclimate:** lay to rest planted grass in maize fields to cut back the soil temperature, increasing survival of augmentative discharged Trichogramma brassicae (Orr et al. 1997).
5. **Refugia:** by artificial means created grasses seeded on raised earth bank square measure termed as Beetle banks (Thomas et al. 1992). they're seeded with perennial grasses, like grass (Dactylis glomerata) and grass (Holocus lanatus). It provides environment for birds, tiny mammals, invertebrates and predators like carbides and Staphylinds.
6. **Alternate host /Prey insect:** establishment of different insect hosts might improve synchronization between pests and its natural enemies. Alternate host of natural enemies may be created offered through vegetation diversity wherever they will multiply in massive numbers before offensive the most important host. Higher mutuality of genus Acherontia River Styx prod herbaceous plant by Trichogamma Chilonis in cotton-sesame intercropping ends up in the redoubled mutuality of Helicoverpa armigera eggs in cotton.
7. **Behavioural manipulation:** sirup grass (Melinis minutiflora) once intercropped with maize, cut back the infestation of crops by stem borer and increase the mutuality significantly by the native larval parasitoid, Cotesia herbaceous plant (Khan, 1997).
8. **Alternative cultural practices:** Cultural practices like soil management e.g., NPV of cabbage semilooper (Trichoplusia ni) is a lot of persistent in less acid soils and liming of soil for virus conservation (Thomas, 1973). Watering was found in increase effectualness of fungus lecanii in greenhouse aphids (Nayak et al.2020).

Different Types of Plants utilized in Ecological Engineering

1. **Plants which magnetize Natural Enemies of Pests:** These embody mustard, sunflower, buckwheat, carrot, marigold, haricot vert, maize/corn, cowpea, spearmint. thanks to sweetening of diversity by the

flowering plants, the quantity of parasitoids and predators (natural enemies) conjointly increase thanks to handiness of nectar, pollen, fruits, insects, etc. the key predators square measure a large sort of spiders, ladybug beetles, long antlered grasshoppers, Chrysoperla, earwigs, etc.

2. **Entice Plants:** A entice crop may be a crop that's planted to lure insect pests removed from the most crop. Basil and flower as a border crop (main crop-Garlic) controls Thrips. Castor plant as a border crop in Cotton and hot pepper field, controls Tobacco caterpillar.
3. **Repellent Plants that repel harmful insect-pests:** fully grown either as border crop or main crop, these repel the pests removed from the crop primarily thanks to the discharge of volatile repellent plant chemicals. Basil repels flies, mosquito, and tomato borer. Garlic repels beetles, aphids, weevils, spider mites, carrot fly. Radish deters cucumber beetle, Marigold repels beetles, cucumber beetles, nematodes.
4. **Barrier/ Border plants** which are a magnet for insect-pests and scale back pests' population on main crop: These shield the most crop against little soft bodied flying insects that migrate from one field to different field like whiteflies, hoppers, aphids, mealy bugs, thrips etc. Eg. Maize, sorghum, bajra, red gram etc. as barrier crops.

Ecological Engineering Applications in Pest Management

1. On top of ground:

a. Raising flowering plants on the border by arrangement shorter plants towards main crop and taller plants towards the border to draw in natural enemies additionally on avoid immigrating insect-pests population.
b. Inter-cropping, border-cropping and blend cropping of the flowering plants give nectar/ spore as food for numerous bio-control agents. entice crops and distasteful crops for pests also are grownup as intercrop together with the most crop.
c. Focus is on creating the environs less appropriate for pests and additional engaging to natural enemies.

2. Below ground:

a. Reducing tillage intensity in order that dormant natural enemies may be saved.
b. Applying balanced dose of nutrients exploitation bio fertilizers.
c. Keeping soils coated around the year with living vegetation and/or crop residue.
d. Adding organic matter within the style of farm yard manure (FYM), Vermicompost, crop residue that enhance below ground diverseness.

Recommendations and Further Research

The community approach on this ecological engineering is anticipated to bring the region as chemical free port and enhance the soil microbic activity agro scheme. there's basic have to be compelled to strengthen the analysis on shaping the role of the tritrophic interactions, cultural practices and different practices in rising the potency of the natural enemies. Integration of the conservation and manipulation techniques within the IPM modules ought to be done and be tested for

correct insect-pests management practices for various crop pests. Most of the experiments on the ecological engineering restricted to some crops solely, in order that plans area unit on to introduce this technique in different crops like cole crops, medicative crops and fiber crops within the forthcoming years.

Conclusion

Ecological engineering may be a human action that modifies the atmosphere supported ecological principles. In reality, he implementation of an ecologically based pest management strategy usually occurs while an agro ecosystem is undergoing conversion from a high-input conventional management system to a low external-input system. The form of ecological engineering presents an attractive option for the design of sustainable agro-ecosystems and it is also less risky. It can be complemented by other methods and should not be promoted as a standalone method. Habitat manipulation is another form of augmentation and conservation of natural enemies in which cropping system altered successfully to augment and enhance the effectiveness of the natural enemies. In the near future, these formerly separate branches of biological control will be merged to synergistic effect in ‘‘integrated biological control’’.

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