Fungicides propineb, mancozeb, cuprous oxide, a metalaxyl and mancozeb mixture, benomyl, edifenphos, sulfur, and captan were studied. For each, solutions containing 100, 500, and 1,000 ppm were prepared using distilled water. Agar media were prepared using 1 ml of each fungicide solution for every 20 ml of potato dextrose agar and poured into sterile petri dishes. The control sample (0 ppm) was made by adding 1 ml of distilled water. *Metarrhizium* sp. grown in pure cultures were transferred aseptically as agar slugs (6-mm-diameter disks) to the center of each petri dish, replicated four times in a completely randomized design. Petri dishes were then incubated in the laboratory at 29 ± 2 °C and 76-89% relative humidity. Colony diameters were measured from incubation at 24 h intervals for 5 d. Data were analyzed using Duncan's multiple range test (see table).

Of the eight fungicides tested, benomyl was most toxic to *Metarrhizium* sp., limiting growth to 0.6 cm even at the lowest concentration (100 ppm) (see table). Edifenphos inhibited mycelial growth to a lesser degree, while the remaining six fungicides enhanced mycelial growth at some or all concentrations.

This experiment clearly indicates the benefits of applying sulfur, captan, cuprous oxide, a metalaxyl and mancozeb mixture, mancozeb, and propineb at low concentrations because they enhanced the development of this entomophagous fungus. Application of benomyl should be limited because of its powerful fungicidal action on *Metarrhizium* sp. In an integrated pest management program for a rice - pulse cropping system, fungicides that minimally affect entomopathogenic fungi should be selected. ■

Evaluation of rice, maize, and 56 ricefield weeds as hosts of planthopper *Peregrinus maidis* (Ashmead)

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In the Philippines, rice is reportedly a host of the maize planthopper *Peregrinus maidis,* a vector of several viral diseases in the tropics. We compared the oviposition, egg survival (the number of eggs developing to first instar divided by the total eggs laid multiplied by 100), and nymphal survival (the number of first instar developing to last instar divided by the total first instar multipled by 100) of the planthopper on rice, maize, and 56 common ricefield weeds as potential hosts.

The test plants were dug in the vegetative stage from the IRRI farm and transplanted into pots. The plants were allowed to recover for 3 wk. A mating pair of P. maidis was introduced onto a potted plant enclosed with a 10-cm-diameter × 72-cm-high mylar cylinder cage pushed into the soil. The eggs laid were counted by dissecting the plants after 5 d of caging.

More eggs per female (72.7) were laid on maize than on *Rottboellia cochinchinensis* (56.9), *Panicum maximum* (19.6), *Leptochloa chinensis* (15.2), or *Ludwigia octovalvis* (2.2) (Table 1). No eggs were laid on rice and 52 other plant species in the 16 botanical families tested.

Egg survival was determined by splitting the stems of the plants to recover the eggs and incubating them in petri dishes on moist filter paper saturated with a fungistatic agent (M-tegosept). Egg survival was greatest on R. cochinchinensis (96.9%) followed by *P. maximum* (95.4%), maize (94.7%), and L. chinensis (89.7%). None of the eggs laid on *L. octovalvis* were viable.

Nymph adaptation showed highest survival (94.1 %) on maize followed by 88.6% on *R. cochinchinensis,* 81.7% on *P. maximum,* and 71.9% on *L. chinensis.* Developmental periods for nymphs on

Table 1. Host plant range of *P. maidis.* IRRI, 1990-93.[a]

Host	Eggs laid (no./female)	Survival (%)		Nymph development period (d)[b]	Fecundity of surviving females (no. eggs laid)[c]
		Egg	Nymph		
Poaceae					
Maize	72.7 ± 8.7 a	94.7 ± 3.5 b	94.1 ± 3.8 a	17.2 ± 0.4 a	65.3 ± 2.8 a
Rottboellia cochinchinensis	56.9 ± 5.4 b	96.9 ± 3.2 a	88.6 ± 8.4 b	127.5 ± 0.5 b	52.3 ± 3.3 b
Panicum maximum	19.6 ± 2.2 c	95.4 ± 5.2 b	81.7 ± 8.4 c	17.6 ± 0.9 b	17.3 ± 3.8 c
Leptochloa chinensis	15.2 ± 2.5 d	89.7 ± 8.0 c	71.9 ± 15.7 d	17.6 ± 0.7 b	8.7 ± 1.6 d
Onagraceae					
Ludwigia octovalvis	2.2 ± 0.8 e				

[a]Values are means ± standard errors at 95% confidence level. Av of 10 replications. In a column, means followed by a common letter are not significantly different (P < 0.05) by LSD statistical test. Nonhosts: Aizoaceae — *Trianthema portulacastrum;* Amaranthaceae — *Alternanthera sessilis, Amaranthus spinosus;* Asteraceae — *Ageratum conyzoides, Eclipta prostrata, Synedrella nodiflora, Tridax procumbens, Vernonia cinerea;* Capparaceae — *Cleome rutidosperma;* Commelinaceae — *Commelina benghalensis, C. diffusa, Murdannia nudiflora;* Convolvulaceae — *Ipomoea aquatica, I. triloba;* Cyperaceae — *Cyperus brevifolfus, C. difformis, C. haplan, C. iria, C. kyllingia, C. rotundus, Fimbristylis millacea;* Euphorbiaceae — *Euphorbia hirta;* Fabaceae — *Calopogonium mucunoides, Mimosa pudica, Sesbania sesban;* Poaceae — *Brachiaria distachya, B. mutica, Chloris barbata, Chrysopogon aciculatus, Cynodon dactylon, Dactyloctenium aegyptium, Digitaria ciliaris, D. setigera, Echinochloa colona, E. crus-galli* ssp. *hispidula, E. glabrescens, Eleusine indica, Eriochloa procera, Imperata cylindrica, Ischaemum rugosum, Leersia hexandra, Oryza sativa, Panicum repens, Paspalidium flavidum, Paspalum conjugatum, P. dlstichum, P. scrobiculatum;* Pontederiaceae — *Monochoria vaginalis;* Portulacaceae — *Portulaca oleraceae:* Rubiaceae — *Borreria ocymoides, Hedyotis biflora;* Scrophularlaceae — *Lindernia anagallis;* Sphenocleaceae — *Sphenoclea zeylanica.* [b] n = 10. [c] n = 10.

Table 2. Life history of *P. maidis* on maize in a greenhouse. IRRI, 1993.

	$\bar{X}$ ± sd
Egg incubation period (d)	5.2 ± 0.8
Nymphal stadium (d)	
I	3.8 ± 0.8
II	3.6 ± 1.0
III	3.3 ± 1.0
IV	3.2 ± 0.6
V	3.3 ± 0.5
Total immature developmental period (d)	22.4 ± 4.8
Adult longevity (d)	
Male	10.1 ± 3.3
Female	11.0 ± 4.8

the four hosts ranged from 17.2 to 17.6 d. Fecundities of the females reared on each host were very similar to those initially tested as ovipositional hosts from adults reared in the stock culture on maize.

The incubation period of the egg stage on maize was 5.2 d (Table 2). Each of the five nymphal stadia lasted 3.2 to 3.8 d for a total developmental period of the egg and nymph of 22.4 d. The adult female lived 11.0 d while the male lived 10.1 d.

Rice is neither an ovipositional nor a developmental host of *P. maidis,* which develops best on maize, *R. cochinchinensis, P. maximum,* and *L. chinensis.* ■

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Biology of the maize orange leafhopper *Cicadulina bipunctata* (Melichar) on rice and maize

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The leafhopper *Cicadulina bipunctata* is a vector of rice leaf gall in the Philippines. Plant injury is by removal of leaf tissue and leaf galls. Excessive feeding causes leaf yellowing or wilting. Its biology was compared on rice and maize in a greenhouse with an average ambient temperature of 27.6 ± 1.2 °C and relative humidity of 69.4 ± 4.3%.

Newly emerged adult pairs were obtained from a stock culture and released to oviposit on rice and maize. The mean incubation period was determined from eggs extracted from plants and held on moist filter paper in petri dishes with 1% M-tegosept, a fungistatic agent. Ten neonate nymphs were individually reared on a one-tillered host plant covered with a 6- × 25-cm cylindrical mylar cage with side and top nylon mesh (5 mm) vents. The duration of each instar was recorded from daily observations.

Life history of *C. bipunctata*[a] on rice and maize in a greenhouse. IRRI, 1993.

	Rice	Maize	Difference[b]
	$\bar{x}$ ± sd	$\bar{x}$ ± sd	t-test
Egg incubation period (d)	7.5 ± 0.8	7.5 ± 0.5	ns
Nymphal stadium (d)			
I	3.0 ± 0.0	2.5 ± 0.5	
II	3.3 ± 0.8	2.3 ± 0.6	
II	3.5 ± 0.5	2.0 ± 0.0	
IV	3.4 ± 1.0	2.1 ± 0.3	
V	3.3 ± 0.9	2.2 ± 0.4	
Nymph developmental period (d)	16.5 ± 3.2	11.1 ± 1.8	**
Adult longevity			
Male	11.0 ± 1.6	11.4 ± 0.8	ns
Female	14.5 ± 0.9	13.9 ± 1.1	ns
Eggs laid (no./female)	15.3 ± 4.5	729.0 ± 34.4	**

[a]n = 10. [b]ns = not significant ($P > 0.05$). ** = highly significant ($P < 0.01$).

Incubation period of whitish elongated eggs, normally laid singly on rice and maize, averaged 7.5 d on both (see table).

Neonate nymphs disperse in search of food, becoming increasingly mobile with age. The nymphs passed five nymphal instars in 16.5 d on rice, but the period was significantly shorter on maize (11.1 d). On rice, nymphal moltings occurred in 3.0, 3.3, 3.5, 3.4, and 3.3 d, while on maize, five nymphal stadia were observed in 2.5, 2.3, 2.0, 2.1, and 2.2 d from first to fifth instar. Shorter nymph development indicates greater fitness on a plant host. Adult longevity was equal on rice and maize. On both the host plants, however, females lived longer (14 d) than the males (11 d). Fecundity averaged 15.3 eggs on rice and 729 eggs on maize.

We conclude that in the laboratory, *C. bipunctata* is more adapted to maize than to rice because of its shorter nymphal period and greater fecundity, but rice can sustain its development. ■