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Recent Advancements in The Biological Management Methods Adapted for Rice Pests

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Introduction

Rice is one of the most important cereal crops and staple food for about half of the world's population (Liu *et al*., 2014). Farmers worldwide are increasing plant densities in their management schemes, resulting in an increased population of certain pests, resulting in a frequent over-optimum application of insecticides and herbicides (Brevik and Sauer, 2015; Mekonnen *et al*., 2015). A variety of insect pest species harm rice plants like yellow stem borer, leaf folder, brown planthopper, white-backed planthopper, rice hispa, grasshopper, mealy bugs, hornworm, and gundhi bug (Ko *et al*., 2014). Only a few species are economically significant, and they can inflict a 25–30 % economic loss. Leaf folders, plants, and leafhoppers are only a few that were once considered small pests but have now become severe problems.

Biological control of rice pests:

- **Benefits of using biological management for pest control programs:**
  - Eco-friendly tactics or free from environmental pollution
  - Having a sustainable effect on the eco-system
  - Don't have a broader pest target (Specific)
  - Positive impact on crop productivity, more insecticides
  - Cost-effective tactics for the farmers
- **Disadvantages of biological management methods:**
  - Time consuming
  - Labour intensive
  - Not instantly effective like insecticides
  - The mass-culturing methods are difficult

Biological control agents have been tested for their effects in reducing infestations by herbivorous insects, nematodes, and snails in rice, after the introduction of noxious weeds and damaging insects to new regions (Culliney, 2005).

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1. **Important parasitoids of rice pests –**

➢ ***Trichogramma* spp. –**

- Inundative biological control has been investigated for the control of rice field insects, nematodes, and storage pests, which includes *Trichogramma* spp. (Trichogrammatidae) for stem borers and leaf folders (Ko *et al*., 2014).
- *Trichogramma* species have been studied extensively and play a vital role in insect pest management in China (Lou *et al*., 2013). Research into releasing *Trichogramma* spp. for the control of main Lepidoptera pests in rice fields has been conducted since the 1950s in China.
- *T. japonicum*, *T. chilonis*, *T. dendrolimi*, and *T. ostriniae* are the four most prevalent *Trichogramma* spp. discovered in rice fields (Wang *et al*., 2015).
- *T. dendrolimi* thrives in temperatures between 18 and 26 degrees Celsius, while *T. japonicum* thrives in temperatures between 30 and 34 degrees Celsius. Meanwhile, after 4 days, *Trichogramma* is unable to parasitize any SSB egg successfully (Yuan *et al*., 2012; Zhang *et al*., 2014).

➢ **Other parasitoids of rice pests –**

- The other important parasitoid species of lepidopterans include *Cotesia chilonis* (Matsumura) (Hymenoptera: Braconidae) and *Apanteles cypris* Nixon (Hymenoptera: Braconidae).
- *Anagrus nilaparvatae* (Pang et Wang) (Hymenoptera: Mymaridae) is an important egg parasitoid of *Nilaparvata lugens*, *Sogatella furcifera*, and *Laodelphus striatellus* (Ren and Xian, 2017).

2. **Important predators of rice pests –**

❖ Different potential predators such as the wolf spider (*Lycosa pseudoannulata* Bösenberg & Strand) and mirid (*Cyrtorhinus lividipennis* (Hemiptera: Miridae: Orthotylinae)) attack *Scirpophaga incertulas* (YSB), *Nilaparvata lugens* (BPH), and *Cnaphalocrocis medinalis* (RLF). The predators that nourish on eggs and larvae of leaf folders are almost identical to stem borers.

❖ The wolf spider is considered an important predator because it feeds on the larvae and adults of stem borer, larvae of leaf folder, and the nymphs and adults of *N. lugens* and *C. medinalis* (Fahad *et al*., 2015).

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- ❖ Mirid eats the eggs and nymphs of *N. lugens* and also feeds on the green leafhopper and the eggs of leaf folders. Grasshopper (*Conocephalus longipennis*) consumes the stem borers and leaf folder eggs (Fahad *et al*., 2015).

3. Microbial pathogenic bioagents -

- *Bt* is the most popular biological insecticide for rice stem borers and RLFs and is officially recommended for use against rice stem borers. SSB and RLF effects are 65.31-96.69%, and 88.00–97.17%, respectively.
- After spraying the control effect of nuclear polyhedrosis virus (NPV) *Mamestra brassicae* on RLF, 14 d is more than 83%. *Cnaphalocrocis Medine* Granulovirus (Cnme GV), which possesses an RLF synergy of *Bt* compounds, is another possible biological insecticide in the management of RLF (Gao *et al*., 2012; Mo *et al*., 2014).
- *Metarhizium* spp. (Clavicipitaceae) and *Beauveria* spp. (Cordycipitaceae) for several insect and nematode pests; and the use of pathogenic bacteria (i.e. *Pseudomonas fluorescens* [Flügge] Migula and *Bacillus* spp.) for insects, nematodes, and rice diseases (Padgham and Sikora, 2007).

4. Other biocontrol agents -

- ✓ Biocontrol of insects and snails using ducks and fish has gained recent attention as part of integrated farming systems to reduce snail densities.
- ✓ Farmers in many regions where apple snails have been introduced will invite duck herders to direct their ducks through rice fields (Teo, 2001).
- ✓ For example, the common carp, *Cyprinus carpio* L, clearly reduces snail densities in rice, but carp is an invasive threat in some regions (Ip *et al*., 2014).
- ✓ *Anagrus* spp. and some Invertebrate predators, including damselflies (e.g., *Ischnura sengalensis*, *Agriocnemis femina*) are also used in rice pest management in advanced ecological engineering methods for BPH, RLF, and rice grasshoppers (**Chen *et al.*, 2016**).

Conclusion

Biological control is a multimodal management method that aims to avoid negative environmental impacts, as this is an important step towards providing healthy and maintaining a healthy ecosystem. There are several biocontrol agents in the rice ecosystem, which include predators, parasitoids, vertebrates, and entomopathogens. They kill by directly neutralizing the

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crop pests. They are relatively safer and specific for a pest. This review aims to provide information on the impact of biological control in a rice agroecosystem including the pests. Continued research and training on biocontrol methodologies will be required to create sustainable management tactics.

Reference

Brevik, E. C. and Sauer, T. J. (**2015**). The Past, Present, and Future of Soils and Human Health Studies. *Soil*, **1**: 35–46.

Chen, G. H., Zhu, P. Y., Zheng, X. S., Yao, X. M., Zhang, F. C., Sheng, X. Q., Xu, H. X. and Lu, Z. X. (2016). The practice of ecological engineering on the control of rice insect pests in Jinhua. *China Plant Prot*., **36** (1):31–36.

Culliney, T. W. (2005). Benefits of classical biological control for managing invasive plants. *Critical Reviews in Plant Sciences*, **24**: 131–150.

Fahad, S., Nie, L., Hussain, S., Khan, F., Khan, F.A., Saud, S., Muhammad, H., Li, L., Liu, X., Tabassum, A., Wu, C., Xiong, D., Cui, K. and Huang, J. (2015). Rice Pest Management and Biological Control, in Sustainable Agriculture Reviews. Springer International Publishing, pp. 85–106.

Gao, X. W., Wu, M. X., Sun, J. H. and Wang, Y. C. (2012). *Empedobacter brevis* on insecticidal effect and technology for *Cnaphalocrocis medinalis* Guenee. *Pest Sci. Admin*., **33**: 43–50.

Ip, K. K. L., Liang, Y., Lin, L., Wu, H., Xue, J. and Qiu, J.-W. (2014). Biological control of invasive apple snails by two species of carp: Effects on non-target species matter. *Biological Control*, **71**: 16–22.

Ko, K., Liu, Y., Hou, M., Babendreier, D., Zhang, F. and Song, K. 2014. Evaluation for potential *Trichogramma* (Hymenoptera: Trichogrammatidae) strains for control of the striped stem borer (Lepidoptera: Crambidae) in the Greater Mekong Subregion. *Journal of Economic Entomology*, **107**; 955–63.

Liu, G. L., Zhang, X. M., Zhao, L. W., Zhang, J. L., Wang, X. T., Chen, Y. B. and Zheng, X. S. (2014). Application of ecological engineering technology for managing rice pests and the benefit analysis. *J. Zhejiang. Agric. Sci.*, **55** (12): 1809–1811.

Lou, Y. G., Zhang, G. R., Zhang, W. Q., Hu, Y. and Zhang, J. (2013). Biological control of rice insect pests in China. *Biol. Control.*, **67** (1):8–20.

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Mekonnen, M., Keesstra, S. D., Stroosnijder, L., Baartman, J. E. M. and Maroulis, J. (2005). Soil Conservation through Sediment Trapping: *A Review. Land Degrad. Dev*., **26**; 544–556.

Mo, J., Ding, W. B., Li, Y. Z. and Li, G. H. (2014). Control effect of 9% 12 _-hydroxy-rotenone EW against three pests of Rice. *Hunan Agric Sci*., **10**; 40–42.

Padgham, J. L. and Sikora, R. A. (2007). Biological control potential and modes of action of *Bacillus megaterium* against *Meloidogyne graminicola* on rice. *Crop Protection,* **26**; 971–7.

Ren, L., Su, S., Yang, X., Xu, Y., Huang, Q. and Shen, Q. (2008). Intercropping with aerobic rice suppressed fusarium wilt in watermelon. *Soil Biol. Biochem*., **40**: 834–844

Teo, S. S. (2001). Evaluation of different duck varieties for the control of the golden apple snail (*Pomacea canaliculata*) in transplanted and direct-seeded rice. *Crop Protection,* **20**; 599–604.

Wang, G. R., Han, R. P., Shen, Q., Yang, W. T., Wang, G. D., Lu, Z. X. and Zheng, X. S. (2015). Effects of modified fertilizer application on rice pests, diseases, and yields. *China Rice*, **21**; 94–97.

Yuan, X. H., Song, L. W., Zhang, J. J., Zang, L. S., Zhu, L., Ruan, C. C. and Sun, G. Z. (2012). Performance of four Chinese *Trichogramma* species as biocontrol agents of the rice striped stem borer, Chilo suppressalis, under various temperature and humidity regimes. *J. Pest Sci*., **85**; 497–504.

Zhang, S., Jia, X. W., Sun, S. F., Pang, Y., Chen, Q. J. and Yang, K. (2014). Phylogenetic analysis and epidemiologic investigation of a *Cnaphalocrocis medinalis* granulovirus strain. *J. Environ. Entomol*., **36**; 756–762.