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*Full Length Research Paper*

# Impact of certain corn cultivars on some ological parameters of *Rhopalosiphum maidis* (Fitch) tera: Aphididae)

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**The development, survival rate, reproduction and biological parameters of the corn leaf aphid, *Rhopalosiphum maidis* (Fitch), on five corn cultivars were evaluated at 25°C under laboratory conditions. The corn leaf aphid had a longer nymphal developmental time of 4.99, 4.98, 4.73, 4.46, and 5.60 day of Ada9516, K. Arifiye, PrimerG626, Pegaso and TTM815, respectively. The corn leaf aphid reared on K. Arifiye had the highest fecundity (69.65 offspring/aphid). The lower percentage survival rates were observed on TTM815 than that of the others. Net reproductive rate ($R_o$) was lowest (67.35 offspring/aphid/generation) on TTM815. The intrinsic rate of increase ($r_m$) was lower on TTM815 than that of the other corn cultivars. TTM815 showed resistance to the pest.**

**Key words:** *Rhopalosiphum maidis*, biological parameters, corn cultivars.

## INTRODUCTION

Maize (*Zea mays* L.) is a widely cultivated crop. Yield and quality of corn are severely affected by pests. One of the major pests causing severe damage every year is aphid, a sap-sucking homopteran insect. Aphids cause mechanical harm and malnutrition to plants by the removal of phloem sap. They also transmit various plant viruses such as maize mosaic stripe virus (MMSV) (Zhang and Zhong, 1983). There are about 23 types of aphids such as corn leaf aphid (*Rhopalosiphum maidis* (Fitch)), peach-potato aphid (*Myzus persicae* (Sulzer).), cotton-melon aphid (*Aphis gossypii* (Glover)), birdcherry-oat aphid (*Rhopalosiphum padi* L.), greenbug (*Schizaphis graminum* (Rodani)) and English grain aphid (*Macrosiphum avenae* (Fabricius)) e.t.c. Among these, corn leaf aphid *Rhopalosiphum maidis* (Fitch), is cosmopolitan in distribution and occurs world-wide (Blackman and Eastop, 1984) and is the major pest which severely affects maize production (Zhang and Zhong, 1983). The corn leaf aphid is probably the most important pest of cereals in tropical and warm temperate regions. Hosts include maize, sorghum, barley and members of more than 30 other genera of Poaceae (Blackman and Eastop, 1984). The corn leaf aphid is one of the most serious corn pests in the Trakya region of Turkey (Bayhan and Özder, 1999).

The corn leaf aphid first colonizes whorl leaves and immature tassels. Populations may become numerous enough to interfere with pollen shed and to stunt plants. Maize dwarf mosaic virus may be spread by the corn leaf aphid, though the most important vector of this disease is the green peach aphid. The presence of high aphid populations or honey dew on corn ears can render the ears unmarketable. Honey dew on ears has been reported to increase the number of corn earworm moths attracted to plants.

It has been proved difficult to control aphids by using insecticides and indiscriminate pesticide usage is harmful to natural predators of aphids, the environment and human health (Whitten and Oakenshott, 1991). As a result of concerns related to human health, non-target organisms and the environment, the reduction of pesticide use in corn agriculture is an important goal. A means to achieve this goal is through the development and adoption of the integrated pest management (IPM) strategy, an ecologically based strategy that promotes the use of non-chemical control tactics. Pesticides are a key component of IPM, but they are only used when all other options fail to control the pest. The continued availability of pesticide options is in jeopardy due to the development of resistant pests and changes in pesticide

**Table 1.** Development period (days ± SE) of immature stages of *R. maidis* at 25°C on some corn cultivars.

| Corn cultivar | 1st nymphal period | 2nd nymphal period | 3rd nymphal period | 4th nymphal period | Total nymphal period |
|---|---|---|---|---|---|
| Ada9516 | 1.55 ± 0.16 b | 1.29 ± 0.14 b | 1.11 ± 0.08 ab | 0.99 ± 0.12 a | 4.99 ± 0.22 b |
| PrimerG626 | 1.38 ± 0.06 a | 1.14 ± 0.09 a | 1.06 ± 0.04 a | 0.92 ± 0.06 a | 4.46 ± 0.14 a |
| K. Arifiye | 1.54 ± 0.08 b | 1.26 ± 0.09 b | 1.10 ± 0.04 ab | 1.08 ± 0.06 b | 4.98 ± 0.12 b |
| Pegaso | 1.44 ± 0.09 ab | 1.26 ± 0.10 b | 1.08 ± 0.08 a | 0.94 ± 0.04 a | 4.73 ± 0.12 ab |
| TTM815 | 1.70 ± 0.08 c | 1.58 ± 0.08 c | 1.27 ± 0.12c | 1.04 ± 0.11 b | 5.60 ± 0.16 c |

Means within a column sharing the same letter are not significantly different ($\alpha = 0.05$, Tukey's HSD multiple range test).

regulations. Alternatives may be developed for corn.

The development of effective and rational management of *R. maidis* relies on a thorough understanding of the biology of the pest and in particular, of the effect of prevailing temperature on key life history parameters governing the timing and rate of population development. Temperature and host plant cultivars affect insect population processes such as development, pre-reproductive delay, fecundity and survival.

This study reports the results of laboratory experiments on the effects of certain corn cultivars on the developmental time, age-specific fecundity, survival and intrinsic rate of increase of *R. maidis* under constant temperature, which will form the basis of forecasting and IPM systems.

## MATERIALS AND METHODS

### Aphid source

The laboratory colonies of *R. maidis* were started with aphids collected from the leaves of a corn plant in Tekirdağ, Turkey. Aphid colonies were maintained on the young plant in a climatic room held at 25 ± 1°C, a relative humidity of 65 ± 5% and a light regime of 16 h light: 8 h dark. The offspring had been reared under these conditions before the aphid individuals were used in the experiments.

### Development and survivorship of immatures

Randomly selected apterous females from a stock culture were transferred onto excised corn leaf discs placed upside down on wet filter papers in Petri dishes. The newly born nymphs, less than 24 h old, from the Petri dish were transferred to each of the fresh-cut corn leaf disc in a Petri dish (6 cm diameter × 1.5 cm deep) with a small brush. All replications in which the nymphs died within 24 h after transfer were omitted. The filter papers in the Petri dishes were wetted daily and every 2 - 3 days, the aphids were transferred to new corn leaf discs. The nymph and adult on each Petri dish were checked daily under a stereoscopic microscope and their survival recorded. The presence of discarded exuviae was used to determine when molting had occurred. Experiments were carried out in a climatic cupboard under a constant temperature of 25 ± 1°C, at 65 ± 5% relative humidity and a light: dark photoperiod of 16: 8 h.

### Adult longevity and reproduction

After the immatures became adults, they were observed daily for reproduction and survival and all new-born nymphs were removed. Observations were recorded until all of the aphids had died. The developmental time for each instar was recorded and included. Nymphal instar, the duration for adult pre-reproductive, reproductive and post-reproductive periods, the lifetime fecundity and the average number of offspring produced daily were determined for each individual aphid. These parameters were examined for fifty aphids at 25°C on each corn cultivar. Throughout the study, fresh corn leaves were provided to aphids every 1 - 2 days.

### Data analyses and statistics

The effect of corn cultivars on the life history of aphids was illustrated by constructing a life table for age-specific survival rate ($l_x$) and fecundity ($m_x$) for each age interval (x) per day. The net reproductive rate $R_o = \Sigma l_x m_x$, the mean generation time $T_o = \Sigma(x.l_x.m_x)/\Sigma l_x.m_x$, the intrinsic rate of increase $r_m = \Sigma e^{-rx} l_x.m_x = 1$ and the growth potential for a population under a given set of laboratory conditions $\Sigma e^{-r.x} l_x.m_x$ were calculated as described by Birch (1948).

Results for nymphal development time, adult life span, fecundity and daily reproduction at constant temperature were analyzed using a package program of SPSS 10.0 version for windows. The significance of differences between treatments was determined by Tukey's HSD multiple range test. Differences at a probability level of $P<0.05$ were considered significant.

## RESULTS AND DISCUSSION

Developmental times of different nymphs of *R. maidis* on five corn cultivars are presented in Table 1. Total developmental time of nymphs showed significant differences within the corn cultivars tested. Total develop-mental time of *R. maidis* was the shortest on PrimerG626 (4.46 d) and the longest on TTM815 (5.60 d).

Total survival rate of first, second and third instars was generally lower than the fourth instars (Table 2). The survival rate of the total nymphal period was highest with 94.92% on PrimerG626 and lowest with 79.86% on TTM815.

Pre-reproductive, re-productive and post-reproductive periods, longevity and fecundity of the corn leaf aphid are given Table 3. Pre-reproductive period was the shortest on PrimerG626. Corn cultivars used in this study had a pronounced effect on the reproductive period of the corn leaf aphid. The reproductive period was longest for adult females reared on PrimerG626 (15.96 d) followed by Pegaso (15.38 d), TTM815 (15.06 d), K.

**Table 2.** Survivorship (%) of immature stages of *R. maidis* at 25°C on some corn cultivars.

| Corn cultivar | 1st nymphal period | 2nd nymphal period | 3rd nymphal period | 4th nymphal period | Total nymphal period |
|---|---|---|---|---|---|
| Ada9516 | 96.82 | 97.36 | 98.82 | 100.00 | 93.16 |
| PrimerG626 | 97.42 | 96.58 | 98.90 | 99.76 | 94.92 |
| K. Arifiye | 96.40 | 97.74 | 99.96 | 99.44 | 93.26 |
| Pegaso | 96.88 | 98.76 | 98.46 | 98.96 | 92.94 |
| TTM815 | 88.86 | 95.44 | 96.68 | 96.52 | 79.86 |

**Table 3.** Reproduction (mean ± SE), fecundity per female and longevity of female *Rhopalosiphum maidis* at 25°C on some corn cultivars.

| Corn cultivar | Pre-reproductive period | Reproductive period | Post-reproductive period | Longevity of female | No. Progeny/ female |
|---|---|---|---|---|---|
| Ada9516 | 0.31 a | 14.83 a | 2.88 b | 23.00 ± 0.162 b | 69.45 ± 0.419 c |
| PrimerG626 | 0.29 a | 15.96 c | 1.65 a | 22.35 ± 0.181 a | 68.06 ± 0.926 b |
| K. Arifiye | 0.51 b | 14.86 a | 3.21 c | 23.55 ± .114 bc | 69.65 ± 0.448 c |
| Pegaso | 0.32 a | 15.38 b | 1.82 a | 22.25 ± 0.145 a | 68.75 ± 1.028 bc |
| TTM815 | 0.58 b | 15.06 b | 3.36 c | 24.59 ± 0.146 c | 67.10 ± 0.584 a |

Means within a column sharing the same letter are not significantly different ($\alpha = 0.05$, Tukey's HSD multiple range test).

**Table 4.** Biological parameters of *Rhopalosiphum maidis* at 25°C on some corn cultivars.

| Corn cultivars | $r_m$ | $R_o$ | $T_o$ |
|---|---|---|---|
| Ada9516 | 0.417971 | 69.45 | 11.93 |
| PrimerG626 | 0.517055 | 68.30 | 10.24 |
| K. Arifiye | 0.418228 | 69.65 | 11.92 |
| Pegaso | 0.477208 | 68.75 | 10.94 |
| TTM815 | 0.383765 | 67.35 | 12.77 |

$r_m$ = The intrinsic rate of increase, $R_o$ = net reproductive rate, and $T_o$ = mean generation time.

Arifiye (14.86), and Ada9516 (14.83 d). The postreproductive period was shortest on PrimerG626.

Adult longevity varied significantly among cultivars. The recorded longevity was 24.59, 23.55, 23.00, 22.35 and 22.25 days for adults reared on TTM815, K. Arifiye, Ada9516, PrimerG626 and Pegaso, respectively.

Total fecundity of *R. maidis* was highest on K. Arifiye (69.65 nymphs/female) followed by Ada9516 (69.45 nymphs/female), Pegaso (68.75 nymphs/female), PrimerG626 (68.06 nymphs/female) and TTM815 (67.10 nymphs/female) (Table 3). The obtained fecundity value of PrimerG626 was similar to that reported by Foott (1977) on corn at 25.5°C. Also, the fecundity value on Pegaso was similar to that reported by Belén et al. (2004) for *R. padi* on transgenic Bt corn and the fecundity value obtained on Ada9516 was similar to that reported by Silva Maia et al. (2004) on corn at 24°C. This study's data of fecundity were different from that reported by Fonseca et al. (2003) for *R. maidis* on sorghum at 25°C. This different value for the corn leaf aphid may be attributable to differences in plant cultivars and species. With attention to biological parameters data of corn leaf aphid (Table 4), Kennedy and Abou-Ghadir (1979) reported that the developmental time from birth to first reproduction may be related to the level of resistance or susceptibility, because high levels of resistance increases reproduction compared with susceptible accession.

The $r_m$ value obtained on Pegaso for *R. maidis* was similar to that reported by Belén et al. (2004) for *R. padi* on non-transgenic Bt corn, but was lower than the $r_m$ value (0.506) reported by Belén et al. (2004) for *R. padi* on transgenic Bt corn at similar temperatures. Asin and Pons (2001) reported an $r_m$ value for *R. padi* on durum wheat (Mexa) of 0.45 at 25°C. The different $r_m$ values for corn leaf aphids in the stated studies may be attributable to differences in rearing conditions, aphid species and biotypes and plant species and cultivars. The intrinsic rate of increase ($r_m$) and survival rates were lower on TTM815 than that of the other corn cultivars. TTM815 showed resistance to the pest. In summary, corn cultivars have a significant effect on survivorship, developmental rate, fecundity, longevity and biological parameters of *R.*

*maidis*.

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