Predation rates of *Atypena formosana* on brown planthopper and green leafhopper

L. Sigsgaard and S. Villareal, IRRI

Atypena formosana (Araneae: Linyphiidae) and *Pardosa pseudoannulata* (Boesenberg and Strand) (Araneae: Lycosidae) are the most common spiders in irrigated rice fields in the Philippines shortly after crop establishment (Sigsgaard et al 1999). It may be a significant predator of small-bodied pests such as hopper nymphs, being a possibly important part of the natural enemy complex that checks hoppers in unsprayed irrigated rice. This study focused on the predation of *A. formosana* on the brown planthopper (BPH) *Nilaparvata lugens* (Stål) (Hemiptera: Delphacidae) and the green leafhopper (GLH) *Nephotettix virescens* (Distant) (Hemiptera: Cicadellidae).

Functional response is defined as the number of preys eaten per predator at different prey densities. A functional response has two essential components: the instantaneous attack rate **a** and the handling time **Th**. The functional response of *A. formosana* adult females exposed to hopper nymphs was assessed in the insectary (60-80% relative humidity, 24-29 °C, 12 hours light:12 hours dark). The spiders were captured from rice fields and starved for 3 days. Twenty-four hours before the experiments, hoppers were introduced into 30-40-d-old potted TN1 plants.

Plants were pruned to four tillers. The mylar cages were 13 cm in diameter and 50 cm tall and each enclosed one hill. Functional response was evaluated at densities of 2, 4, 8, 16, 32, 64, 128, and 256 hoppers per cage. The experiments lasted for 24 h. The functional response of *A. formosana* was fitted to Hollings type I, II, and III functional response equations.

Supplementary studies included (a) determination of dry weight of BPH and GLH taken from 20 samples of 20 individuals each; (b) recording of the encounter and success rates in 1-hour observations of six individual *A. formosana* females in the same experimental setup as above, but with 50 BPH and 50 GLH in each cage; and (c) assessment of preference in a 24-h experiment in the same experimental setup as above, but with 40 preys in varying proportions of GLH and BPH. Prey preference **a** was analyzed following the method of Chesson (1983), which allows for preference analysis in experiments with food depletion (i.e., where the number of prey available is not assumed to be constant during the experiment).

A. formosana attacked many of the nymphs within 24 hours, with more second instars than third instars being eaten. The best fit was obtained with a Hollings type II equation using the random predator model and n-weighted means (Rogers 1972) (see figure). The attack rate was highest for the second instars, the handling time was lowest for the GLH nymphs, while the handling times for the second- and third-instar BPH did not differ significantly. Of the second instars, the handling time for GLH was the shortest (mean ± SE; second-instar BPH: $a = 0.308 \pm 0.045$, **Th** $= 0.018 \pm 0.002$, $R^2 = 0.98$; second-instar GLH: $a = 0.280 \pm 0.017$, **Th** $= 0.003 \pm 0.001$, $R^2 = 1.00$; third-instar BPH, $a = 0.090 \pm 0.014$, **Th** $= 0.012 \pm 0.008$, $R^2 = 0.99$).

The dry weights of the second-instar GLH and BPH were not significantly different; thus, the shorter handling time for GLH may be attributed to differences in prey preference. In cages with equal numbers of GLH and BPH, 73% (confidence interval 62-84%, n = 75) of *A. formosana*'s encounters with prey were with BPH. However, an equal number of the two prey species were eaten (5 each).

An equal number of encounters were observed at a prey ratio of 1:4 (BPH: GLH). At this prey ratio, *A. formosana* preferred GLH ($a = 0.794$, SE = 0.123, $t = 3.75$, $P<0.01$). At less extreme proportions, no significant preference was observed. Brown planthoppers aggregate on the lower stem. Thus, once a predator enters the lower part of the stem, its chances of encountering BPH will be higher. In the field, *A. formosana* webs are most often found in the lower portion of the rice plant.

These observations support the higher attack rate found on BPH. Heong and Rubia (1989) also found a higher attack rate on adult BPH than on adult GLH when they assessed the functional response of adult female *P. pseudoannulata*, which also primarily searches the lower parts of the stems.

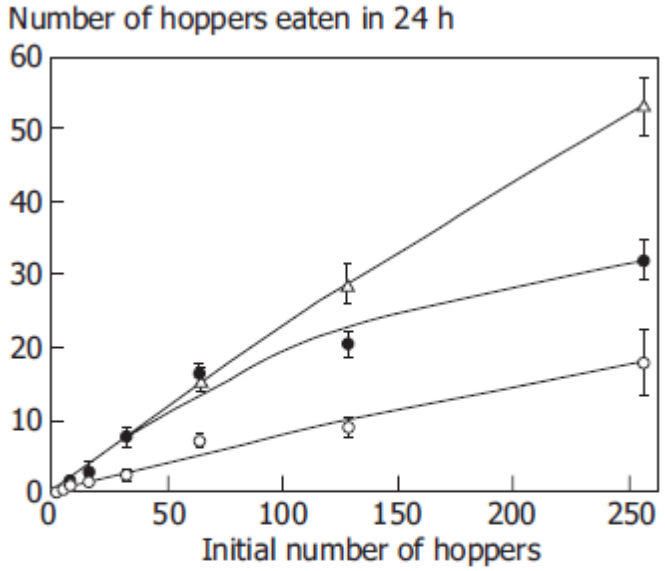
References

Chesson J. 1983. The estimation and analysis of preference and its relationship to foraging models. Ecology 64(5):1297-1304.

Heong KL, Rubia EG. 1989. Functional response of **Lycosa pseudoannulata** on brown planthoppers (BPH) and green leafhoppers (GLH). International Rice Research Notes 14(6):29-30.

Rogers D. 1972. Random search and insect population models. Journal of Animal Ecology 41:369-383.

Sigsgaard L, Villareal S, Gapud V, Rajotte E. 1999.Directional movement of predators between the irrigated rice field and its surroundings. In:Hong LW, Sastroutomo SS, Caunter IG, Ali J, Yeang LK, Vijaysegaran S, Sen YH, editors. Biological control in the tropics, towards efficient biodiversity and bio-resource management for effective biological control. Proceedings of the Symposium on Biological Control in the Tropics. Malaysia: CAB International. p. 43-47.



Functional response of *A. formosana* (mean ± SE) to second-instar BPH (●), third-instar BPH (○), and second instar GLH (Δ)

Sigsgaard L, S Villareal. 1999. Predation rates of *Atypena formosana* on brown planthopper and green leafhopper. International Rice Research Notes 24 (3) 18.