

**Rapid evolution of imidacloprid resistance in the brown planthopper, *Nilaparvata lugens*:
influences of the cross resistance and life history traits**

T. Fujii, S. Sanada-Morimura & M. Matsumura

Insect Pest Management Group, Kyushu Okinawa Agricultural Research Center (KARC), National Agriculture and Food Research Organization (NARO), 2421 Suya Kumamoto, Japan

Repeated applications of insecticides often promote the development of insecticide resistance in insect pests. The brown planthopper *Nilaparvata lugens* (BPH), the most important pest on rice, have developed imidacloprid resistance since mid-2000s in East Asia and Vietnam (Matsumura *et al.* 2008). Susceptibilities to some other neonicotinoids have also increased by degrees in this decade (Matsumura *et al.* 2014). Two resistant strains (Res-PH and Res-VN) were established from two field populations collected from the Philippines and Vietnam in 2009, by exposing to imidacloprid with 50% lethal dose (LD₅₀) for more than 20 generations. Control strains (Con-PH and Con-VN) were only exposed to acetone. After selection, the susceptibilities to five neonicotinoids and fipronil were compared between the control and the resistant strains using a standard topical application method. Life history traits were also compared between both strains in laboratory experiments. The LD₅₀ values of imidacloprid in Res-PH and Res-VN (36.0-138.7 µg/g) were 9.0 and 4.7 times higher than those in Con-PH and Con-VN (4.0-29.8 µg/g), respectively. The LD₅₀ values of clothianidin in Res-PH and Res-VN (4.0-4.9 µg/g) were 12.1 and 3.2 times higher than those in Con-PH and Con-VN (0.33-1.5 µg/g), respectively. The LD₅₀ values of thiamethoxam in Res-PH and Res-VN (1.4 -5.5 µg/g) were 16.4 and 5.0 times higher than those in Con-PH and Con-VN (0.28-0.34 µg/g), respectively. These results suggest that imidacloprid susceptibility is positively correlated with susceptibilities against clothianidin and thiamethoxam, but not against other insecticides (dinotefuran, nitenpyram and fipronil). Fecundity and female adult life span in resistant strains were lower and shorter than those in control strains, respectively. As the result, net reproductive rate (R₀) in Res-PH and Res-VN (178.72-202.32) were lower than those in Con-PH and Con-VN (304.78-350.02). Our study found that fitness costs associate with development of imidacloprid resistance in BPH.

References

- Matsumura, M., Takeuchi, H., Satoh, M., Sanada-Morimura, S., Otuka, A., Watanabe, T. & Thanh, D.V. (2008) Species-specific insecticide resistance to imidacloprid and fipronil in the rice planthoppers *Nilaparvata lugens* and *Sogatella furcifera* in East and South-East Asia. *Pest Management Science*, 64, 1115–1121.
- Matsumura, M., Sanada-Morimura, S., Otuka, A., Ohtsu, R., Sakumoto, S., Takeuchi, H. & Satoh, M. (2014) Insecticide susceptibilities in populations of two rice planthoppers, *Nilaparvata lugens* and *Sogatella furcifera*, immigrating into Japan in the period 2005-2012. *Pest Management Science*, 70, 615–622.