



Reducing vulnerability of rice crops to pre harvest losses
caused by planthopper outbreaks
(RETA 6489)

Status of the problems caused by rice planthoppers and related virus diseases in Asian rice production

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Between 2004 and 2008 several countries in Asia suffered heavy pre harvest losses caused by outbreaks of planthoppers and the virus diseases they transmit. In China planthopper problems are persistent causing losses of about 1 million tons a year. But in 2005, the damages were extensive and a loss of about 2.8 millions was reported. Also in 2005/2006 numerous outbreaks occurred in Japan and Korea. In Vietnam rice production suffered a loss of about 400,000 tons or 1.1% of Vietnam's annual production. The problem persisted in 2007 and the government suspended exports that might have contributed to the rice price crisis in 2008.

In early 2008 IRRI completed a scoping study of the planthopper and virus problems in Vietnam that was funded by ACIAR. The study found that the planthopper outbreaks were attributed to the lack of "system resistance" and breakdown in ecosystem services. Such ecological breakdowns may be caused by abnormal weather conditions, like droughts and floods, while in most cases they are caused by excessive use of insecticides. Farmers' sprays in the early crop periods often to control leaf feeders with chemicals highly toxic to parasitoids and spiders that cause biodiversity loss and the ecosystem functions they perform. Fields sprayed in early crop periods tend to be more vulnerable to invading planthoppers which would multiply exponentially into outbreak proportions.

The Rice Planthopper Project (RETA 6489) was initiated in December 2008 with 3 participating countries, China, Thailand and Vietnam and one affiliate country, Malaysia, funding her own participation. Monitoring of planthopper outbreaks, occurrence and spread of virus diseases they carry and insecticide resistance began in early 2009. This report provides a summary of the occurrence of the planthoppers and virus diseases, their implication to pre harvest losses, rice prices, pesticide misuses and food security.

In 2009, there were numerous reports of outbreaks of planthopper and virus diseases were received. These outbreaks are shown in the map below. We have not received any report from Laos, Japan, Taiwan, and Sri Lanka and in some countries like China there have been under reporting or reports were not released to the public.

Planthopper outbreaks in Asia in 2009

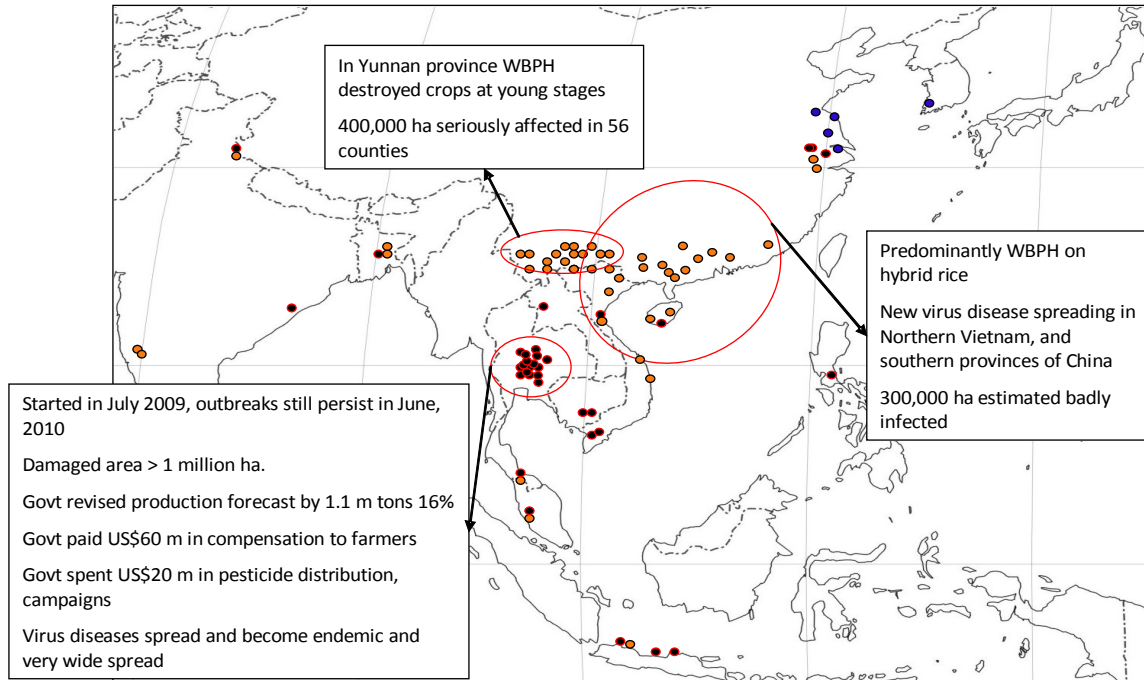


Figure 1: Map showing outbreaks that were reported in 2009

The most significant outbreaks caused by the planthoppers were in Central Thailand, Southern provinces of China and Northern Vietnam, and Yunnan province in China.

Outbreaks in Thailand

Rice production in Thailand suffered one of the biggest losses they have ever experienced caused by the brown planthopper (BPH) and 2 virus diseases, the grassy stunt and ragged stunt. About 3 million ha were heavily infested and at least 1.1 million tons paddy or export potential of US\$ 275 million was reported lost as the government announce a revision of Thailand's rice output forecasts by about 16% from 8.3 to 7.0 million tons in January 2010¹. In addition, the Thai Government spent about US\$ 80 million in compensations, campaigns and pesticide distributions². The planthopper problem seemed to have worsened in the first quarter of 2010 with large areas in Suphan Buri completed destroyed by the virus diseases. In March, the Rice Department launched another campaign to motivate farmers to plow in their infested fields and stop growing rice for

¹ <http://ricehoppers.net/2010/01/28/thailand-cuts-second-crop-rice-output-forecasts-by-16-because-of-bph-and-water-shortage/>

² <http://ricehoppers.net/2010/02/10/thai-government-to-provide-b2bn-to-compensate-farmers-hit-by-bph/>

one season. In the months of April to June 2010, rice production was affected by drought and many fields were not planted. Infested area declined from 380,000 ha in December 2009 to 25,000 ha in mid June. The 2 virus diseases had remained endemic causing general losses of about 1%. Most rice fields in Central Thailand remain vulnerable to potential planthopper outbreaks as the biodiversity, both in varieties and ecosystem services remain low. Last year 75% of the farms were grown to 2 varieties, Chainat-1 and Suphan Buri-1. The Rice Department has been encouraging farmers to switch varieties, but due to lack of seed stocks, most farmers are still confined to a few varieties. Insecticide use remains high and most farmers remain dependent (or addicted). Poor extension services to advice farmers on the right chemicals and proper use are forcing farmers to rely on pesticide vendors for advice, which has resulted in the high use of resurgence causing chemicals, such as cypermethrin, abamectin and chlorpyrifos, known for their toxicity to bees and parasitoids.

Although the government had revised Thailand's rice production forecast by 16%, it has not affected exports since there was a huge stockpile of about 5 million tons. Rice prices had remained relatively unchanged and likely to remain so. The impact of the losses on rice supply and food security at least in the short term seems negligible. The government paid about US\$28 million to compensate farmers who had lost their crops and US\$ 3.3 million to provide farmers with new varieties. The pesticide industry has expanded by at least US\$22 million from government pesticide subsidies. And hundreds of farmers had fallen in debts from loans and credits, especially to purchase pesticides. In addition the expanded pesticide market would impact further misuse and deterioration of ecosystem services. The impact of such externalities and social impacts would need further analyses.

The government also provided an additional US\$ 700,000 to support research.

New virus problem in Southern provinces of China and northern provinces of Vietnam

In Northern Vietnam, a new virus disease transmitted by the white back planthopper (WBPH) surfaced³ Discovered in China in 2001, the Southern Rice Black Streak Dwarf Virus (SRBSDV) was found to have spread into most provinces in the Red River Delta and South to Central Vietnam. In China the virus is now endemic in most of the southern provinces, like Hainan, Guangdong, Guangxi, Yunnan and Fujian. An estimated 300,000 ha were heavily infected in 2009 and more than 6500 ha suffered complete crop failures⁴. IRRI initiated the formation of the China-IRRI-Vietnam rice virus consortium to focus research to gain better understanding of this new problem⁵. Monitoring and research activities in Northern and Central Vietnam have been initiated by the National Institute of Plant Protection (NIPP) and Plant Protection Department (PPD) and coordinated by the Vietnam Academy of Agricultural Sciences (VAAS). The Ministry of Agriculture and Rural Development (MARD) of Vietnam has provided about US\$ 130,000 to enhance the monitoring activities.

³ <http://ricehoppers.net/2009/11/03/new-virus-carried-by-wbph-becoming-wide-spread-in-hybrid-rice/>.

⁴ <http://ricehoppers.net/2010/06/new-rice-virus-disease-spreading-in-china/>.

⁵ <http://ricehoppers.net/2010/01/08/consortium-initiated-to-research-on-new-virus-disease-southern-rice-black-streak-dwarf-virus/>

The new virus is transmitted by the WBPH, a planthopper species that is dominant in hybrid rice. Planthoppers species composition changed from the brown to the white back as hybrid rice expanded in China. As hybrid rice varieties continue to expand in Vietnam and many other Asian countries, the WBPH will likely become more dominant. Hybrid varieties seem particularly susceptible to this species. At the moment the new virus that WBPH carry is restricted to China and northern Vietnam. Some plants with the virus were found in central Vietnam, implying that the virus is spreading south. In China the new virus is found in Shandong area indicating the northward spread. As planthoppers are constantly displaced by wind currents the spread of the virus diseases they carry will be inevitable.

In the short term the spread of the virus is likely to be restricted to areas with hybrid rice varieties since its main carrier is the WBPH that is dominant in hybrids. The WBPH and the virus can infect inbred varieties as well and in addition the virus can multiply in alternate host plants, including maize, sorghum and *Echinochloa* (common weed of rice) and thus has the potential to increase its local spread upon arriving in new areas. Its immediate impact on food security is probably negligible but in the long term this problem can become persistent and damaging. Because the virus was only described in 2008, very little research has been conducted to understand its biology, virus-insect-plant relationships and to develop management strategies. More investments into such research in the next 5 to 10 years will be able to provide sufficient information to develop management strategies.

Heavy attacks by the white back planthopper (WBPH) in seedling stages

In Yunnan, China, young rice crops were badly destroyed by the WBPH. This was reported to have affected most of the Southern districts of Yunnan⁶. The crop destruction seemed to be caused by massive displacements of the adult hoppers from areas with very high WBPH populations, possibly the northern provinces of Vietnam. About 400,000 ha were badly damaged. This clearly shows that for such mobile pests, like planthoppers, international cooperation is essential for its management. The China-IRRI-Vietnam consortium has initiated an effort to monitor and understand planthopper displacement patterns. Macro level studies integrated with inputs from meteorology will be able to establish reliable models to predict migration patterns. Some research investments can have large payoffs.

The sudden and heavy attacks by planthoppers in Yunnan had impacted the local mostly poor farmers. But the Chinese government had responded by providing compensations. The immediate impact on food security is probably negligible but there is limited knowledge for the longer term.

The association between WBPH and hybrid varieties seems clear from macro data sets from China. Many of the outbreaks in hybrid varieties in India, Bangladesh, Indonesia and the Philippines were also damaged by the WBPH. In IRRI, hybrid rice varieties

⁶ <http://ricehoppers.net/2009/08/18/yunnan-china-infested-by-the-white-backed-planthoppers-wbph/>

grown in the field had significantly more WBPH. However we still lack micro level information on the physiological elements that make WBPH dominant in hybrids. Research investments on understanding these physiological factors will benefit both entomologists and plant breeders in developing management strategies, both in the seed as well as in production fields.

Multiple folds in insecticide resistance have developed.

Of deep concern is the rapid development by the 2 species of planthoppers to insecticides in the intensive rice areas. Several new chemistries introduced just 10 years ago are now less effective. Figure 2 shows resistance ratios of 3 chemicals in China, Philippines, Thailand and Vietnam.

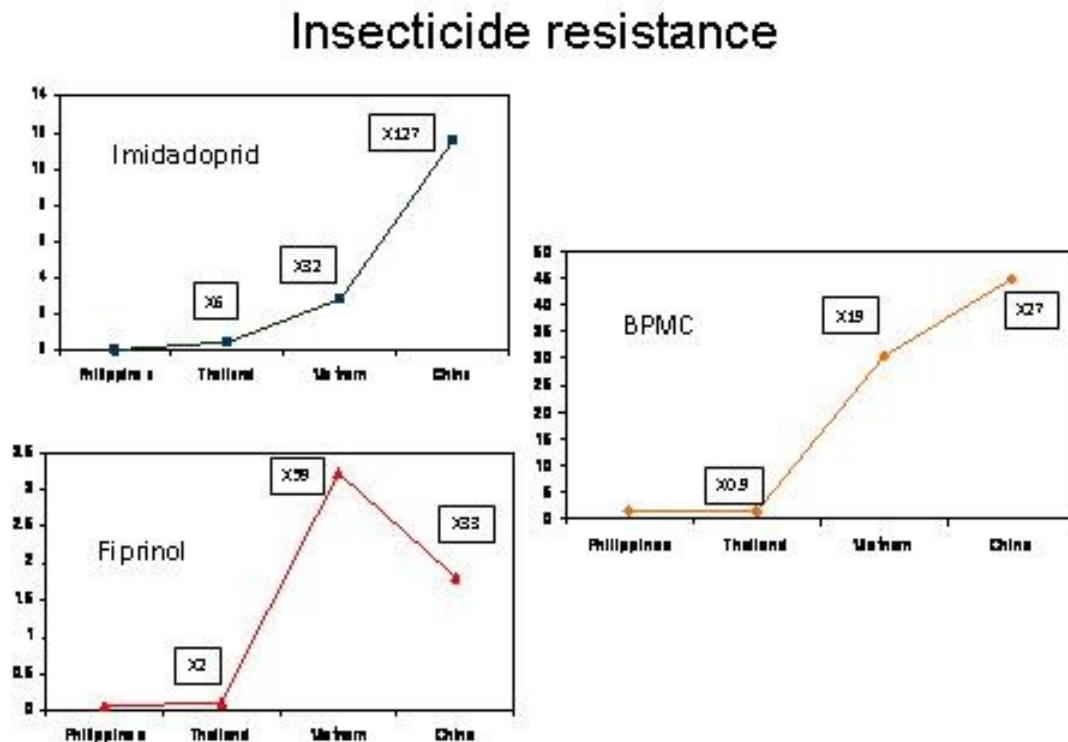


Figure 2: Folds of insecticide resistance in 4 countries.

The Chinese BPH is about 127 times more resistant to imidacloprid than in those in Philippines, where the compound is hardly used. This resistance has developed in just 10 years after introduction. At the current rate of use, the resistance factor is likely to increase and spread widely because of the planthoppers' migratory behavior. The insecticide in China is sold in more than 1000 tradenames and farmers are often not aware that they are using in succession or in mixtures the same active ingredients. The

other compound is fripinol which has little effects on WBPH and has been removed from the market in China early this year. The heavy use of fripinol has also contributed to the switch in planthopper species from BPH to WBPH in many areas. In Vietnam the fripinol in seed dressing is a standard recommendation in hybrid rice and this will inevitably favor WBPH which is a carrier of the new virus disease.

The rapid loss in efficacies of new pesticide chemistries for planthoppers is of concern. Insecticides will remain the last resort to control massive displacements and outbreaks. Since it is unlikely that new pesticide chemistries can developed rapidly the loss of these new compounds from pesticide misuses can result in the lack of control measures. In addition farmers would have to resort to heavier dosages. Imidacloprid and fripinol are also extremely toxic to bees and heavier dosages could result in further threats to not only the biological control services but the pollination services.

Sustainability of current situation

Planthoppers are outbreak pests and are often symptoms of unsustainable management. The development of insecticide resistance is another symptom. The current situation of repeated planthopper outbreaks, development of insecticide resistance, farmers' high dependence on (or misuse of) insecticides and development a new virus are potential threats to sustainable rice production in the long term. The planthopper is a macro level problem of multiple scales and dimensions and thus require macro level strategies. Outbreaks are directly due to genetic biodiversity loss from the few varieties grown and species biodiversity loss from the destruction of predator and parasitoids by intense monocropping and insecticide use and misuse. These factors are however the result of distortions in market, preferences and (mis)information systems caused by the weakening of pesticide regulations, implementation, extension systems and strengthening of pesticide marketing. The current institutions, structures and policies that govern crop protection in many Asian countries favor pesticide use and misuse. There is lack of support and incentives for the use of sustainable practices, like conservation of biological control services, the use of resistant varieties and synchronous planting. Thus besides developing management methods, such as ecological engineering, resistant cultivars and biological control services, there is need to review and reform current crop protection structures. Without radical reforms in structures and policies, it is likely that the planthopper pests and the virus diseases they carry will spread and become huge and persistent threats to food security. Studies in IRRI showed that biodiversity can be restored through ecological engineering techniques and using pesticides rationally. We need to develop sustainable techniques, policies and structures to avoid the system reaching the "tipping" point.