Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 02, Issue: 01 (JAN-FEB, 2022)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Approaches to Conserve Natural Enemy Populations in Field

(*Deepika Kalyan[1], Surabhi Bhardwaj[1] and R. K. Kalyan[2])

[1]Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan-313001

[2]Agricultural Research Station-Banswara, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan-327001

* deepikakalyan20@gmail.com

Natural enemies of agricultural pests include predators, parasitoids & pathogens and their usage in regulating the pest populations is known as biological control. Natural enemy biodiversity is thought to play a vital role in agricultural pest suppression. They aid in control of harmful pests, maintenance of ecological balance, reduction or elimination of pesticides, and therefore play an important role in agricultural ecosystems. However, natural enemies are subjected to continuous deterioration especially in modern agricultural systems that are characterized by complete removal of plants after harvesting as well as by insecticide applications, which gives rise to disappearance of natural enemies after each crop season. Therefore, it becomes necessary to conserve these bio-control agents.

In general, biological control consists of three principles: introduction, augmentation and conservation; among which, conservation is widely practiced as it is easy to understand by the growers. Conservation biological control is the implementation of practices that maintain and enhance the reproduction, survival, and efficacy of natural enemies of pests (McCravy, 2008). Approaches to conserve these natural enemies involve avoidance of practices harmful to them, as well as adoption of practices that benefit them. It takes the advantage of resident natural enemies and involves management strategies which conserve their populations to uplift ecosystem services they provide.

Measures to Conserve Natural Enemies

- **Maintaining vegetation diversity:** Diversity in agro ecosystems may favor reduced pest pressure and enhanced activity of natural enemies. Choosing vegetation that can help in a) improving the availability of nectar, pollen, and honeydew b) providing shelter or a moderated microclimate in which natural enemies may overwinter or seek refuge from factors such as environmental extremes or pesticides and c) providing habitat in which alternative hosts or prey are present, will surely help in conserving natural enemies. In addition, the temporal availability of such resources may be manipulated to encourage early season activity of natural enemies. Also, the spatial arrangement of such resources to enhance natural enemy activity within the crop can be considered.

- **Providing alternative sources for nectar/pollen:** Plants provide nectar, pollen and plant sap as food resources for natural enemies. Floral nectar is taken by many beneficial species and can result in increased adult longevity, parasitization and oviposition rate

(Hithesh *et al*., 2021). Extra-floral nectar is produced by various plants such as faba bean, lima bean, cotton, pumpkin etc.

Pollen is also used as a food source by adult beneficial insects. For example, adult hoverflies, which are aphid predators, use pollen and may need it for their eggs to mature and produce young ones. Adding some flowering plants like sweet alyssum and coriander result in higher densities of hoverflies and predatory bugs like *Orius laevigatus* and *O. majuscules.* Similarly, castor plants, that produce a lot of pollen, are found beneficial for predatory mites. Growing sunflower in vegetable or oilseed crops significantly increases beneficial insects and birds. Thus, the availability of plant-provided food can be a driving force in biocontrol success program.

- **Providing alternate host/prey:** Providing a constant source of food will slow emigration of beneficial insects and keep them at high population levels. For instance, providing wild plants of *Rubus* spp. near grape vineyards increases the parasitization of grape leafhopper (*Erythroneura elegantula*) by a hymenopteran parasitoid *Anagrus* as it can overwinter on *Rubus* plants (Costello *et al*., 2021). Given sufficient alternative prey, populations of generalist predators may establish within a crop before the arrival of seasonal pests.

- **Field borders and hedge rows:** Many beneficial insects will spend part of their life time in field borders or hedge rows. These areas also serve as corridors that beneficial insects use to move from one field to another. Plants in hedge rows usually consist of natural vegetation that as much as practically possible should be preserved. Field borders, depending on how they are managed, usually consist of annual plants. Growing Good bug blends on the borders of strawberry fields provide habitat for predators and parasitoids. Using taller non-host border crops like maize, sorghum and pearl millet can act as a barrier for white fly.

- **Providing oviposition sites and shelters**: Suitable oviposition sites are essential for reproduction of many predators. For example, predatory mites use the vein axils of sweet pepper plants for oviposition which reduce cannibalism and increases survival. Similarly, *Orius* spp. prefer to lay their eggs into soft plant parts.

Plants that can provide shelter for overwintering of natural enemies also help in their conservation. Adding *Viburnum tinus* and *Vitis riparia* plants in roses enhance mite control by predatory mites. Overwintering of natural enemies has also been investigated in a number of temperate perennial systems where shelter has been provided by augmenting leaf debris/ vegetable debris or providing on-tree refugia (Landis *et al*., 2000).

- **Intercropping:** Keeping beneficial insects in and around annual crops may be achieved by intercropping, which involves growing a crop plant and another plant within close proximity to promote insect interaction. Studies have shown that the natural enemy density increases when the main crop is grown with suitable intercrops (Landis *et al*., 2000). In another study, intercropping maize with the grass *Melinis minutiflora* led to reduced infestation by the stem borer and increased rates of parasitism.

- **Banker plant method:** It is used to breed the predators within a crop and also when the crop is not favorable for natural enemies to establish. For example, a banker plant grass species, *Leersia sayanuka* (L.) is planted adjacent to rice fields to attract the planthopper, *Nilaparvata muiri* (Muir). It does not attack rice plants, but is an alternative host for an

egg parasitoid, *Anagrus nilaparvatae*, which is the main natural enemy of brown plant hopper (Zheng *et al*., 2017).

- **Beetle banks:** Beetle banks are raised strips which run through a field, typically planted with grasses. They primarily serve as an overwintering habitat for beetles, which provide pest control in the spring, but may also harbor other natural enemies. A mixture of perennial grass seeds should be sown along with seeds of perennial flowers in order to attract and provide shelter for natural enemies such as syrphids, parasitoids, lady beetles, spiders and ground beetles. It is commonly used in wheat crop in Europe.

- **Trap crop**: A plant species able to simultaneously attract both pests and their natural enemies can be used in a trap cropping system for conservation biological control program. Trap plant like borage (*Borago officinalis*) has been found to attract aphids and its parasitoid, along with chrysopid predators in tomato crop (Hithesh *et al*., 2021).

- **Food sprays:** Natural or artificial food supplements can be sprayed or dusted onto the crop to support natural enemies in crops where nectar and pollen are absent or are present at low densities. For example, pollen sprays of corn, that can be mechanically collected in large quantities, can serve as food for predatory mites and enhance their efficacy against thrips and whiteflies in cucumber. Other types of pollen like that of apple and date palm are also commercially available. The pollen of Narrow leaf cattail, (*Typha angustifolia* L.) is commercially sold as 'Nutrimite' and is being used to increase population of pollen feeding predatory mites. It is commercially used in roses, poinsettia and pepper @ 500 g/ha. It is available in dust formulation and has to be applied once in 2 weeks.

Artificial food supplements can also be used for this purpose. For instance, in chrysanthemum application of yeast and sugars maintains populations of astigmatic mites that are suitable prey for phytoseiid predatory mites.

- **Supplementing mixed diet for natural enemies:** The population of natural enemies in crops can be increased by providing mixed diets of prey and/or non-prey food sources. Studies have shown that survival and reproduction of *O. insidiosus* was enhanced when aphids with thrips were supplemented as a prey source. Supplementing thrips with pollen increased egg production of *O. laevigatus* and predation rates of thrips larvae (Wakeil *et al*., 2017). Thus, supplementing diets of single pest species for predators with alternative prey or food may increase predator population and enhance biological control.

- **Selective use of pesticides:** Usually pesticides have lethal/adverse effects on natural enemies. There is a need to develop truly selective pesticides for the conservation of natural enemies by using active ingredients with the least non-target toxicity. Undesired side effects of pesticides on natural enemies could be reduced by taking care of proper timing, place and mode of application. Some examples for selective pesticides are spinosad, azadirachtin, Insect Growth Regulators etc.

- **Use of bio-pesticides**: Since bio-pesticides are comparatively safer for natural enemies, they must be incorporated in the pest management practices. For example, various organics and botanicals were found safe to coccinellids and predatory mites; organic soil amendments *viz*., vermicompost, neem cake and botanical sprays like NSKE were found to be quite safe to the natural enemy fauna in chilli ecosystem; neem products are considered safe to spiders, adults of numerous beneficial insect species and eggs of many predators such as coccinellids (Haldhar *et al*., 2017).

- **Use of semiochemicals:** These are substances released by an organism that affect the behaviour of other organisms. Lures may also be used to attract released natural enemies in order to help them establish. Applying attractants in combination with food sprays may promote oviposition of released chrysopid predators into the target crop. Hexane extract of corn borer larvae when applied on corn plants enhances performance of larval parasitoid *Bracon brevicornis* against the corn borers *Ostrinia nubilalis* and *Sesamia cretica* (Wakeil *et al*., 2017). However, attraction of natural enemies with synthetic compounds, similar to plant volatiles, is still being tested in crops.

- **Induced plant responses:** Induced plant resistance against insects includes indirect traits such as the plant producing volatiles and floral nectar which attract and/or retain natural enemies. Insect-induced plant volatiles help natural enemies to detect their prey/hosts in a crop, whereas floral nectar production is increased in response to insect attack, guiding natural enemies to find their prey/hosts. Preservation of natural enemies might be enhanced in different crops by breeding varieties that produce more volatiles and nectar.

- **Others:**

Construction of artificial structures like bird perches or nesting shelters to enhance the population of predatory birds. Avoiding harmful cultural practices like mowing or burning. Eg: Burning of sugarcane trashes destroys the resting stages of *Epiricania melanoleuca* that is a parasitoid of sugarcane pyrilla.

References

1. Costello, M.J., Thrupp, A. and McGourty, G. (2021). Influence of vineyard vegetational borders on western grape leafhopper (*Erythroneura elegantula* Osborn), its egg parasitoids (*Anagrus* spp.) and generalist insect predators. *South African Journal for Enology and Viticulture*, **42** (1): 25-35.
2. Hithesh, G.R., Suroshe, S.S. and Shashank, P.R. (2021). Conserving natural enemies in crop ecosystems. *Indian Entomologist*, **2**(2): 69-72.
3. Haldhar, S.M., Jat, G.C., Deshwal, H.L., Gora, J.S. and Singh, D. (2017). Insect pest and disease management in organic farming. In Book: Towards Organic Agriculture. pp. 359-390.
4. Landis, D.A., Wratten, S.D. and Gurr, G.M. (2000). Habitat management to conserve natural enemies of arthropod pests in agriculture. *Annual Review of Entomology*, **45**(1): 175-201.
5. McCravy, K.W. (2008). Conservation Biological Control. In: Encyclopedia of Entomology. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-6359-6_812.
6. Wakeil, N., Saleh, M., Gaafar, N. and Elbehery, H. (2017). Conservation Biological Control Practices. In Book: Biological Control of Pest and Vector Insects. https://www.intechopen.com/ chapters/53043.
7. Zheng, X., Yanhui, L., Zhu, P., Zhang, F., Tian, J., Hongxing, X., Chen, G., Nansen, C. and Zhongxian, L. (2017). Use of banker plant system for sustainable management of the most important insect pest in rice fields in China. *Scientific Reports*, **7**: 1-6.