Long-distance migrations of brown planthopper *Nilaparvata lugens* (Homoptera: Delphacidae) across the border between the East Asian and Southeast Asian Population

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The brown planthopper *Nilaparvata lugens* is a major migratory pest of rice. The insect's insecticide susceptibility, wing polymorphism and feeding on resistant rice varieties affect reproductive rate, and consequently, damage to rice plants. These properties differ among brown planthopper populations, which are grouped into three populations: the East Asian, the Southeast Asian and South Asian Population, based on biotype shifts (Sogawa, 1992). It is thought that these populations are maintained independently without migrations between them. However, migrations that occurred between the East Asian and Southeast Asian Population were estimated with a three-dimensional backward trajectory analysis. This study discusses the effect of such migrations on the East Asian Population.

Methods and Materials

Capture data observed at Kin (26.4 ˚N, 127.9 ˚E) on Okinawa island in south-western Japan in June 1999 and 2000 and at Shao-Ma (23.2 ˚N, 121.3 ˚E) in eastern Taiwan in August 1978 were analyzed using the backward trajectory analysis method (Otuka et al., 2005a) to find migration source, or migration paths across the border between the East Asian and Southeast Asian population.

In response to the results of the above analysis, forward migration simulations with 10-year weather data from 1995 to 2004 were conducted using a migration simulation model (Otuka et al. 2005b) to find possible migrations from the Philippines to southern China in the early season (i.e. April to mid-June). Southern China, especially Fujian province, is estimated to be a major migration source of planthoppers immigrating into western Japan.

Results

Backward trajectories from Kin as well as Shao-Ma reached over the Luzon in the Philippines. The Philippines is in a region inhabited by the Southeastern Asian Population, and Okinawa and Taiwan are located in the range of the East Asian Population. Therefore, migrations from the Southeast Asian Population to East Asian Population were estimated (bold arrows in Fig. 1).

The 10-year migration analysis found 21 possible migrations from the Philippines to southern China in the early season (the dotted arrow in Fig. 1) Weather conditions under which these migrations might have happened were mainly depressions located in the South China Sea, which caused southeasterly winds blowing from the Philippines to southern China.

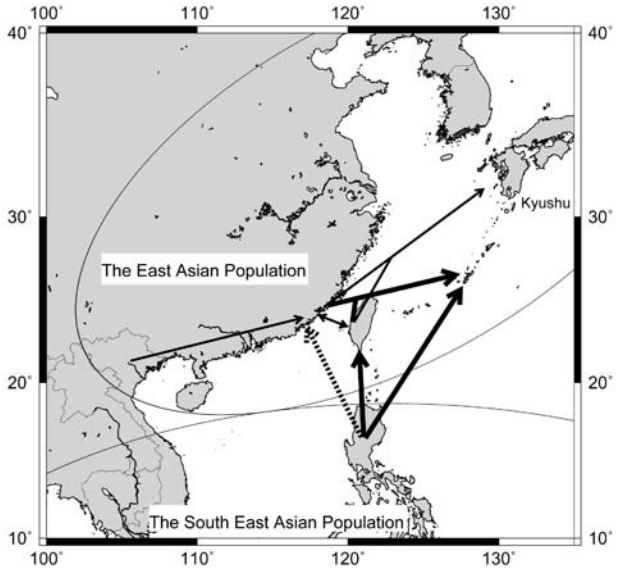

Fig.1. Migration paths across the border of the East Asian and Southeast Asian Population. Bold and dotted arrows indicate those path found in this study, and a feasible path, respectively.

Discussion

The backward trajectory analysis strongly suggested the migration of *N. lugens* from the Philippines to Okinawa and Taiwan. Immigrants from a different population likely invaded southern Japan. In other words, there were probably mixtures of the Southeast Asian and the East Asian population that entered south-western Japan.

The 10-year migration analysis suggested that the planthoppers in the Philippines can invade southern China in the early months before mid-June, given that appropriate weather conditions occur. This is another migration path from the Philippines. One of the most important consequences would be that the planthoppers from the Southeast Asian population might indirectly migrate to Japan after a few generations of reproduction in southern China. If so, special care should be taken for pest management in Japan, because immigrants from the different populations, which show different properties, could invade Japan.

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Abundance of leafhoppers (Hemiptera: Cicadellidae) in organic and conventional coffee farms within the Turrialba-Jiménez Biological Corridor, Costa Rica

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Multistrata, shaded, organic coffee farms are known to support higher biodiversity (including insects) than conventional full-sun coffee plantations. As a consequence, shaded organic coffee farms are being promoted as a sustainable land use within biological corridors in Central America. However, the impact of these practices on coffee pests is not well understood. We investigated the effect of shade structure and management (organic vs. conventional) on the abundance and community composition of leafhoppers. Leafhoppers in the subfamily Cicadellinae are considered potential vectors of *Xylella fastidiosa*, the bacteria that causes "crespera" disease in coffee. We selected four treatments of combined management and structure types: a) certified organic two strata systems with *Erythrina* shade, b) certified organic three strata systems with *Cordia-Musa-Erythrina* shade, c) conventional two strata systems with *Erythrina* shade and d) conventional three strata systems with *Cordia-Musa-Erythrina* shade. We used yellow sticky traps to survey the leafhoppers in farms. Results of samplings will be presented.