Vol. 5 Issue- 2, October 2024 (e-ISSN: 2582-8223)

JUST AGRICULTURE multidisciplinary e-Newsletter

Distribution and Infestation of Brown Plant Hopper in Rice

Rathna Ganamala and Vinay Kumar
Department of Genetics and Plant Breeding, MS Swaminathan School of Agriculture
Centurion University of Technology and Management, Odisha 761211, India

ARTICLE ID: 14

Abstract

The brown planthopper, *Nilaparvata lugens* (Stal), is a phloem sucker of rice plants that has recently become a prominent pest in all rice-producing regions. It can harm rice crops from the vegetative to the reproductive stages, resulting in the symptom known as "hopper burn." It causes direct losses and serves as a vector for viral infections that lead to stunting. In this review, we focus on the impact of climate change on plant hopper biotypes, highlighting the need for continuous research and monitoring. The brown planthopper, *Nilaparvata lugens* (Stål), is the most harmful rice pest globally and is known to spread stunted viral illness, damaging the rice vascular system and costing money when grown commercially. Climate change is a major global issue, predicted to decrease crop production by 3% ha^{-1}, alter crop suitability, and increase the risk of pests and diseases. Climate change impacts insect pest dispersal, which is crucial for crop productivity. *Nilaparvata lugens*, a phloem sucker of rice plants, has become a prominent pest in all rice-producing regions. Its life cycle consists of adult nymphs, eggs, and larvae. The first significant outbreak in India occurred in Kerala in the late 1960s. The pest has been present in Kerala occasionally since 1958 and 1962, but the 1973-1974 outbreaks were the state's first significant outbreak. Climate change is predicted to impact insect species diversity, distribution patterns, niche areas, appropriate habitats, reproduction ability, risk of invasion, and frequency of outbreaks.

Keywords: Brown Plant Hopper, Outbreak, Hopper Burn, Biotypes, Infestation

Introduction

The most harmful rice pest in the world is the brown planthopper, *Nilaparvata lugens* (Stål). It is also known to spread stunted viral illness, which damages the rice vascular system and costs money when grown commercially. This can happen when the bug acts alone or in concert with a virus.

JUST AGRICULTURE
multidisciplinary e-Newsletter

One of the biggest worldwide issues of the twenty-first century is climate change, which studies indicate will decrease crop production by 3% ha^{-1} (refs 1, 2), alter crop suitability 3, and raise the danger of pests and diseases 4-6, with all of these effects resulting in food insecurity, disruptions to livelihood and the economy, migration, and conflict.

Climate change is predicted to have an impact on insect pest dispersal, which is often overlooked or understated in impact assessments while being crucial for crop productivity. Insect species diversity, distribution patterns, niche areas, appropriate habitats, ability to reproduce, risk of invasion, and frequency of outbreaks are all impacted by climate change.

For significant rice pests like the brown planthopper (BPH), *Nilaparvata lugens*, the alterations may be disastrous. The first case of *N. lugens* was discovered in Tamil Nadu in 1950. The first significant outbreak in India took place in Kerala in the late 1960s. It is a phloem sucker of rice plants that has recently become a prominent pest in all rice-producing regions. *N. lugens* not only causes direct loss but also serves as a vector for viral infections that cause stunting. It can harm rice crops from the vegetative to the reproductive stages, resulting in the symptom known as "hopper burn."

Life Cycle of BPH

The destructive insect in rice fields is called *Nilaparvata lugens* (Stal) (Hemiptera: Delphacidae). This insect exhibits incomplete metamorphosis; it goes through three stages to finish its life cycle:

- Adult
- Nymphs,
- Eggs, and
- Larvae.

1. **Adult:** Displaying two wing forms at this stage of BPH indicates that the short wing is brachypterous and the long wing is macopterous. According to Noda et al. (2008), brachypterous adults are adapted for reproduction and have a large number of progeny, but macropterous adults are able to fly over great distances. Environmental conditions and population density have an impact on BPH wing dimorphism, according to Liu et al. (2000). Adults have brochraceous morphology, with a deep brown ventral region and a brown dorsal region. Males are 4.5 mm and females are 5 mm length, according to Raghavaiah et al. (2012). BPH bodies have a dark to brownish brown appearance.

JUST AGRICULTURE
multidisciplinary e-Newsletter

2. **Nymph:** This stage of BPH significantly affected by Nitrogen application, Rashid et al. (2017). Nymph is similar to adults. A freshly hatched nymph seen as cottony white and 0.6 mm long. Nymph molts 5 times and turns purple brown, 3 mm long during the fifth instar. The nymphal period of BPH varies between 12 to 15 days Upadhyay and Mathur (2011).
3. **Egg:** The eggs of BPH are white; transparent cylindrical arranged in 2 straight lines. 1 female can lay up to 650 during its life time. The size of the egg may be 1mm long and 0.2 mm in width. Eggs are thrust within the parenchymatous tissues of the plant along the midrib of leaves in bunches of 2-12 eggs, Raghavaiah et al. (2012). The hatching period of the egg varies from 5-8 days.

Distribution of Brown Plant Hopper in India

Kerala state saw the worst BPH outbreak in India around the end of 1973 and the beginning of 1974 (Koya 1974; Nalinakumari and Mammen 1975). The pest has been present in Kerala occasionally since 1958 and 1962, but the 1973–1974 outbreaks were the state's first significant outbreak. The 'Kole' lands in the Trichur district and the Kuttanad area in the Kottayam and Alleppy districts are where it happened. Approximately 50,000 acres of rice fields suffered economic losses as a result of the insect outbreak (Freeman 1976). Approximately 8,000 hectares were nearly entirely destroyed (Gopalan 1974). Hopper burn typically appeared in patches, perhaps covering entire fields. Although some crop loss occurred at every stage of growth, the majority of damaged crops had already headed (Kulshreshtha 1974). (Mammen and Das 1973). The damage was so severe in several fields that farmers gave up on the crop (Das et al 1972). 10% of fields with moderate damage and 70% of fields with severe damage lost grain yield (Kulshreshtha et al., 1974). There were instances when the standing crop suffered 100% devastation. The area is the same as the area that lost its entire rice crop in recent years; this estimate was calculated by summing losses of varying degrees in various areas. An estimated $12 million is lost in Kerala between 1973-1974 and 1975-1976.

Distribution of Brown Plant Hopper in Odisha

In the whole Indo-Gangetic region, which stretches from West Bengal, Bihar, and Jharkhand to Uttar Pradesh, Haryana, and Punjab, BPH has emerged as the most common pest. During Kharif 2013, the AICRIP on rice has revealed extensive plant hopper infestations in Ludhiana, New Delhi, Raipur, and Nalganda. Both in 2014 and 2017, the NRRI documented

JUST AGRICULTURE
multidisciplinary e-Newsletter

cases of BPH outbreaks and significant damage in Odisha's coastal and western districts, specifically in Cuttack, Jagatsinghpur, Bargarh, Sambalpur, Ganjam, and Berhampur.

In moderate infestations, yield loss from BPH can reach 10%, whereas in severe infestations, it can reach 70%. Sometimes a standing crop sustains 100% damage.

Infestation of BPH:

From the late vegetative stage until the grains hardening stage, it attacks the crop. Adults and nymphs gather near the plant's base above the water, where they suck the sap from the tillers. The impacted plant dries out and develops "hopper burn," a burnt appearance. Typical signs of this pest are mature plants lodging and circular spots of drying. Their excrement, known as honeydew, encourages the growth of sooty mold on plants. It is a carrier of the illnesses ragged stunt and grassy stunt.

Biotypes of Brown Plant Hopper

Although resistant rice variants have shown to be very successful in controlling the brown planthopper *Nilaparvata lugens* (Stal), the emergence of proliferating biotypes poses a danger to the long-term stability of these kinds. Currently, the primary method for identifying biotypes is the difference in how host rice varieties respond to pests in field plantings of test nurseries at various sites and in greenhouse screenings. Three *N. lugens* biotypes that target various types of rice have been found in the Philippines thus far. Biotype 1 is limited to surviving on and harming types devoid of resistance genes. Varieties with the Bph 1 resistance gene and those vulnerable to biotype 1 are suitable hosts for biotype 2. The bph 2 resistance gene can be inserted into and destroyed by biotype 3 Along with those who are vulnerable to biotype 1. But none of these biotypes may harm variations that have resistance genes for Bph3 and Bph4, and the variety Ptb 33, which has two unknown genes, is immune to nearly all known biotypes.

Studying how different biotypes react physiologically and behaviourally to plants with known genotypes can also help distinguish between them. Insect feeding, growth, longevity, fecundity, oviposition, population growth on different types, and relative vulnerability or tolerance for hosts' allelochemics all exhibit distinct variances. The results of hybridization experiments and recent studies examining the occurrence of minute morphological, cytological, and electrophoretic variations among *N. lugens* biotypes provide a solid supplement to existing techniques for biotype identification. The genetic composition of

JUST AGRICULTURE
multidisciplinary e-Newsletter

cultivated varieties and the genetic and other biological traits of pest populations combine to drive the complicated process of biotype evolution. Although the technique of releasing significant resistance gene variations one after the other has been relatively successful, such varieties are monogenic.

Infestation of BPH in Rice

In rice, *Nilaparvata lugens* hinders growth and development, which has a negative impact on grain yield. Their ability to use their food sources sucking sap and laying eggs in stems is influenced by host prominence (Rashid and al., 2016). BPH is consistently supported as a deterrent pest of rice by the nymphs' eating habits, fecundity, nymphal development, and transmitted diseases of ragged stunted disease and grassy stunted disease (Jegadeeswaran et al. 2014). The impact of BPH is explained in depth with reference to the economic threshold level, which has a connection to yield and revenue loss. According to Prokopy and Kogan (2009), the main goal of modern pest management is to eradicate pests as soon as possible at a cost that is affordable. Additionally, there are many other elements that contribute to ETL, such as the kind of pest (biotype), developmental stage, life cycle, diffusion of pests, population density, duration of infestation, population dynamics, crop variety (prone to pest attack), plant stage (attack duration, tolerance), and so on (Cheng 1979). The rice plant characterized as "hopper burn" becomes severely discoloured and dehydrated due to a complex wound response brought on by a severe BPH infestation (Backus, Serrano, & Ranger, 2005). By spreading the ragged stunt virus and rice grassy stunt virus, BPH also indirectly harms the rice crop (Fujita, Kohli, & Horgan, 2013; Jena & Kim, 2010; Sarao et al., 2016). The most popular technique for controlling BPH infestations is chemical management, yet it is expensive and may be hazardous to both human health and the environment.

Conclusion

In conclusion, the brown planthopper, *Nilaparvata lugens*, is a significant threat to rice crops globally, causing direct losses and serving as a vector for viral infections that lead to stunting. Climate change poses a serious risk to crop productivity and exacerbates pest issues like the brown planthopper. The insect's life cycle involves stages from eggs to nymphs and adults, with varying impacts on rice plants. Biotypes of the brown planthopper present challenges to managing infestations, highlighting the need for continuous research and monitoring. The negative impact of brown planthopper infestations on rice includes reduced grain yield and indirect harm through the spread of diseases. Effective pest management strategies, such as identifying resistant rice variants, are crucial in mitigating the devastating effects of the brown planthopper on rice production.

References

Anant, A. K., Guru-Pirasanna-Pandi, G., Jena, M., Chandrakar, G., Chidambaranathan, P., Raghu, S., & Rath, P. C. (2021). Genetic dissection and identification of candidate genes for brown planthopper, Nilaparvata lugens (Delphacidae: Hemiptera) resistance in farmers' varieties of rice in Odisha. Crop Protection, 144, 105600.

Bottrell, D. G., & Schoenly, K. G. (2012). Resurrecting the ghost of green revolutions past: The brown planthopper as a recurring threat to high-yielding rice production in tropical Asia. Journal of Asia-Pacific Entomology, 15(1), 122-140.

Dyck, V. A., & Thomas, B. (1979). The brown planthopper problem. *Brown planthopper: threat to rice production in Asia*, *3*, 17.

Elanchezhyan, K., Sathyan, T., & Manikandan, K. R. (2020). Brown plant hopper (BPH) and their management in rice. *Research Today*, *2*(4), 90-92.

Iamba, K., & Dono, D. (2021). A review on brown planthopper (Nilaparvata lugens Stål), a major pest of rice in Asia and Pacific. Asian Journal of Research in Crop Science, 6(4), 7-19.

Jeevanandham, N., Raman, R., Ramaiah, D., Senthilvel, V., Mookaiah, S., & Jegadeesan, R. (2023). Rice: Nilaparvata lugens Stal interaction current status and future prospects of brown planthopper management. *Journal of Plant Diseases and Protection*, *130*(1), 125-141.

Kumar, K., Kaur, P., Kishore, A., Vikal, Y., Singh, K., & Neelam, K. (2020). Recent advances in genomics-assisted breeding of brown planthopper (*Nilaparvata lugens)* resistance in rice (*Oryza sativa*). Plant Breeding, 139(6), 1052-1066.

Kumar, S., Singh, H., Patel, A., Patel, J. N., & Kant, C. (2022). Brown plant hopper, Nilaparvata lugens (Stal) (Insecta: Delphacidae) a major insect of rice in India: A review. *Journal of Entomological Research*, *46*(2), 333-338.

Mishra, A., Barik, S. R., Pandit, E., Yadav, S. S., Das, S. R., & Pradhan, S. K. (2022). Genetics, mechanisms and deployment of brown planthopper resistance genes in rice. Critical Reviews in Plant Sciences, 41(2), 91-127.

Muduli, L., Pradhan, S. K., Mishra, A., Bastia, D. N., Samal, K. C., Agrawal, P. K., & Dash, M. (2021). Understanding brown planthopper resistance in rice: Genetics, biochemical and molecular breeding approaches. Rice Science, 28(6), 532-546.

Saxena, R. C., & Barrion, A. A. (1985). Biotypes of the brown planthopper Nilaparvata lugens (Stål) and strategies in deployment of host plant resistance. *International Journal of Tropical Insect Science*, *6*(3), 271-289.