Asian rice planthoppers have developed species- and area-specific insecticide resistance to imidacloprid and fipronil since mid-2000s

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The brown planthopper (BPH), *Nilaparvata lugens* (Stål), the whitebacked planthopper (WBPH), *Sogatella furcifera* (Horváth), and the small brown planthopper (SBPH), *Laodelphax striatellus* (Fallén) (Homoptera: Delphacidae), are serious pests of rice throughout Asia. The northern limit of continuously breeding populations of BPH and WBPH is located around the Red River Delta in Vietnam and Hainan Island in China, where rice (*Oryza sativa*), their only host plant, is cultivated all year round. Neither of the two species is able to overwinter successfully in temperate areas (Japan, Korea, and most areas of China), and colonization occurs annually following long-distance migration from the overwintering areas. Thus, occurrence of these two species of rice planthopper in temperate areas is highly dependent on populations in the overwintering areas. In contrast, SBPH is able to overwinter in the temperate zone of East Asia, including Japan and China, by diapausing as third- or fourth-instar nymphs. SBPH transmits the *Rice stripe virus* to rice plants, which causes rice stripe disease.

Since 2005, outbreaks of BPH and WBPH have occurred in East Asian countries such as Vietnam, China, and Japan. Outbreaks of SBPH have also occurred in eastern China and western Japan since mid-2000s. These outbreaks are closely related to the development of insecticide resistance in the populations in these regions. Here, we determined and compared insecticide susceptibilities in BPH, WBPH, and SBPH collected from East and Southeast Asian countries.

Insecticide susceptibility in BPH and WBPH was evaluated by a topical application method on insects collected from East Asia (Japan, China, and Taiwan), Vietnam, and Philippines (Matsumura et al., 2008). Species-specific changes in insecticide susceptibility were identified: imidacloprid resistance in BPH and fipronil resistance in WBPH. Topical LD_{50} values for imidacloprid in the BPH populations collected from East Asia and Vietnam were significantly higher than those from the Philippines, suggesting that resistance to imidacloprid has developed in BPH in East Asia and Vietnam, but not in the Philippines. In contrast, almost all the WBPH populations had extremely large LD_{50} values for fipronil, suggesting that resistance to this insecticide is widespread in WBPH populations across East and Southeast Asia.

The insecticide susceptibility of SBPH was evaluated using insects collected in East Asia and Vietnam from 2006 to 2008. The SBPH populations in Jiangsu Province, China showed resistance only to imidacloprid, whereas populations collected from western Japan showed resistance only to fipronil. In contrast, the populations in China (Fujian Province), Taiwan, and Vietnam were highly susceptible to both imidacloprid and fipronil. These results suggest that area-specific insecticide resistance has developed in East Asian SBPH.

SBPH populations were believed to be largely indigenous, unlike migratory rice planthoppers such as BPH and WBPH. However, traps in western Kyushu, Japan recorded large catches of SBPH in early June, 2008. A backward trajectory analysis indicated that the migration source was probably Jiangsu Province, China (Otuka et al., 2010). The insecticide susceptibilities of populations collected in rice fields of western Kyushu before and after the trapping period, and the presumed migration source region (Jiangsu) were determined and compared. Both the Chinese and migrant populations showed resistance only to imidacloprid, whereas the Japanese local populations collected before the trap catch showed resistance only to fipronil. Because SBPH is able to overwinter successfully in Japan, it is feasible that intercrossing between immigrant and domestic populations produces different characteristics in insecticide resistance in local populations in Japan. Indeed, some SBPH populations in

western Kyushu, Japan developed insecticide resistance to both imidacloprid and fipronil in 2009. This may be a typical example of insect migration from an overseas population altering the insecticide resistance of local (domestic) populations of SBPH.

References

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