to 3 hours was equally effective. Chlorpyrifos was not effective.

Seedling root dip of isofenphos or chlorpyrifos had no effect on grain filling. Isofenphos 0.04% was most effective when dipping time was 12 hours, but was ineffective, regardless of concentration, when dipping time was reduced to 1 hour. ■

Efficacy of granular insecticides on different developmental stages of brown planthopper

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A literature review reveals that almost nothing is known about the effect of granular insecticides on the developmental stages.

Laboratory experiments with 9 granular insecticides were carried out on 1-month-old potted plants of varieties Taichung Native 1. Test insecticides at 1 kg a.i./ ha were applied in standing water. A circular polythene sheet was placed on the water surface so the stem passed through a central hole while the upper part of the plant stood in its natural position. The treated plants were caged in transparent plastic tubes and 6 individual stages of the brown planthopper *Nilaparvata lugens* were released on the test plants. Each treatment was replicated four times. The mortality caused by individual insecticides was recorded 48 hours after the insects were released.

The table indicates that nymphs of the first and second instars were highly susceptible to AC 64475, carbofuran, phorate, and isofenvinphos; those of the third instar were highly susceptible to the first three.

For the fourth- and fifth-instar nymphs, carbofuran and phorate were most effective. Among adults, the females were comparatively less susceptible than the males. However, both were highly susceptible to carbofuran and phorate. The mortality caused by the other insecticides at all the active stages was significantly less.

Overall, carbofuran, phorate and AC 64475 were most effective because they resulted in high mortality in all the active stages of *N. lugens.* Quinalphos, fenitrothion, and fenthion registered low mortality. ■

Mean percentage of mortality of different stages of *N. lugens* due to granular insecticides. Pantnagar, India.

Insecticide	Mortality (%)							
	First-instar nymph	Second-instar nymph	Third-instar nymph	Fourth-instar nymph	Fifth-instar nymph	Adult male	Adult female	Mean
AC 64475	100.0 (90.0)	100.0 (90.0)	100.0 (90.0)	95.0 (80.0)	92.5 (76.2)	97.5 (85.4)	87.5 (72.1)	96.1 (83.5)
AC 92-100	79.4 (63.4)	71.7 (58.1)	67.5 (55.4)	55.0 (47.9)	50.0 (45.0)	60.0 (50.8)	45.0 (42.1)	61.2 (51.8)
Carbofuran	100.0 (90.0)	100.0 (90.0)	100.0 (90.0)	100.0 (90.0)	100.0 (90.0)	100.0 (90.0)	100.0 (90.0)	100.0 (90.0)
Fenthion	61.4 (51.3)	52.8 (46.6)	42.5 (40.7)	40.0 (39.2)	32.5 (34.7)	45.0 (42.1)	20.0 (26.2)	42.0 (40.2)
Fenitrothion	46.1 (42.8)	35.8 (36.7)	40.0 (39.2)	30.0 (32.9)	25.0 (29.9)	27.5 (31.4)	15.0 (22.5)	31.3 (33.6)
lsofenvinphos	100.0 (90.0)	100.0 (90.0)	85.0 (67.5)	85.0 (67.5)	72.5 (58.5)	82.5 (67.5)	87.1 (65.6)	87.1 (72.4)
Mephosfolan	92.2 (75.9)	68.6 (56.0)	60.0 (50.8)	50.0 (45.0)	50.0 (45.0)	55.0 (47.9)	52.0 (46.4)	61.2 (52.4)
Phorate	100.0 (90.0)	100.0 (90.0)	100.0 (90.0)	97.5 (85.4)	97.5 (85.4)	100.0 (90.0)	100.0 (90.0)	99.3 (86.7)
Quinalphos	38.6 (38.4)	35.0 (36.2)	28.9 (32.5)	22.5 (28.3)	8.1 (16.1)	8.1 (16.1)	4.4 (11.4)	20.8 (25.6)
Control	2.5 (9.1)	2.5 (9.1)	2.5 (9.1)	2.5 (9.1)	2.5 (9.1)	2.5 (9.1)	2.5 (9.1)	2.5 (9.1)
Mean	72.0 (64.4)	67.6 (60.3)	62.6 (56.2)	57.8 (52.6)	53.1 (48.9)	58.1 (53.0)	50.9 (47.5)	

Data in parentheses are angular transformed values.
C.D. at 5%

Insecticide (I) (2.44)
Stages (S) (2.04)
Interaction (I × S) (6.46)

Potential wind-assisted migration by planthoppers in the Philippines

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Long-distance migration, assisted by wind, may play a part in the development of planthopper populations in the tropics as it does in Japan and Korea.

A suction trap, 11 m above the ground, monitors daily aerial activity over a 2-ha rice plot at Liliw (Philippines) near IRRI, in a study of the effect of migration on insect population dynamics at the site. A peak catch of both brown planthoppers and whitebacked planthoppers was recorded when the trap was emptied on the morning of 15 October 1979. The captured insects could have originated at the site or immigrated from other rice areas. The airborne planthoppers encountered windspeeds of about 3-9 km/ hour. This is probably greater than their flight speed. In such winds, the track of the planthoppers would tend to be the same as that of the air in which they were flying.

With the use of weather maps to determine the airflow above the Philippines, it is possible to simulate the movement of planthoppers captured 14-15 October. To illustrate the potential displacements, the tracks of planthoppers taking off from or arriving at the site either at dusk on 14 October or at dawn on 15 October are shown in Figures 1 and 2.

The height and duration of migratory flight were limited. Previous studies found that:

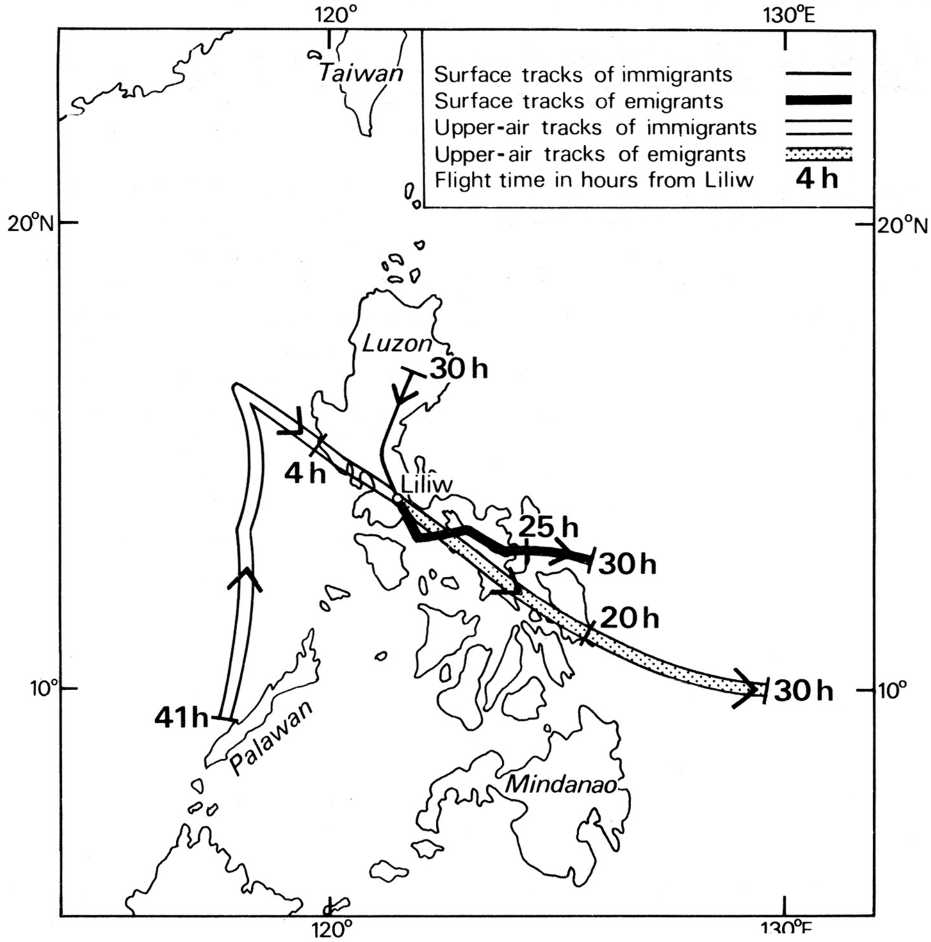
- Migration is restricted to the lowest 1,500 m of the atmosphere. Temperatures above this height are lower than 17° C and therefore too low for sustained flight.
- Some planthoppers are capable of flying downwind for 30 hours (the calculated migration time from China to Japan). Weather maps were drawn for 6-hour intervals at the earth's surface and for 12-hour intervals at 1,500 m for 12-16 October.

Planthoppers flying near the surface would have originated within Luzon even if they had been airborne for the suggested maximum 30 hours. The upper-air tracks show that for immigrants, back tracks of more than 4 hours before dusk on 14 October and 8 hours dawn on 15 October reach the sea. The insects therefore probably originated on Luzon because the next sources were 40-41 hours flying time away in Taiwan and Palawan, respectively, which are far longer migration flights than previous work suggests. Downwind emigration would have been toward the southeast near the surface and in the upper air.

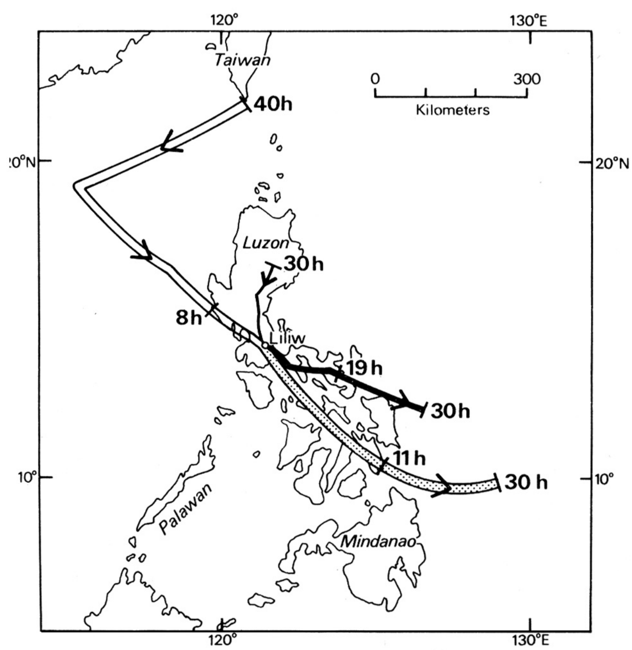
Three important aspects of windborne displacement are illustrated by the figures:

1. Tracks vary with height of flight because wind direction and speed change with height.
2. The track of any airborne insect varies with the time of migration because the airflow changes from hour to hour.
3. The tracks of airborne insects reflect the airflow at the time of migration, not the mean seasonal airflow.

October is a transition period when the southwest monsoon is replaced by the northeast monsoon. Displacement of planthoppers toward the northeast or the southwest did not occur because the prevailing airstreams were disturbed by typhoons to the east and west of the Philippines. The potential tracks of the planthoppers reflect the influence of these typhoons and demonstrate the importance of considering the effects of short-duration weather systems when studying insect migration. ■



1. Surface and upper-air tracks of planthoppers arriving at or leaving Liliw, Philippines, at dusk on 14 October 1979.



2. Surface and upper-air tracks of planthoppers arriving at or leaving Liliw, Philippines, at dawn on 15 October 1979.