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Effect of nitrogen fertilization of corn on the development, survivorship, fecundity and body weight of *Peregrinus maidis* (Hom., Delphacidae)

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Abstract: Corn plants, *Zea mays* L. cv. Saccharata 'Guardian' fertilized with low (100 mg N/l), medium (300 mg N/l) and high (500 mg N/l) nitrogen doses at three times per week were used to study the effect of foliar nitrogen on the development, survivorship, reproduction, intrinsic rate of increase and adult body weight of *Peregrinus maidis* (Ashmead), a serious pest and the vector of maize stripe tenuvirus and maize mosaic rhabdovirus in tropical and subtropical areas. The results showed that the higher nitrogen treatments resulted in the higher nitrogen concentrations in the plants. The insects that developed on corn plants receiving more nitrogen had a significantly shorter development time and higher immature survival rate and laid significantly more eggs. Plants with higher nitrogen concentration also resulted in significantly greater adult mass. Heavier body weight is advantageous because heavier adult females have greater daily oviposition rates than lighter ones. These life history parameters as well as population intrinsic rate of increase were positively correlated with the nitrogen levels in the treated plants. The differences of adult longevity and preoviposition period among different nitrogen treatments were also significant; however, no significant correlation was found between the nitrogen fertilization rate and adult longevity, as well as preoviposition period.

Key words: corn delphacid, development, nitrogen fertilization, reproduction

1 Introduction

Nitrogen, fundamental for amino acid and protein synthesis in any biological system, constitutes around 0.5–5% of plant tissue and 10% of animal tissue (Mattson, 1980), and is considered to be frequently limiting for both plants and their consumers (McNeill and Southwood, 1978; Mattson, 1980). Often, nitrogenous compounds are scare in plant tissue, particularly in phloem sap (Mattson, 1980). Therefore, sucking insects show a strong response to nitrogen level in their host plants (van Emden, 1996). Plant leaf nitrogen concentration is generally considered as an indicator of food quality (Scriber and Slansky, 1981) and as a factor affecting host selection by phytophagous insects (McNeill and Southwood, 1978; Mattson, 1980). Many studies have shown a positive effect on herbivore density or performance (fecundity, development, growth and survivorship) when plant nutrient status is enhanced through fertilization. However, a substantial number of studies have also found negative effects or no effects (Scriber and Slansky, 1981; Waring and Cobb, 1992; Blua and Toscano, 1994; Bethke et al., 1998; Casey and Raupp, 1999). Thus, a definitive pattern on the response of herbivores to host quality cannot be concluded for all species (Cisneros and Godfrey, 2001).

The corn delphacid, *Peregrinus maidis* (Ashmead) (Hom., Delphacidae) is a phloem-feeding insect, which has been recorded from most tropical and subtropical regions (Metcalf, 1943). It is not only a major pest of corn and sorghum (Chelliah and Basheer, 1965; Namba and Higa, 1971; Tsai and Wilson, 1986; Tsai, 1996), but also the vector of two important maize viruses (maize mosaic rhabdovirus and maize tenuivirus) (Tsai, 1975; Nault and Knoke, 1981), 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; Nault, 1983).

Peregrinus maidis, like other phloem-feeding insects, may adjust its feeding rate to compensate for the amount and quality of dietary nitrogen. If plant nitrogen status drives the developmental rate, the feeding rate, and subsequently the reproduction and the production of honeydew by *P. maidis*, nitrogen status may be manipulated to manage infestation and honeydew secretion (Blua and Toscano, 1994). To date, the relationship between host plant nitrogen fertilization and performance of insects and mites that feed on plant sap has been studied in great detail. No research has been conducted to evaluate the effect of nitrogen level in corn plants on the biology of *P. maidis*. The objective of this study was to quantify the effect of nitrogen fertilization of corn on the developmental rate, survival and reproduction as well as body weight of *P. maidis*.

2 Materials and Methods

2.1 Insect source

The *P. maidis* used throughout this study was from a stock colony maintained on sweet corn (*Zea mays* L. cv. Saccarata 'Guardian') in an insectary at 25 ± 1°C and photoperiod of 12 : 12 (L : D) h for over 15 years at the University of Florida, Fort Lauderdale Research and Education Center, FL.

2.2 Nitrogen treatment

Sweet corn seeds were planted four per 1 l plastic container in a substrate consisting of five parts pine bark, four parts sedge peat and one part sand by volume. This substrate was amended with 890 g of Micromax, a micronutrient blend (Scotts Co., Marysville, OH) and 7.1 kg of dolomitic limestone per m^3. Plants were grown in a screenhouse with a maximum light intensity of 1425 $\mu E/m^2/s$. They were irrigated daily with about 2 cm of water from overhead irrigation. Pots were fertilized three times per week with 50 ml per pot of a solution containing 66 mg P/l and 132 mg K/l from monobasic potassium phosphate and potassium sulphate, plus 100, 300 or 500 mg N/l from urea.

At approximately 4 weeks after shoot emergence, the first fully expanded leaves from each plant were removed for insect feeding. To confirm that nitrogen treatment differences were reflected in the plant tissue, additional leaves of similar age were harvested for leaf nitrogen analysis. These samples were dried for 4 days at 65°C, ground and digested using a modified Kjedahl method (Hach et al., 1987). Nitrogen determinations on the digested samples were carried out using an ammonium-specific ion electrode (Greenberg et al., 1992).

The experiment was conducted with three nitrogen levels over three cycles. Cycles 1, 2 and 3 were conducted from September to December 2000, January to March 2001 and April to June 2001, respectively.

2.3 Insect rearing

Experiments were conducted at 25 ± 1°C and a photoperiod of 12 : 12 (L : D) h. For each experiment, about 100 *P. maidis* adults from the stock colony were transferred into three corn seedlings fertilized with different nitrogen levels for a 12-h oviposition period respectively. The corn plants were covered with a cylinder cage (50 cm × 25 cm diameter with a nylon cloth top). At the end of this period, the adults were removed and plants with eggs were maintained. At least 30 first instar nymphs collected within 4 h of egg hatch for each experiment were transferred to individual plastic bottles (8 cm × 5 cm diameter) containing fresh leaf pieces of corn (7 cm long) from different nitrogen-fertilized corn plants. These plastic bottles were placed in the growth chamber (Percival, Boone, IA). Individual insects were checked daily for ecdysis and survivorship. The exuviae were used to determine moulting. Fresh leaf pieces were introduced daily. The dates of moulting, length of stadia and mortality were recorded.

Upon adult emergence, adults were paired. Each pair was transferred daily to a fresh leaf piece in a plastic bottle, which was then dissected for egg count. The length of the preoviposition period, the number of eggs laid per female each day, the number of eggs laid per female per life and adult longevity were recorded.

To test the effect of nitrogen fertilization on the body weight of *P. maidis*, four corn plants (about 30–40 cm high) from each nitrogen treatment were covered individually with a cylinder cage (50 cm × 25 cm diameter with a nylon cloth top). Twenty pairs of adults were introduced into each cage for a 12-h oviposition period. At the end of this period, the adults were removed. Four plants treated with the same dose of nitrogen were placed into a screened cage (50 cm wide, 60 cm deep, 70 cm high) in an insect rearing room at 25 ± 1°C and a photoperiod of 12 : 12 (L : D) h. After the eggs hatched, the corn plants were replaced with fresh corn plants from the same nitrogen treatment every 4–5 days. After adult emergence, 2–3 day-old adults were collected from cages and placed in a refrigerator at 0°C for 4 h. Thereafter, adults were separated according to sex and 10 adults as a group were weighed. These insects were then placed in an oven at 50°C for 3 days and dry weights were measured. The experiment was conducted for both cycles 2 and 3.

2.4 Data analysis

Corn leaf nitrogen levels were subjected to analysis of variance (anova) for the effects of treatments. General linear model procedure (PROC GLM, SAS Institute, 1988) was used and means were separated by Fisher protected least significant difference (LSD) test when a significant *F*-value was obtained ($P < 0.05$). The percentage data were transformed to the arcsine square-root [arcsine $(\text{percent}/100)^{1/2}$] before analysis to stabilize error variance (Steel and Torrie, 1980). Regression analysis was used to analyse the relationship between corn leaf nitrogen levels and developmental times, survivorship, preoviposition period, longevity, fecundity and adult body weight of *P. maidis*.

Additionally, the intrinsic rate of increase (r_m) (Birch, 1948) was also estimated for each nitrogen treatment by constructing a life table, using age-specific survival rate (l_x) and fecundity (m_x) for each age interval (x) per day (Andrewartha and Birch, 1954). From these data, the following population growth parameters were calculated: net reproductive rate (R_0) = $\sum l_x m_x$; intrinsic rate of increase (r_m) was calculated by iteratively solving the equation $\sum e^{-r_m x} l_x m_x = 1$; mean generation time ($T$) = ln R_0/r_m; and population doubling time (DT) = $\ln 2/r_m$.

3 Results

3.1 Host plant tissue analysis

There was a significant effect of nitrogen fertilizer rate on percent nitrogen in dry leaf weight (table 1; $P < 0.05$). Plants fertilized at the highest nitrogen rate of 500 mg/l in the second cycle had the highest leaf tissue nitrogen (2.58%), which was significantly greater than all other fertilizer treatments. The lowest leaf tissue nitrogen (0.82%) was recorded in the third cycle with the lowest fertilizer rate of 100 mg/l (table 1).

Table 1. *Percentage of total Kjeldahl N of corn plants (mean ± SD) fertilized with varying levels of nitrogen (n = 3)*

Treatment (mg N/l)	Cycle 1	Cycle 2	Cycle 3
100	1.10 ± 0.0095 a	1.16 ± 0.0058 a	0.82 ± 0.0057 a
300	1.72 ± 0.0513 b	1.74 ± 0.0000 b	1.20 ± 0.0000 b
500	2.35 ± 0.0400 c	2.58 ± 0.0208 c	1.30 ± 0.0208 c
F (d.f. = 2, 6)	506.94	12785.36	1478.79
P	0.0001	0.0001	0.0001

Within the same row, means followed by the same letters are not significantly different ($P > 0.05$, GLM) in ANOVA (Fisher protected LSD test). Percentage data were transformed to arcsin square root before statistical test; untransformed data are presented.

3.2 Nymphal development and survivorship

The egg developmental periods were not significantly different among the different treatments ($P > 0.05$) and with a mean of 9.6 days ($n = 964$). Effects of nitrogen fertilization on the nymphal development of *P. maidis* are presented in table 2. The developmental periods of instars 1–5, and total nymphal stages were all significantly affected by the nitrogen fertilizations ($P < 0.05$). Correlation analysis showed that the developmental periods of total nymphal stages were correlated significantly with leaf nitrogen levels as evidenced by the high Pearson correlation coefficient value of 0.9107 ($n = 9$, $P = 0.0006$). *Peregrinus maidis* that fed on the leaf tissue with the highest nitrogen level (2.58%) in cycle 2 (table 1) had the shortest developmental period (16.5 days, table 2), while those that fed on the leaf tissue with the lowest nitrogen level (0.82%) in cycle 3 (table 1) had the longest developmental period (22.7 days, table 2).

Nymphal survival rate varied among the different nitrogen treatments. The mortality was higher in instars 1–2, and lower in instars 3–5 for all treatments. *Peregrinus maidis* that fed on the leaf tissue with the lowest nitrogen level (0.82%) in cycle 3 had an extremely low survival rate of total nymphal stages (57.6%) compared with other treatments. Correlation analysis also showed that the survival rates of total nymphal stages were correlated significantly with the leaf tissue nitrogen levels ($r = 0.6889$, $n = 9$, $P = 0.0402$).

3.3 Adult longevity and reproduction

Pre-oviposition periods of *P. maidis* were significantly different among the different nitrogen treatments in different cycles ($P < 0.05$; table 3); however, correlation analysis showed that pre-oviposition period was not correlated significantly with the leaf tissue nitrogen level ($r = -0.6069$, $n = 9$, $P = 0.0831$).

Correlation analysis revealed that the leaf tissue nitrogen levels were not correlated significantly with either male longevity ($r = 0.5826$, $n = 9$, $P = 0.0997$) or female longevity ($r = 0.5931$, $n = 9$, $P = 0.0923$).

Nitrogen fertilization rate had a significant effect on female fecundity ($P < 0.05$; table 3). The highest number of eggs laid per female (212.8) was recorded in the second cycle in insects that fed on the leaf tissue with the highest nitrogen level (2.58%). Accordingly, the lowest number of eggs laid per female (24.0) was recorded in the third cycle in insects that fed on the leaf

Table 2. *Effect of corn plants fertilized with varying levels of N on the development of nymphal stages of* Peregrinus maidis

N (mg/l)	Mean development period of instars (day ± SE) First	Second	Third	Fourth	Fifth	Total
Cycle 1						
100	4.1 ± 0.23 cd (26)	4.3 ± 0.32 ab (23)	4.2 ± 0.35 a (20)	3.6 ± 0.23 ab (19)	5.1 ± 0.33 a (19)	20.7 ± 0.81 b (19)
300	4.1 ± 0.21 cd (24)	3.5 ± 0.20 c (21)	3.7 ± 0.19 ab (20)	3.4 ± 0.19 ab (19)	4.0 ± 0.23 c (19)	18.9 ± 0.36 c (19)
500	3.8 ± 0.13 d (28)	3.1 ± 0.10 d (25)	3.1 ± 0.13 bc (24)	3.2 ± 0.12 b (21)	3.9 ± 0.14 c (21)	17.0 ± 0.28 d (21)
Cycle 2						
100	4.4 ± 0.11 c (37)	3.5 ± 0.17 c (37)	3.4 ± 0.14 b (36)	3.5 ± 0.16 ab (33)	4.7 ± 0.24 b (29)	19.3 ± 0.42 c (29)
300	4.1 ± 0.13 cd (40)	2.9 ± 0.12 de (38)	3.1 ± 0.12 bc (35)	3.0 ± 0.10 b (34)	4.3 ± 0.11 c (32)	17.3 ± 0.20 d (32)
500	3.9 ± 0.15 (38)	2.7 ± 0.13 e (36)	2.7 ± 0.15 c (35)	3.0 ± 0.17 b (34)	4.2 ± 0.20 c (32)	16.5 ± 0.32 d (32)
Cycle 3						
100	5.7 ± 0.26 a (34)	4.5 ± 0.35 a (24)	4.0 ± 0.18 a (18)	3.8 ± 0.30 a (17)	4.9 ± 0.26 ab (17)	22.7 ± 0.63 a (17)
300	4.8 ± 0.14 b (38)	4.0 ± 0.26 b (36)	4.0 ± 0.17 a (31)	3.7 ± 0.14 a (30)	4.3 ± 0.26 c (29)	20.5 ± 0.43 b (29)
500	4.8 ± 0.11 b (40)	3.8 ± 0.14 bc (40)	3.2 ± 0.13 bc (34)	3.5 ± 0.13 ab (32)	4.2 ± 0.16 c (29)	19.2 ± 0.25 c (29)
F	13.78	9.18	8.06	3.28	2.86	22.23
d.f.	8, 296	8, 269	8, 244	8, 230	8, 218	8, 218
P	0.0001	0.0001	0.0001	0.0015	0.0048	0.0001

Within the same column, means followed by the same letters are not significantly different ($P > 0.05$, GLM) in ANOVA (Fisher protected LSD test). Nitrogen expressed as total N available to the corn plant in fertilizer solution.

Table 3. *Effect of corn plants fertilized with varying levels of N on the pre-oviposition period, fecundity and longevity of* Peregrinus maidis

N (mg/l)	Pre-oviposition period (day ± SE)	Total eggs laid per female	Mean longevity (day ± SE)	
			Male	Female
Cycle 1				
100	2.9 ± 0.30 bc	26.3 ± 3.65 e	28.4 ± 4.2 bc	24.3 ± 3.8 bc
300	2.9 ± 0.15 bc	135.0 ± 14.94 c	31.7 ± 3.5 b	34.1 ± 4.8 b
500	3.2 ± 0.18 b	204.0 ± 27.45 a	37.7 ± 5.4 a	44.4 ± 3.4 a
Cycle 2				
100	4.3 ± 0.45 a	33.2 ± 4.10 e	19.5 ± 1.55 cd	24.5 ± 2.96 bc
300	2.2 ± 0.24 c	178.9 ± 13.94 b	24.5 ± 1.89 c	23.0 ± 3.33 bc
500	2.1 ± 0.15 c	212.8 ± 29.31 a	23.9 ± 3.44 c	28.6 ± 3.54 bc
Cycle 3				
100	4.7 ± 0.64 a	24. 0 ± 9.79 e	19.3 ± 3.43 cd	27.7 ± 2.59 bc
300	2.8 ± 0.30 bc	83.6 ± 13.53 d	16.9 ± 2.09 d	18.7 ± 2.34 c
500	2.8 ± 0.24 bc	124.6 ± 19.63 c	18.6 ± 2.54 cd	22.3 ± 2.61 bc
F	7.61	15.22		
d.f.	8, 100	8, 100		
P	0.0001	0.0001		

Within the same column, means followed by the same letters are not significantly different ($P > 0.05$, GLM) in ANOVA (Fisher protected LSD test). Nitrogen expressed as total N available to the corn plant in fertilizer solution. The two-way ANOVA results for adult longevity were: N levels ($F = 8.25$, d.f. = 8, 184, $P < 0.0001$), sex ($F = 4.36$, d.f. = 1, 184, $P = 0.0381$), and interaction ($F = 0.60$, d.f. = 8, 184, $P < 0.7778$).

tissue with the lowest nitrogen level (0.82%). The general trend of increase in fecundity with the increase in leaf tissue nitrogen level was confirmed by correlation analysis ($r = 0.9266$, $n = 9$, $P = 0.0003$).

The intrinsic rate of increase (r_m), net reproductive rate (R_o), mean generation time (MT) and population doubling time (DT) of *P. maidis* were calculated for the populations that fed on leaf tissue with the different nitrogen levels (table 4) by constructing a life table, using age-specific survival rate (l_x) and fecundity (m_x) for each age interval (x) per day. The effects of nitrogen fertilization on the life table parameters were evident. Correlation analysis revealed that leaf tissue nitrogen level was correlated significantly with r_m ($r = 0.8550$, $n = 9$, $P = 0.0033$).

Table 4. *Effect of corn plants fertilized with varying levels of N on the life table parameters of* Peregrinus maidis

N (mg/l)	r_m	R_0	MT	DT
Cycle 1				
100	0.0588	10.20	39.5	11.8
300	0.1008	53.91	39.5	6.9
500	0.1087	84.32	40.8	6.4
Cycle 2				
100	0.0686	12.53	36.9	10.1
300	0.1210	69.79	35.1	5.7
500	0.1260	83.66	35.2	5.5
Cycle 3				
100	0.0444	7.34	44.9	15.6
300	0.0877	31.13	39.2	7.9
500	0.0977	47.40	39.5	7.1

r_m, the intrinsic rate of increase (per capita rate of population growth); R_o, net reproductive rate; MT, mean generation time (in day); DT, doubling time (in day) for population.

3.4 Adult body weight

Nitrogen fertilization rate had a significant effect on adult body weight, including both wet and dry weights (table 5). Generally, insects that fed on tissue with higher nitrogen fertilization rate had higher body weights with few exceptions. The variations in wet body weights of female adults among different treatments were somewhat higher than those of male adults ($CV_{♀} = 1.86\%$, $CV_{♂} = 1.10\%$). This was more evident when compared with the dry weight ($CV_{♀} = 2.76\%$, $CV_{♂} = 1.35\%$).

4 Discussion

Nitrogen is a constituent of amino acids, protein and chlorophyll, and is a critical nutrient for plants, which in turn is critical for phytophagous insects. Our study clearly demonstrated that nitrogen fertilization had a significantly different effect on *P. maidis* performance, including development, survivorship and reproduction.

Tissue analysis of the treated corn plants showed that the different nitrogen fertilization rates resulted in significantly different nitrogen level in the leaf tissue. The leaf tissue nitrogen level even with the same fertilization rate was also different among three experiment cycles. It was evident that the leaf tissue nitrogen levels in the third cycle were different from those in the first and second cycles. This could be related to the environmental conditions such as temperature and sunlight in the greenhouse. A similar observation was also reported for Russian wheat aphid, *Diuraphis noxia* (Mordvilko) reared on hydroponically grown wheat with varying nitrogen levels by Moon et al. (1995).

Our study showed that nymphal developmental rate was positively correlated with leaf tissue nitrogen level. This is in agreement with the results reported by other

Table 5. *Effect of corn plants fertilized with varying levels of N on the body weight of adult* Peregrinus maidis

	Wet weight (mg/10 insects ± SD)		Dry weight (mg/10 insects ± SD)	
N (mg/l)	Male	Female	Male	Female
Cycle 2				
100	11.1 ± 0.05 c (420)	25.2 ± 0.45 b (520)	3.6 ± 0.04 b	8.4 ± 0.22 cd
300	11.8 ± 0.08 b (500)	29.5 ± 0.65 a (700)	3.8 ± 0.04 a	10.0 ± 0.29 ab
500	12.2 ± 0.11 a (440)	30.0 ± 0.65 a (540)	3.9 ± 0.03 a	10.5 ± 0.25 a
Cycle 3				
100	10.1 ± 0.09 d (300)	25.1 ± 0.50 b (260)	3.3 ± 0.08 c	7.7 ± 0.38 d
300	10.0 ± 0.16 d (400)	26.5 ± 0.31 b (300)	3.8 ± 0.05 a	9.5 ± 0.16 b
500	10.2 ± 0.23 d (260)	25.5 ± 0.45 b (240)	3.9 ± 0.06 a	8.6 ± 0.21 c
F	61.33	13.87	20.93	14.18
d.f.	5, 226	5, 250	5, 226	5, 250
P	0.0001	0.0001	0.0001	0.0001

Within the same column, means followed by the same letters are not significantly different ($P > 0.05$, GLM) in ANOVA (Fisher protected LSD test). Nitrogen expressed as total N available to the corn plant in fertilizer solution. Numbers in parenthesis are numbers of weighed adults.

authors (McNeill and Southwood, 1978; Mattson, 1980; Hunt et al., 1992; Denno and Perfect, 1994; Wier and Boethel, 1995). However, Barker and Tauber (1951) reported that there was no relationship between the rate of nitrogen fertilization of peas and the developmental rate of the green peach aphid. Similarly, Casey and Raupp (1999) reported that there was no significant effect of nitrogen fertilization on the immature development of the azalea lace bug *Stephanitis pyrioides* (Scott) (Het., Tingidae). Pfeiffer and Burts (1983) reported that the developmental rate of pear psylla, *Cacopsylla pyricola* (Foerster) increased initially and then decreased as nitrogen fertilization rate increased.

Our study has shown that the nymphal survivorship of *P. maidis* was positively correlated with the nitrogen level in the leaves. Similar observations were also reported for the elongate hemlock scale *Fiorinia externa* (Ferris) fed on hemlock *Tsuga canadensis* (L.) (Carriere), and for soya bean looper *Pseudoplusia includens* (Walker) fed on soya bean (Wier and Boethel, 1995). On the contrary, the survivorship of *Aphis gossypii* (Glover) on chrysanthemum, *Dendranthema grandiflora* (Tzvelev) (Bethke et al., 1998), the azalea lace bug *S. pyrioides* on azalea (Casey and Raupp, 1999), and *Bemisia argentifolii* Bellows & Perring on cotton (Blua and Toscano, 1994) were not affected by nitrogen fertilization. Moreover, we found that high mortality occurred in the earlier instars rather than in later instars. This could be due to the fact that the nitrogen balance may be critical to young insects, whereas old nymphs and adults could successfully utilize nutrients from an unbalanced profile (Brodbeck et al., 1999).

In our study we found that nitrogen fertilization had a significant effect on the preoviposition period and adult longevity; however, we failed to find a correlation between these parameters. Moon et al. (1995) reported that varying nitrogen levels did not significantly change the duration of the preoviposition period, reproductive period and adult longevity of the Russian wheat aphid. Our study showed that adult fecundity was positively correlated with leaf tissue nitrogen levels. This agrees with the results found in other insects, such as the greenhouse whitefly *Trialeurodes vaporariorum* (Westwood) on tomato (Jauset et al., 1998), and *A. gossypii* on cotton (Nevo and Coll, 2001). In contrast, nitrogen fertilization had no effect on the fecundity of the mesophyll-feeding leafhopper *Zyginidia scutellaris* (Herrich-Schaeffer) on grass *Holcus lanatus* (L.) (Prestidge, 1982), the Russian wheat aphid on wheat (Moon et al., 1995) and the azalea lace bug on azaleas (Casey and Raupp, 1999). We also found that *P. maidis* that fed on leaf tissue with higher nitrogen levels generally had heavier adult body weight. Similarly, Nevo and Coll (2001) reported that *A. gossypii* reared on higher nitrogen plants were significantly bigger, and the body size was positively correlated with fecundity.

The intrinsic rate of increase (r_m) describes the growth potential of a population under a given set of environmental conditions. It is often used to measure the influence of various environmental factors on population growth. Variation in the intrinsic rates of population increase could be attributed to three main factors: developmental rate, fecundity and longevity. Our study demonstrated that nitrogen fertilization of sweet corn enhanced nymphal developmental rate and adult fecundity, which in turn increased the intrinsic rate of population increase (Jauset et al., 1998; Bi et al., 2001; Cisneros and Godfrey, 2001).

Nitrogen fertilizers are used in many crops throughout the world. Our study clearly demonstrated a positive effect on the performance of *P. maidis* on corn when plant nutrient status is enhanced through fertilization. This information could be used to predict the population dynamics of *P. maidis* and be incorporated in the development of control measures.

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