

DEVELOPMENT AND OVIPOSITION OF *PEREGRINUS MAIDIS*  
(HOMOPTERA: DELPHACIDAE) ON VARIOUS HOST PLANTS

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ABSTRACT

The development and oviposition of *Peregrinus maidis* (Ashmead) (Homoptera: Delphacidae), a serious pest and the only known vector of maize stripe tenuivirus and maize mosaic rhabdovirus in tropical and subtropical areas, was studied on the following plants in the laboratory: corn (*Zea mays* L. var. Saccharata 'Guardian'), itch grass (*Rottboellia exaltata* L.), rice (*Oryza sativa* L. var. Mars, Saturn, Nato, Bellevue, Labelle, Labonnet, and Starbonnet), sorghum (*Sorghum bicolor* (L.) Moench var. AKS 614), goose grass (*Eleusine indica* (L.) Gaertn), oats (*Avena sativa* L.), rye (*Secale cereale* L.), gama grass (*Tripsacum dactyloides* L.), barnyard grass (*Echinochloa crus-galli* L.) and sugarcane (*Saccharum officinarum* L.). *Peregrinus maidis* nymphs did

not develop on rye, oats, rice and sugarcane, but the adults survived for various lengths of time on these test plants. The average length of nymphal development on corn, itch grass, sorghum, goose grass, barnyard grass and gama grass was 17.20, 17.87, 20.21, 24.97, 27.24 and 60.50 days, respectively. Adult longevity ( $\bar{X} \pm SD$ ) on corn, gama grass, itch grass, sorghum, goose grass, and barnyard grass was  $36.1 \pm 20.0$ ,  $42.7 \pm 16.6$ ,  $28.3 \pm 11.9$ ,  $7.6 \pm 6.4$ ,  $8.1 \pm 7.3$  and  $7.3 \pm 6.6$  days, respectively. Oviposition rarely occurred on sorghum, goose grass and barnyard grass. The numbers of eggs laid per day per female on corn, itch grass and gama grass was ( $\bar{X} \pm SD$ )  $21.0 \pm 2.0$ ,  $6.4 \pm 6.6$ ,  $3.5 \pm 3.0$  eggs, respectively; the numbers of eggs per female per life on these respective plants was ( $\bar{X} \pm SD$ )  $612 \pm 170.1$ ,  $146 \pm 156.7$  and  $48 \pm 45.6$  eggs.

Key Words: Corn delphacid, corn, itchgrass, rice, sorghum, goosegrass, barnyard grass, gama grass.

#### RESUMEN

El desarrollo y la ovoposición de *Peregrinus maidis* (Ashmead) (Homoptera: Delphacidae), una seria plaga y el único vector conocido del tenuivirus de la raya del maíz y del rhabdovirus del mosaico del maíz en áreas tropicales y subtropicales, fue estudiado en el laboratorio en las siguientes plantas: arroz (*Oryza sativa* L. var. Mars, Saturn, Nato, Bellevue, Labele, Labonnet y Starbonnet), avena (*Avena sativa* L.), caña de azúcar (*Saccharum officinarum* L.), centeno (*Secale cereale* L.), maíz (*Zea mays* L. var. Saccharata 'Guardian'), sorgo (*Sorghum bicolor* (L.) Moench var. AKS 614), *Echinochloa crusgalli* L., *Eleusine indica* (L.) Gaertn., *Rottboellia exaltata* L., y *Tripsacum dactyloides* L. Las ninfas de *P. maidis* no se desarrollaron en centeno, avena, arroz y caña de azúcar pero los adultos sobrevivieron diferente tiempo en estas plantas. El desarrollo promedio de las ninfas en maíz, *R. exaltata*, sorgo, *E. indica*, *E. crusgalli* y *T. dactyloides* fue de 17.20, 17.87, 20.21, 24.97, 27.24 y 60.50 días, respectivamente. La longevidad de los adultos ( $\bar{X} \pm SD$ ) en maíz, *T. dactyloides*, *R. exaltata*, sorgo, *E. indica* y *E. crusgalli* fue de  $36.1 \pm 20.0$ ,  $42.7 \pm 16.6$ ,  $28.3 \pm 11.9$ ,  $7.6 \pm 6.4$ ,  $8.1 \pm 7.3$  y  $7.3 \pm 6.6$  días, respectivamente. La ovoposición raramente ocurrió en sorgo, *E. indica* y *E. crusgalli*. El número de huevos puesto por día por hembra en maíz, *R. exaltata* y *T. dactyloides* fue de ( $\bar{X} \pm SD$ )  $21.0 \pm 2.0$ ,  $6.4 \pm 6.6$ , y  $3.5 \pm 3.0$ , respectivamente. El número de huevos por hembra puestos durante toda su vida en esas plantas fue ( $\bar{X} \pm SD$ )  $612 \pm 170.1$ ,  $146 \pm 156.7$  y  $48 \pm 45.6$ .

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The corn delphacid, *Peregrinus maidis* (Ashmead), is not only a major pest of corn and sorghum (Namba & Higa 1971, Chelliah & Basheer 1965), it is also the only known vector of two important maize viruses [maize mosaic rhabdovirus (MMV) and maize tenuivirus (MStV)] (Nault & Knoke 1981, Tsai 1975), and it is of particular economic importance in the lowland humid tropics. It has even been suggested that its introduction and the spread of two devastating viral diseases into Central America resulted in the collapse of the Mayan civilization (Brewbaker 1979; however, see Nault 1983).

Namba & Higa (1971) reported that *P. maidis* was able to survive for various lengths of time on napiergrass (*Pennisetum purpureum* Schumach), vaseygrass (*Paspalum urvillei* Steud.), sugarcane (*Saccharum officinarum* L.), sorghum (*Sorghum vulgare* Pers.), sourgrass (*Trichachne insularis* Nees), Californiagrass (*Bra-chiaria mutica* Stapf), Job's tears (*Coix lacryma-jobi* L.), pangolagrass (*Digitaria decumbens* Stent), and nutgrass (*Cyperus rotundus* L.). Chelliah & Basheer (1965) stated that this insect utilized *Pennisetum typhoides* (Stapf. and Hubbard), *Sorghum*

*halepense* (L.), *Setaria italica* (Beauv.), *Echinochloa colona* var. *frumentacca* (L.) and *Paspalum scrobiculatum* (L.) as breeding or feeding hosts.

Earlier studies have shown that itch grass (*Rottboellia exaltata* L.) was a common host for two corn viruses, MSTV and MMV, and their vector, *P. maidis* (Tsai 1975, Falk & Tsai 1983, Nault & Knoke 1981). However, little is known of the relationship between *P. maidis* and its alternate hosts in south Florida. The role of alternate hosts in the epidemiology of these diseases between growing seasons and the extension of the host range of *P. maidis* is of great significance in studying the ecology of this insect.

This paper reports the development and oviposition of *P. maidis* on six host plants.

#### MATERIALS AND METHODS

A stock colony of *P. maidis* was maintained on corn (*Zea mays* L. var. Saccharata 'Guardian') in an insectary at  $27\pm 1^\circ\text{C}$  and a 12:12 (L:D) photoperiod for over 15 years. *P. maidis* eggs were excised from the midribs of corn plants and placed on cut leaf pieces of corn and allowed to hatch. At least 30 newly hatched nymphs were singly transferred to individual culture tubes (25 mm diam) containing fresh leaf pieces of corn, itch grass (*Rottboellia exaltata* L.), sorghum (*Sorghum bicolor* (L.) Moench. var. AKS 614), gama grass (*Tripsacum dactyloides* L.), sugarcane (*Saccharum officinarum* L.), and seedlings of goose grass (*Eleusine indica* (L.) Gaertn.), barnyard grass (*Echinochloa crusgalli* L.), rye (*Secale cereale* L.), oats (*Avena sativa* L.) and rice (*Oryza sativa* L. var. Mars, Saturn, Nato, Bellevue, Labelle, Labonnet and Starbonnet). The opening of the culture tube was covered with a piece of stretched Parafilm to prevent escape or desiccation. At the same time, a group of 70-80 newly hatched nymphs was reared on the potted young plants of each test plant species or variety and used as replacements for dead or missing insects. The ages of replacement insects were determined by body sizes and morphological characteristics as described by Tsai & Wilson (1986). All tests were conducted at  $27\pm 1^\circ\text{C}$ , 60% RH, and a photoperiod of 12:12 (L:D) in three growth chambers (Percival Scientific Inc., Boone, IA) over a period of nine months. Each insect was checked daily for molting, and plant tissue was replaced every two days or sooner. The dates of molting, duration of stadia, mortality, and adult longevity were recorded. Differences in nymphal development and adult longevity on different hosts were analyzed by Student-Newman-Keul (SNK) multiple range test (Sokal & Rohlf, 1969).

Ten to 15 pairs of newly emerged adults were placed on single plants at the 4- to 5-leaf stage and covered by a plastic cage to test for oviposition. Pairs were removed daily to new plants which were then dissected for egg counts.

#### RESULTS

Of the 17 species and varieties of plants tested, only corn, itch grass, gama grass, goose grass and barnyard grass were able to support *P. maidis* development. At least 60 first instar nymphs were singly tested on each of seven varieties of rice and one variety of sugarcane, oats and rye; the survivorships of test insects ranged from 2 to 5 days. A group of 32 adults was also tested individually on these plants. They only survived ( $\bar{X} \pm \text{SD}$ )  $3.0 \pm 2.4$ ,  $4.0 \pm 3.2$ ,  $2.0 \pm 1.5$ ,  $5.0 \pm 3.2$ ,  $3.0 \pm 2.1$ ,  $3.0 \pm 1.8$ ,  $4.0 \pm 2.2$ ,  $4.0 \pm 3.5$ ,  $5.0 \pm 5.3$ , and  $10.0 \pm 9.9$  days on rice var. Mars, Saturn, Nato, Bellevue, Labelle, Labonnet, and Starbonnet, sugarcane, oats, and rye, respectively.

There were significant ( $P < 0.05$ ) differences in total nymphal development times among some hosts, with shortest development time on corn ( $17.20 \pm 1.50$  days;  $\bar{X} \pm$

TABLE 1. DEVELOPMENT ( $\bar{x}$  NO. DAYS  $\pm$  S.D.) OF *P. MAIDIS* ON SIX HOST PLANTS.<sup>1</sup>

Host	Instar										
	1st	(n)	2nd	(n)	3rd	(n)	4th	(n)	5th	(n)	Total
<i>Z. mays</i>	3.8 $\pm$ 1.5	(90) cd	3.0 $\pm$ 1.5	(59) c	3.1 $\pm$ 1.4	(44) d	3.1 $\pm$ 1.5	(38) c	4.2 $\pm$ 1.4	(21) cd	17.20 $\pm$ 1.50 c
<i>R. exaltata</i>	3.0 $\pm$ 1.0	(31) d	3.1 $\pm$ 1.0	(34) c	4.0 $\pm$ 1.5	(25) cd	4.3 $\pm$ 1.7	(24) bc	3.5 $\pm$ 1.1	(14) d	17.87 $\pm$ 2.48 c
<i>S. bicolor</i>	3.9 $\pm$ 0.9	(27) bcd	3.5 $\pm$ 0.7	(27) c	4.1 $\pm$ 1.3	(22) cd	2.8 $\pm$ 0.9	(26) c	4.9 $\pm$ 1.7	(20) cd	20.21 $\pm$ 1.97 c
<i>E. indica</i>	4.4 $\pm$ 1.3	(29) bc	5.3 $\pm$ 1.5	(24) b	4.8 $\pm$ 1.1	(25) bc	5.3 $\pm$ 1.4	(32) b	5.3 $\pm$ 1.7	(32) bc	24.97 $\pm$ 2.81 b
<i>E. crusgalli</i>	5.2 $\pm$ 0.9	(38) a	5.1 $\pm$ 0.9	(20) b	5.7 $\pm$ 1.6	(20) b	5.1 $\pm$ 1.0	(20) b	6.2 $\pm$ 2.0	(22) b	27.24 $\pm$ 2.21 b
<i>T. dactyloides</i>	4.6 $\pm$ 1.9	(64) b	8.6 $\pm$ 2.6	(50) a	12.3 $\pm$ 2.5	(43) a	16.4 $\pm$ 3.2	(35) a	18.6 $\pm$ 1.1	(11) a	60.50 $\pm$ 10.30 a

<sup>1</sup>Means within each column followed by the same letters are not significantly different ( $P > 0.05$ , SNK multiple range test).

SD) and longest on gama grass ( $60.50 \pm 10.30$ ) (Table 1). In general, first instars had higher survival rates, compared with other stages, on most plants tested (Table 2). Cumulative percentage of survival from first instar to adult was higher on sorghum (60.9%) than on other hosts (Fig. 1). The adults lived significantly longer on gama grass ( $42.70 \pm 16.50$  days), corn  $36.10 \pm 20.00$  days), and itch grass ( $28.30 \pm 11.90$  days) than on sorghum ( $7.64 \pm 6.44$  days), goose grass ( $8.00 \pm 7.32$  days) and barnyard grass ( $7.27 \pm 6.55$  days;  $P < 0.05$ ) (Fig. 2).

Adults rarely deposited eggs on sorghum, goose grass and barnyard grass. The number of eggs laid per day per female on corn, itch grass, and gama grass was ( $\bar{X} \pm$  SD)  $21.0 \pm 2.0$ ,  $6.4 \pm 6.6$ , and  $3.5 \pm 3.0$  eggs, respectively; the number of total eggs per female on these respective hosts was ( $\bar{X} \pm$  SD)  $612 \pm 170.10$ ,  $146 \pm 156.75$  and  $48 \pm 45.60$ .

#### DISCUSSION

This study showed that there was no significant difference in length of *P. maidis* nymphal development on sweet corn, itch grass and sorghum, but development times were significantly shorter on these hosts than on goose grass, barnyard grass and gama grass (Table 1). Although adult longevity and egg production on itch grass are significantly less than on corn, the average total number of eggs produced by each female on itch grass is still considerably higher when compared to other host plants. Itch grass is considered to be one of the world's most serious weed pests and is currently found in Florida, Louisiana, Texas, Arkansas, Alabama and Georgia, and as far north as latitude  $23^\circ$  (Holm et al. 1977). Research has shown that itch grass is a good host for MStV and MMV (Bradfute & Tsai 1983, Falk & Tsai 1983, Herold 1972, Gingery et al. 1981, Lastra 1977). It is the most important alternate host for *P. maidis* and MStV and MMV in south Florida between corn growing seasons (Tsai, unpublished).

Sorghum is grown throughout the eastern United States for grain and forage (Bailey & Bailey 1976). Like itch grass, several sorghum species have been shown to be hosts of MStV and MMV (Greber 1983, Herold, 1972, Gingery et al. 1981). Chelliah & Basheer (1966) reported that sorghum was the preferred host for *P. maidis* in laboratory tests. *Peregrinus maidis* has been reported as a serious pest on new sorghum varieties in India (Agriwal et al. 1981). Sorghum species have thus been suggested as the ancestral hosts for *P. maidis* and MStV and MMV (Nault 1983). Although *P. mai-*

TABLE 2. AGE-SPECIFIC SURVIVORSHIP (%) OF *P. MAIDIS* ON SIX HOST PLANTS.

Host	Instar				
	1st	2nd	3rd	4th	5th
<i>Z. mays</i>	94.7	65.6	74.6	86.4	55.3
<i>R. exaltata</i>	70.5	85.0	73.5	80.0	58.3
<i>S. bicolor</i>	90.0	100.0	84.6	100.0	80.0
<i>E. indica</i>	82.9	82.8	65.8	71.1	60.4
<i>E. crusgalli</i>	86.4	44.4	69.0	83.3	88.0
<i>T. dactyloides</i>	91.4	78.1	86.0	81.4	31.4

*dis* feeding on sorghum was demonstrated in the present study, it may not be suitable for breeding because few eggs were laid on this host.

Goose grass is found through the great plains and occasionally in California, Oregon, Utah and Arizona (Bailey & Bailey 1976). Gama grass and barnyard grass are found throughout the eastern United States (Small, 1972). Gama grass, now established in Florida and Louisiana has the potential for spreading as far north as Minnesota as a row crop competitor (Patterson & Quimby 1978; Patterson et al. 1979). This study has demonstrated that *P. maidis* could also feed and reproduce on gama grass, but it is not as suitable a host as sweet corn and itch grass.

Both itch grass and gama grass flower and shed seeds year-round. Germination of seed is staggered, resulting in continuous growth of new seedlings throughout the year. The northward spread of these two weeds and the adaptation of MStV and MMV to a perennial host or to other delphacid species with a broader host range and wider distribution than *P. maidis* might allow these viruses to become established in temperate regions of the United States.

Despite the short adult longevities on sorghum, goose grass and barnyard grass, *P. maidis* lived long enough to oviposit a few eggs on these plants. Tsai & Zitter (1982) reported transovarial passage of MStV. This eliminates the need for an alternate host for the virus, with newly hatched insects already carrying the disease agent.

The long distance spread of *P. maidis* and two viruses by strong winds has been proposed (Brewbaker 1979, Bradfute et al. 1981). It is possible that viruliferous *P. maidis* could be transported in a similar manner to the corn belt during the spring and summer. Although the northward distribution of *P. maidis* is probably prevented by winter temperatures and the apparent absence of an overwintering stage (Tsai & Wilson 1986), the adaptability of the insect and the presence of these alternate hosts as possible overwintering sites may pose a serious threat to northern corn growers.

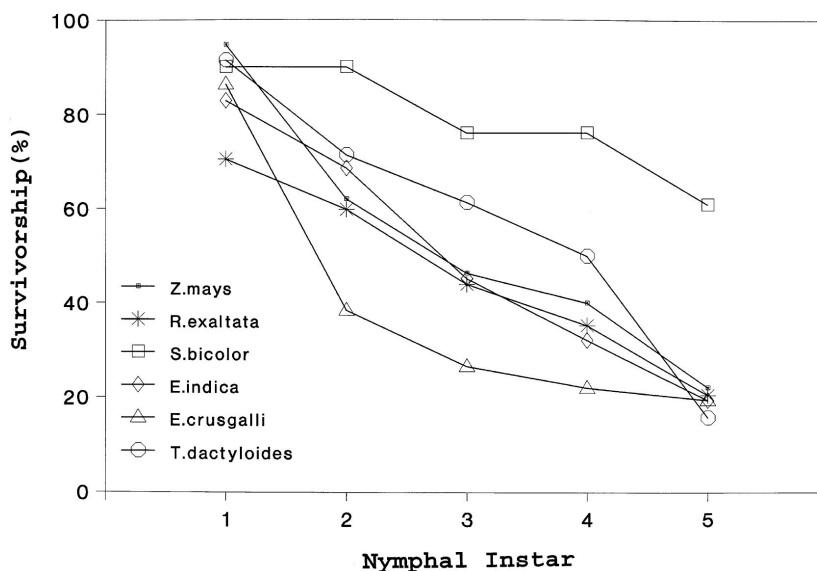


Figure 1. Cumulative percentage survival of *Peregrinus maidis* nymphs reared on six host plants.

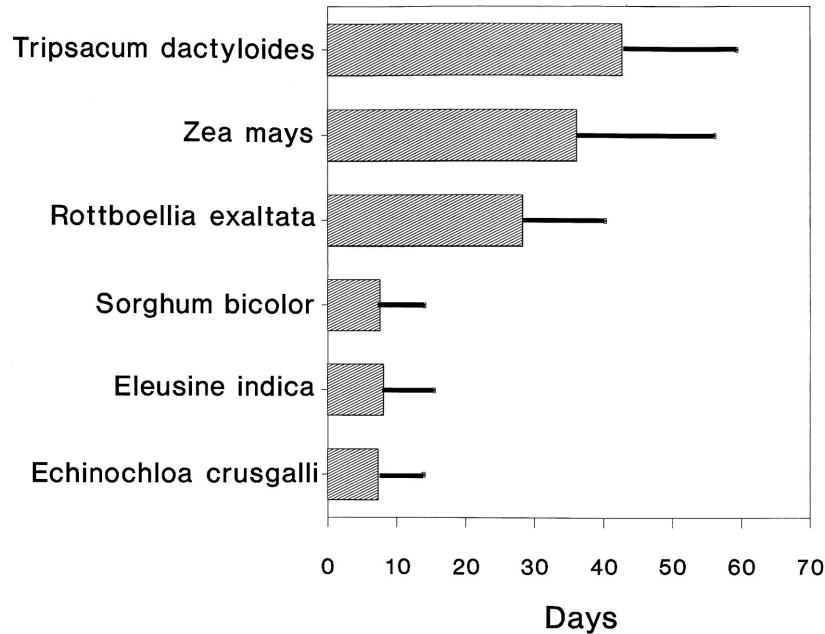


Figure 2. Mean adult longevity (in days) of *Peregrinus maidis* on six host plants (means  $\pm$  SD).

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