Sustainable Management of Brown Planthopper in Rice

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Rice, the primary staple for more than half the world's population, is produced worldwide, with about 90 percent grown in Asia (USDA, 2025). Rice is vital to nutrition in Asia, Latin America, Africa, and the Caribbean. Beyond its nutritional value, rice plays a significant role in the economy, employment, culture, and history. With a global production of 795 million tonnes in 2024 (FAO, 2025). The third most produced cereal worldwide, following corn and wheat (Statista, 2024). In India, rice is of prime importance, with production of approximately 145 million metric tons annually on about approx. 50.0 million hectares in kharif season of 2025 (USDA, 2024). Given its central role in food security, any threat to rice production, such as biotic stress, can have severe aftermath.

What is Brown Planthopper (BPH) and how it damages rice

Across the globe, rice production is significantly affected by a wide range of pests and plant diseases (Mukherjee et al., 2018). Approximately 800 insect species are known to damage rice at different stages, from cultivation to storage and consumption (Agyen-Sampong, 1994). As reported by Heinrichs and Muniappan (2017), only a small subset of insect species—20 in tropical Asia, 15 in Africa, and 20 in the Americas—are economically important, falling into categories such as stem borers, root feeders, hoppers, foliage and panicle feeders, and gall midges. These insect pests, in combination with plant diseases, significantly contribute to yield losses in rice production worldwide (Pathak & Khan, 1994). Hoppers, which include leafhoppers (Cicadellidae) and planthoppers (Delphacidae), cause damage not only by direct feeding but also by transmitting viral diseases such as rice tungro, rice transitory yellowing, hoja blanca virus, and rice yellow mottle virus (RYMV) (Chen et al., 2023; Martin et al., 2020; Morales & Jennings, 2010).

In Asia, the major pest genera damaging rice crops include hemipterans such as *Nilaparvata*, *Sogatella*, and *Nephotettix*, along with lepidopteran genera like *Scirpophaga*, *Chilo*, *Cnaphalocrocis*, and *Sesamia*. Among these, the brown planthopper (*Nilaparvata lugens*), native to the region, is one of the most destructive pests (Bragard et al., 2023), It is regarded as one of the most destructive pests of rice. At high population levels, it causes leaf discoloration that progresses to "hopperburn," ultimately leading to plant death. In addition, *Nilaparvata lugens* serves as a vector for several plant viruses (Bragard et al., 2023). Planthoppers can cause up to 60% yield loss, with $300 million economic damage annually across Asia and USD 12,34,085 in southern part of India (Srivastava *et al.*, 2023).

Rising temperatures are intensifying pest activity and the spread of diseases, particularly impacting species such as *Nephotettix* spp. (green leafhoppers), which transmit rice tungro virus, and *Nilaparvata lugens* (brown planthoppers), vectors of rice grassy stunt and ragged stunt viruses. To mitigate these challenges, there is a critical need to adopt adaptive pest management strategies, develop climate-resilient rice varieties, and implement advanced monitoring systems tailored to the climatic conditions of each region (Conde et al., 2025).

Why chemical control alone fails (resistance, resurgence, natural enemy destruction)

The widespread and often indiscriminate use of insecticides has led to the development of resistance in *N. lugens* to nearly all major classes of insecticides. Worldwide, resistance in *N. lugens* has been reported against 35 active ingredients, with a total of 457 documented cases of field-evolved resistance (Sanchez and Wise, 2024). Insecticides such as triazophos, deltamethrin, and carbendazim can stimulate planthopper reproduction and increase their mobility, while simultaneously eliminating beneficial predators that naturally regulate pest populations. This disturbance of ecological balance ultimately diminishes the effectiveness of biological control (Meena et al., 2023).

BPH infestation in Rice Hopperburn caused by BPH

Integrated Pest Management (IPM) concept for BPH

1. Cultivation of Resistant Rice Varieties: Some resistant varieties include: RP BIO 4918-230S, BM 71, RP 2068-18-3-5, IC 70613, IC 75975, ADT 37, ADT 38, ADT 42, ASD 17, Co. 46, MDU 4, TPS 2, Pant Shankar Dhan 3, Pant Dhan 11.

2. Field Design and Maintenance: Create 30 cm wide sidewalks spaced 2 meters apart to improve air and light circulation.

3. Fertilizer application: Apply nitrogen fertilizers in recommended doses, divided into 2-3 applications along with split application of appropriated dose of potassium fertilizers should be followed to reduce chances of BPH out breaks. Coordinate planting times among farmers in the region to minimize pest buildup.

4. Crop Rotation: Rotate rice with pulses, oilseeds, and other non-rice crops to break the pest cycle. Avoid consecutive rice cultivation to reduce the risk of hopper infestation.

5. Water Management: Alternate wetting and drying of rice fields will be helpful in reducing the initial infestation levels. The fields should be drained (wherever possible) for 3-4 days when heavy infestation occurs.

6. Biological Control: Release natural enemy like *Cyrtorhinus lividipennis* (200–250/ha) during peak brown plant hopper incidence at 10-day intervals. Hymenopteran wasps parasitize eggs, while mirid bugs and mites prey on both eggs and nymphs. Spiders and coccinellid beetles feed on nymphs and adults. Aquatic beetles, dragonflies, and certain bugs consume hopper nymphs and adults that fall into water. Fungal pathogens also infect the hoppers.

7. Environmental Management (Ecological Engineering): Grow plants like marigold, bhendi, cowpea, Sun hemp, Coriander along paddy ridges. These plants provide nectar and pollen, helping sustain natural predators of hoppers and other pests.

8. Chemical Control: Chemical control for hopper infestations should be implemented when populations reach 10-15 hoppers per hill. Recommended insecticides include Acephate 75 SP 200 grams per acre, applied once 45 to 60 days after planting. Dinotefuron 20 SG at 80 grams per acre, and Pymetrozine 50 WG at 120 grams per acre.

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