Preventing planthopper outbreaks in rice

Planthoppers are a major insect pest of rice crops across Asia. They cause hundreds of millions of dollars of losses every year and threaten food security in the region where rice is the staple food.

The International Rice Research Institute (IRRI) has developed an action plan to help nations avoid planthopper outbreaks. This plan aims to boost rice production, slash pesticide misuse, and improve ecosystem health.

IRRI
INTERNATIONAL RICE RESEARCH INSTITUTE

Planthoppers: a costly pest

Since 2004, several Asian countries have experienced severe outbreaks of planthoppers in rice.

In China, planthoppers persistently cause losses of about 1 million tons annually. In 2005, damage was about 2.8 million tons. In 2005 and 2006, numerous outbreaks also occurred in Japan and Korea.

In 2007, Vietnam suspended exports of rice because of losses caused by planthoppers, and their persistent outbreaks in Indonesia have caused severe losses over tens of thousands of hectares since 2008.

In 2009, outbreaks of planthoppers and associated virus diseases intensified in Central Thailand, the southern provinces of China, northern Vietnam, and Indonesia. Between 2009 and 2011, more than 3 million hectares in Thailand were infested, causing losses in excess of 1.1 million tons of paddy rice, with an export potential of US$275 million.

The southern rice black-streaked dwarf virus, transmitted by the whitebacked planthopper, has spread into most provinces in the Red River Delta and further south into Central Vietnam. In 2009, an estimated 300,000 hectares were heavily infested in China and Vietnam, and more than 6,500 hectares suffered complete crop failure. The virus has now also spread to Japan.

Planthoppers

In Asia, the **brown planthopper** and the **whitebacked planthopper** cause major losses in rice production.

Both of these insects feed on rice plants by sucking their sap, which can kill the plant. They also transmit viral diseases that can further reduce rice production.

Smart insecticide use

Invasions of brown planthopper (BPH) are usually not uniformly distributed. If a particular spot in a field has received a large number of "immigrant" BPH, the following control measures are recommended:

- Do NOT spray the immigrants. Wait 10 to 15 days after the immigration has occurred and check fields for nymphs.
- If there is a large presence of nymphs, such as more than a hundred in a hill, then use insecticides that specifically control nymphs such as growth regulators containing the active ingredient buprofezin. In spraying the nymphs, it is vitally important that sprays be directed at the base of the crop, not on the top. Spot-spray: spray only those parts of the field where the nymphs are located.
- Do NOT use broad-spectrum insecticides such as pyrethroids or organophosphates as they are highly toxic to bees, parasitoids, and egg predators.

Insecticides are made up of different active ingredients and sold under a large variety of brand names in each country. Check the label of an insecticide to see which active ingredients are included to determine if and when the insecticide should be used.

Groups	Active ingredient	Effects	Use in rice crops
Carbamates	Fenobucarb	Controls insect nymphs	
Growth regulators	Buprofezin	Specific on nymphs	Spray at base of crop to control planthopper nymphs.
Pyrethroids	Cypermethrin	Broad spectrum	Do NOT use.
	Deltamethrin	Broad spectrum	Do NOT use.
Organophosphates	Chlorpyrifos	Broad spectrum	Do NOT use.
Macrocyclic lactones	Abamectin	Broad spectrum	Do NOT use.

Causes of planthopper outbreaks

Planthopper outbreaks are primarily caused by the breakdown of ecosystem resilience or biological control functions in the rice landscape.

Planthoppers migrate and can be displaced by wind over long distances to invade new rice fields. In a healthy rice landscape, the number of invading planthoppers is controlled by natural enemies, such as spiders, aquatic bugs, predatory bugs, and parasitoid wasps. When such predators and parasitoids are absent, invading pest populations have unconstrained exponential growth, which results in outbreaks.

Insecticide misuse: The principal cause of predator and parasitoid decline is the overuse and misuse of insecticides. Farmers who routinely spray insecticides in the early crop growth period to control leaf feeders such as leaffolder, for example, use chemicals that are highly toxic to parasitoids and spiders. Planthopper outbreaks are ten times more likely to occur in such sprayed fields.

Preventive sprays, especially with broad-spectrum insecticides that are toxic to parasitoids, render rice ecosystems extremely vulnerable to planthopper outbreaks. Also, insecticide applications do not kill planthopper eggs that later hatch into an enemy-free environment.

Excessive fertilizer use: High use of nitrogen fertilizer leads to a crop that is high in protein, which forms a nutritious food for planthoppers and accelerates population growth.

High cropping intensity: Increases in rice cropping intensity from single to double and triple cropping promote the buildup of planthopper populations and eventual outbreaks if they are accompanied by short fallow periods in between the crops and by asynchronous planting. The absence of sufficiently long fallow periods (or of a nonrice crop) and asynchronous planting mean that migrating planthoppers have a high chance of finding a rice crop in a suitable growth stage that will allow them to feed and multiply.

Capacity to adapt: Finally, planthoppers can rapidly overcome resistant rice varieties, especially where planthopper densities are high and when a small number of varieties are widely planted. In addition, planthoppers rapidly develop resistance to insecticides; in some parts of China, this resistance can reach 200-fold.

Pesticide supermarkets: The overuse and misuse of pesticides are a key factor in planthopper outbreaks—regulating pesticide sales and properly training salespeople and extension agents will help farmers get better pest management guidance.

Insecticide misuse: When applying insecticides to rice, avoid spraying in the early crop stages, on top of the rice canopy, and with poor equipment that delivers large droplets.

Joint effort—a path to success

IRRI calls on all stakeholders to join forces to implement this action plan. We encourage:

Governments to review, adapt, and enforce pesticide regulations and policies to prevent overuse and misuse in rice production.

The private sector to collaborate on market regulations to prevent the use of insecticides that may promote planthopper outbreaks when used in rice.

Nongovernment organizations and civil society to help disseminate information about proper insecticide use and how to restore ecological resilience in rice landscapes.

IRRI will develop and disseminate tools that enhance ecosystem resilience and facilitate dialogue among stakeholders to implement the action plan.

Healthy rice landscapes: Planting different types of flowering crops alongside rice can help encourage predators and parasitoids that prey on pests, including planthoppers.

Action plan to reduce planthopper damage to rice crops in Asia

Enhance biodiversity and ecosystem resilience

- **Introduce landscape elements** such as flowers to promote the buildup and sustenance of a healthy population of parasitoids and predators of planthoppers.
- **Promote synchronized planting and fallow periods** of one month in between successive crops of rice.
- **Implement crop diversification schemes** across time and space. As far as possible, avoid insecticide spraying in the early crop stages (the first 40 days after sowing) to enhance the buildup of biodiversity, ecosystem services, and resilience.
- **Deploy resistant and/or tolerant varieties** judiciously by using a combination of varieties that differ in their resistance or tolerance mechanisms, and avoid using the same varieties for more than two years as this promotes the development of resistance in planthoppers.

Regulate the marketing and use of insecticides

- **Regulate insecticides:** Support national and local governments in market regulation of insecticides that shift their classification from consumer goods to regulated materials.
- **Stop certain insecticides:** Support governments in exploring options to stop the use of broad-spectrum insecticides that induce the resurgence of planthoppers, especially those containing the active ingredients cypermethrin, deltamethrin, abamectin, or chlorpyrifos.
- **Certify pesticide retailers:** Urge governments to certify pesticide retailers to prevent sales of fake, banned, or unapproved products, and to foster the promotion of integrated pest management and proper pesticide use.
- **Train pesticide retailers and extension agents** on the correct use of insecticides, such as conditions under which they should be avoided, the correct chemicals to use in case of application, alternating between chemicals with different modes of action to prevent pest resistance, the proper use of spray equipment, and the discouragement of broad-spectrum insecticides and preventive spray schedules.

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