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EDITORIAL

Ecosystem enhancement through conservation of natural enemies

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Natural enemies, also known as bio-agents, are organisms that restrict insect populations, reducing the insects' ability to survive. Weeds, insects, plant pathogens, and other pests can all be controlled using natural enemies. However, the approaches and chemicals employed vary depending on the type of insects. Natural enemies are essential for reducing the numbers of potential pests. Insecticides destroying the natural enemies of prospective insects, has been proved through several studies (Deka *et al*., 2020). However, when a non-toxic practice for removing an extensive pest comes to light, the number of secondary pest outbreaks and the environmental damage they cause usually get reduced. This also helps natural enemies survive and reduce the need for broad spectrum synthetic insecticides. Ecological frameworks support a diverse range of plants and animals. However, there are many risks associated with pesticide usage (Mukherjee, 2016). Natural enemies and pollinators are frequently and more likely to be affected or destroyed by pesticides than the pest itself since they are more vulnerable to them. Because of the widespread use of chemical pesticides in agricultural ecosystems, majority of the pests tend to develop tolerance to them.

Sustainable agronomic practices can establish appropriate habitats in disturbed agro-ecosystems that supply food and shelter to pollinators and other natural enemies of insect pests. Examples of these practices include managing field margins and mid-field strips with carefully chosen flower plants, cover crops, economically important plants, uncultivated areas, headlands, and hedges (Tscharntke *et al*., 2007).

The conservation of natural enemies: In order to maintain and enhance bio-control agent populations, conservation techniques are essential. The following conservation techniques can be used:

1. Crop Rotation and Diversification: Crop rotation and diversification can help to foster a diversified community of natural enemies. Pests specific to monocrops can be prevented by alternating crops, reducing their accumulation and allowing natural enemies to flourish. Diverse cropping systems also provide a diverse set of resources, such as alternative hosts /prey, that supports a diverse set of natural enemies (Sarkar *et al*., 2020).

2. Habitat Management: It is essential to create and maintain suitable habitats for natural enemies. This includes planting a variety of perennial plants that provide food, shelter, and alternate hosts for natural enemies. Incorporating nectar and pollen-producing flowering plants can attract helpful insects such as parasitic wasps and predatory beetles. Reduced pesticide use in the area is also necessary to safeguard natural enemies (Sarkar *et al*., 2020).

3. Minimizing Pesticide Use: Pesticides can directly or indirectly kill natural enemies by reducing their hosts or disturbing their activity. IPM approaches encourage cautious and targeted use of pesticides while reducing their influence on natural enemies. Pesticides that are selective and low in toxicity can be used, and their application should be timed to minimize their impact on natural enemies (Deka *et al*., 2020).

4. Conservation Biological Control: This method involves deliberately releasing natural enemies into agricultural or regulated habitats in order to increase their populations. It is essential to identify and release the most effective natural enemies of the target pests at appropriate times and locations. Conservation biological control can aid in the establishment and maintenance of beneficial insect populations besides improving pest control efficiency (Sarkar *et al*., 2019).

5. Provision of Alternative Resources: Supplemental food and shelter sources can help natural enemies survive when their prey or hosts are scarce. Planting flowering plants can supply nectar, pollen, and shelter for natural enemies, increasing their survival and reproductive potential (Sarkar *et al*., 2020).

6. Education and Awareness: It is essential to increase awareness among farmers, landowners, and the general public about the relevance of natural enemies and the benefits of protecting them. Educating stakeholders on the importance of natural enemies in pest management and encouraging ecologically friendly techniques can help to increase support for conservation initiatives (Mukherjee *et al*., 2019). These conservation strategies seek to establish an environment that encourages the presence and effectiveness of natural enemies in pest management. The use of chemical pesticides can be decreased by following these measures, encouraging sustainable and environmentally sound pest management practices.

Various arthropod pests have a substantial impact on crop production and productivity in majority of agro-ecosystems. Pesticides were mostly used by farmers to control insect populations on various crops. Pesticides

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can be highly toxic to natural enemies, which are crucial bio-control agents in ecosystems. Pesticides induce direct toxicity, sub-lethal effects, destruction of food sources, residue accumulation, and other negative impacts. It is critical to recognize these negative impacts when using pesticides and to implement more sustainable and integrated pest control strategies that could reduce pesticide usage, encourage natural enemy conservation, and maintain a healthy and balanced ecosystem. Natural enemy protection is critical not just for effective pest control, but also for the long-term viability and health of agricultural and natural ecosystems.

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