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# Some Biological Aspects of Rhopalosiphum Maidis (Fitch) Reared on Five Corn Hybrids under Laboratory Conditions

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## ABSTRACT

*The effects of five corn hybrids on some biological parameters of R. maidis were studied under laboratory conditions. The lowest developmental time of nymphal stage was recorded on Hi-Tech-2066 with 5.13 days. The highest mean number of offspring was recorded on Hi-Tech-2066 (46.20 nymphs/ female), while Hybrids Watania-6 and 131 gave the significantly lower mean number of 30.67 and 29.80 nymphs/ female. The same results were obtained for Mean No. of offspring/ day. The longest and the shortest adult longevity of R. maidis recorded on Hi-Tech-2066 and Watania-6, respectively. However, the longest and the shortest life cycle duration were recorded on hybrid 132 and hybrid Watania-6, respectively. The duration of the longest generation time was recorded on hybrid 131 (6.87 days) followed insignificantly by hybrid 132 (6.53 days). However, the duration of the shortest generation time was recorded on hybrid Hi-Tech 2066 (5.80 days) by insignificant differences with Watania-6 and Hi-Tech 2031 with 6.27 days for both.*

**Keywords:** *biological aspects, hybrids, nymphal stage, maize, Rhopalosiphum maidis.*

## INTRODUCTION

Maize (*Zea mays* L.) is a widely cultivated crop. The production of the Arab Republic of Egypt reached to about 1% of the total global production during (2000-2013) while Egypt represents the third place at the level of the African continent (Abd El-Fatah *et al.* 2015).

Yield and quality of corn are severely affected by many pests, especially, aphids which consider one of the major pests causing severe damage every year. Aphid is a sap-sucking homopteran insect, causing mechanical harm and malnutrition to plants by the removal of phloem sap and also transmits various plant viruses such as maize mosaic stripe virus (Zhang and Zhong, 1983). Corn leaf aphid (*Rhopalosiphum maidis* Fitch), a polyphagous species of aphid known to attack more than 30 genera of the Gramineae and most cereal crops, was originally an Asiatic species, but is now distributed worldwide in the tropics, subtropics, and warmer temperate regions (Blackman and Eastop, 2000). Severe infestation of this aphid can cause serious yield losses of cereals through feeding damage, tassel cover by honeydew (Everly, 1960; Foott & Timmins, 1973; Kieckhefer & Kantack, 1980, 1986 and Bing *et al.*, 1991). In Egypt, it feeds on many graminaceous weeds and cereals and is a serious pest of corn crops (El-Ibrashy *et al.*, 1972).

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). It 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 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 corn cultivars on key life history parameters governing the developmental time, fecundity, generation, adult longevity and adult life cycle. The use of relatively resistant hybrids may lessen the harmful effects by this aphid (Razmjou and Golizadeh 2010). So, the present work illustrates the results of laboratory experiments on the effects of certain corn hybrids on some important life cycle parameters of *R. maidis* under laboratory conditions.

## MATERIALS AND METHODS

### Corn Plants

Five maize hybrids, namely, Single crosses of Hi-Tech-2066, Watania-6, 131, 132 and Hi-Tech 2031 were used for this study. To establish plant materials for conducting each experiment, fresh corn leaf pieces (4-5 cm) were used.

### Aphids Culture:

The aphids used in the experiments were collected from a corn field at Shandweel Agricultural Research Station, Sohag Governorate. 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, Longevity And Fecundity

To evaluate the nemphal development, 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 separately to each of the fresh-cut corn leaf disc in a Petri dish (9 cm diameter × 1.5 cm deep) using a fine hair 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 day, the aphids were transferred to new corn leaf discs. The nymph on each Petri dish was 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. 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 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 life cycle, fecundity and the average number of offspring produced daily were determined for each individual aphid. These parameters were examined for fifteen aphids at 25±1°C on each corn hybrid. Throughout the study, fresh corn leaves were provided to aphids every day. The experiment was conducted under completely randomized design with 15 replications.

### Data Analyses and Statistics

For the purpose of statistical analysis, data obtained were statistically analyzed using one – way analysis of variance. Mean values were separated by the least significant difference (L.S.D.) procedure (Snedecor and Cochran, 1980) at P = 5%.

## RESULTS AND DISCUSSION

### Developmental Times of Immature Stage

Developmental times of different nymphs of *R. maidis* on five corn hybrids are presented in Table (1), also, illustrated in Fig. (1). No significantly differences were found between corn hybrids on the development of 1$^{st}$, 2$^{nd}$, 3$^{rd}$ and 4$^{th}$ nymphal instars. The 1$^{st}$ instar recorded 1.07, 1.47, 1.53, 1.33 and 1.40 days when reared on Hi-Tech-2066, Watania-6, 131, 132 and Hi-Tech 2031 hybrids, respectively, while the 2$^{nd}$ instar required 1.47, 1.33, 1.60, 1.20 and 1.40 days when reared on the previous corn hybrids, respectively. For 3$^{rd}$ instar, nymphs reared on Hi-Tech-2066, Watania-6, 131, 132 and Hi-Tech 2031 hybrids required 1.27, 1.40, 1.40, 1.67 and 1.27 days, respectively to develop, however, the 4$^{th}$ instar recorded 1.33, 1.47, 1.47, 1.73 and 1.73 days on previous corn hybrids, respectively. Similar trend was recorded for nymphs development of *R. maidis* which was reared on barley by El-Sheikh *et al.* (2009) and *R. padi* reared on wheat by El-Fatih *et al.* (2015). Also, data revealed that the corn hybrid showed significant effect on the total developmental time of nymphal stage. The lowest developmental time was recorded on Hi-Tech-2066 with 5.13 days. No differences were found between the rest hybrids. Watania-6, 131, 132 and Hi-Tech 2031 hybrids recorded 5.67,

6.00, 5.93 and 5.80 days, respectively. The previous data are in agreement with Bayhan (2009) who find that total developmental time of *R. maidis* nymphs showed significant differences within the corn cultivars tested. Also, Razmjou and Golizadeh (2010) reported that the developmental time of *R. maidis* nymphs differed significantly among the six maize hybrids used.

**Table1.** *Developmental times of immature stages of R. maidis on some corn hybrids.*

| No. | Hybrids | 1st instar | 2nd instar | 3rd instar | 4th instar | Nymphal stage |
|---|---|---|---|---|---|---|
| 1 | **Hi-Tech-2066** | 1.07 **A** | 1.47 **A** | 1.27 **A** | 1.33 **A** | 5.13 **B** |
| 2 | **Watania-6** | 1.47 **A** | 1.33 **A** | 1.40 **A** | 1.47 **A** | 5.67 **A** |
| 3 | **131** | 1.53 **A** | 1.60 **A** | 1.40 **A** | 1.47 **A** | 6.00 **A** |
| 4 | **132** | 1.33 **A** | 1.20 **A** | 1.67 **A** | 1.73 **A** | 5.93 **A** |
| 5 | **Hi-Tech 2031** | 1.40 **A** | 1.40 **A** | 1.27 **A** | 1.73 **A** | 5.80 **A** |
| **F value** | | 2.22 | 1.40 | 1.71 | 2.02 | 3.86* |
| **$LSD_{05\%}$** | | **N.S.** | **N.S.** | **N.S.** | **N.S.** | 0.51 |

*Means within a column sharing the same letter are not significantly different at 5%propability.*

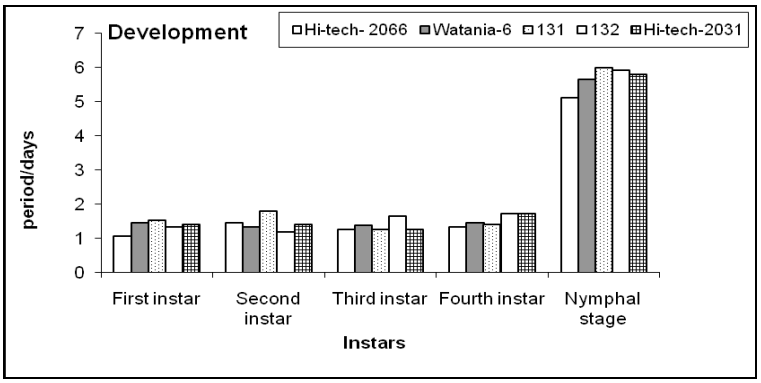


**Figure1.** *Developmental times of immature stages of R. maidis on some corn hybrids.*

## Reproductive Period

Data in Table (2) represent the effect of five corn hybrids on pre-reproductive, reproductive and post-reproductive periods. Data showed that no significant differences were found between hybrids for pre-reproductive period. Aphid adults reared on Hi-Tech-2066, Watania-6, 131, 132 and Hi-Tech 2031 hybrids recorded 0.67, 0.60, 0.87, 0.60 and 0.47 days, respectively. However, the corn hybrids effected on reproductive period of aphid. Corn hybrids can divided into two significantly groups, the 1st and the highest group included Hi-Tech-2066, 132 and Hi-Tech 2031 hybrids with average means of 12.07, 12.13 and 11.73 days, respectively, and the 2nd and the lowest group consisted of Watania-6 and 131 hybrids with average means of 10.00 and 9.87 days, respectively. Data of Table (2) indicated that no significant differences were found between hybrids for post-reproductive period. Aphid adults reared on Hi-Tech-2066, Watania-6, 131, 132 and Hi-Tech 2031 hybrids recorded 1.33, 0.80, 0.93, 0.87 and 1.07 days, respectively (Fig. 2). Also, Auad *et al.* (2009) found that the pre-reproductive, reproductive and post-reproductive periods of *R. padi* were 1.86, 6.75 and 1.40 days, respectively on 24 C° when reared on signal grass.

## Fecundity

Data of Table (2) revealed that the total number of offspring per female affected significantly by corn hybrid. The highest mean number of nymphs was recorded on adults reared on Hi-Tech-2066 (46.20 nymphs/ female) followed insignificantly by Hi-Tech 2031 (42.20 nymphs/ female), then hybrid 132 (39.00 nymphs/ female), with insignificant difference with Hi-Tech 2031. Hybrids Watania-6 and 131 gave the significantly lower mean number of 30.67 and 29.80 nymphs/ female, with insignificant difference between them (Fig. 3). Offspring/ day, hybrids can arranged into three significant groups, the Hi-Tech-2066 was in the 1st one, Hi-Tech 2031 was in the 2nd one and Watania-6, 131 and 132 were in the 3rd group. No significant differences were found between the 2nd group and the other two groups. Aphid adults reared on Hi-Tech-2066, Watania-6, 131, 132 and Hi-Tech 2031 hybrids produced 3.97, 3.16, 3.04, 3.23 and 3.62 nymphs/ day, respectively (Fig. 3). The present results were in

partial agreement with those of Agamy *et al.* (2003). Taheri *et al*. (2010) studied the effect of six wheat cultivars on fecundity of *R. padi*.

**Table2.** *pre--reproductive, reproductive and post-reproductive periods and fecundity of R. maidis on some corn hybrids under laboratory conditions.*

| No. | Hybrids | Pre-reproductive period | Reproductive period | Post-reproductive period | Fecundity | |
|---|---|---|---|---|---|---|
| | | | | | No. of progeny/ female | Mean No. of offspring/ day |
| 1 | **Hi-Tech-2066** | 0.67 **A** | 12.07 **A** | 1.33 **A** | 46.20 **A** | 3.97 **A** |
| 2 | **Watania-6** | 0.60 **A** | 10.00 **B** | 0.80 **A** | 30.67 **C** | 3.16 **B** |
| 3 | **131** | 0.87 **A** | 9.87 **B** | 0.93 **A** | 29.80 **C** | 3.04 **B** |
| 4 | **132** | 0.60 **A** | 12.13 **A** | 0.87 **A** | 39.00 **B** | 3.23 **B** |
| 5 | **Hi-Tech 2031** | 0.47 **A** | 11.73 **A** | 1.07 **A** | 42.20 **AB** | 3.62 **AB** |
| **F value** | | 0.86 | 5.57* | 1.08 | 12.72** | 3.15* |
| **$LSD_{05\%}$** | | **N.S.** | 1.38 | **N.S.** | 5.81 | 0.62 |

*Means within a column sharing the same letter are not significantly different at 5%propability.*

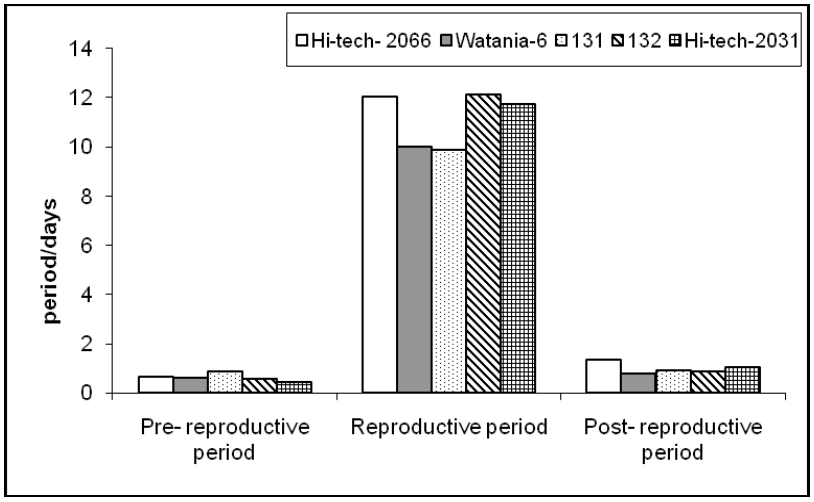


**Figure2.** *Pre-reproductive, reproductive and post-reproductive periods of R. maidis on some corn hybrids under laboratory conditions.*

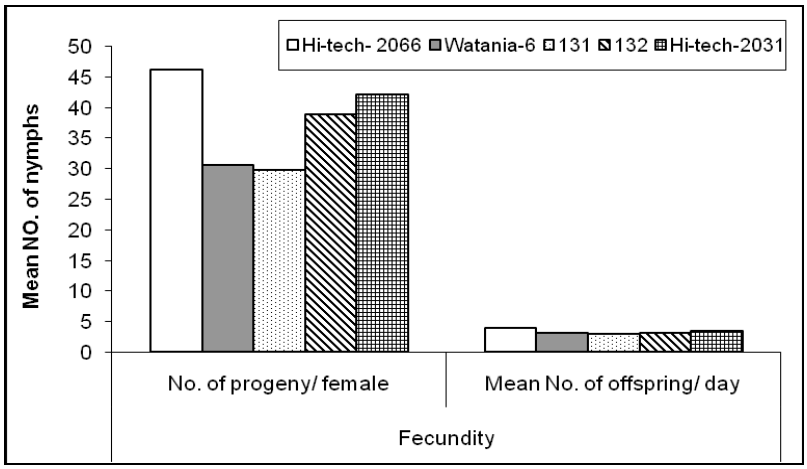


**Figure3.** *Mean number of offspring per female per day and mean number of progeny per female of R. maidis on some corn hybrids under laboratory conditions.*

## Longevity, Life Cycle and Generation

Data in Table (3) summarized Longevity, life cycle and generation period of *R. miadis* on some corn hybrids. There were significant differences in adult longevity of *R. maidis* reared on the corn hybrids examined. The longest adult longevity of *R. maidis* recorded on Hi-Tech-2066 by insignificant differences with 132 and Hi-Tech 2031 hybrids with average numbers of 14.07, 13.60 and 13.27 days,

respectively. While, the shortest adult longevity was recorded on Watania-6 by insignificant difference with hybrid 131 with average numbers of 11.40 and 11.67 days, respectively (Fig 4). There were significant differences in life cycle of *R. maidis* reared on the corn hybrids examined. The longest life cycle duration was recorded on hybrid 132 followed insignificantly by Hi-Tech-2066 then Hi-Tech 2031 with average numbers of 19.53, 19.20 and 19.07 days, respectively. However, the shortest life cycle duration was recorded on hybrid Watania-6 by insignificant difference with hybrid 131 with average numbers of 17.07 and 17.67 days, respectively. No significant differences were found between the last one and Hi-Tech 2066 Hi-Tech 2031 hybrids (Fig 4). The duration of the longest generation time was recorded on hybrid 131 (6.87 days) followed insignificantly by hybrid 132 (6.53 days). However, the duration of the shortest generation time was recorded on hybrid Hi-Tech 2066 (5.80 days) by insignificant differences with Watania-6 and Hi-Tech 2031 with 6.27 days for both. Also, no significant differences were found between the last two hybrids and hybrids of 131 and 132. The longevity of this aphid was studied by Kuo *et al.* (2006) on corn. Also, Descamps Chopa (2011) studied some growth parameters of *R. padi* on some cereal crops.

From the previous results it can be concluded that, corn hybrids have a significant effect on some biological aspects of *R. maidis*.

**Table3.** *Longevity, life cycle and generation time of R. miadis on some corn hybrids under laboratory conditions.*

| No. | Hybrids | Longevity | Life cycle | Generation time |
|---|---|---|---|---|
| **1** | **Hi-Tech-2066** | 14.07 **A** | 19.20 **AB** | 5.80 **B** |
| **2** | **Watania-6** | 11.40 **B** | 17.07 **C** | 6.27 **AB** |
| **3** | **131** | 11.67 **B** | 17.67 **BC** | 6.87 **A** |
| **4** | **132** | 13.60 **A** | 19.53 **A** | 6.53 **A** |
| **5** | **Hi-Tech 2031** | 13.27 **A** | 19.07 **AB** | 6.27 **AB** |
| **F value** | | 5.54* | 3.56* | 2.62* |
| **$LSD_{05\%}$** | | 1.47 | 1.65 | 0.70 |

*Means within a column sharing the same letter are not significantly different at 5%propability.*

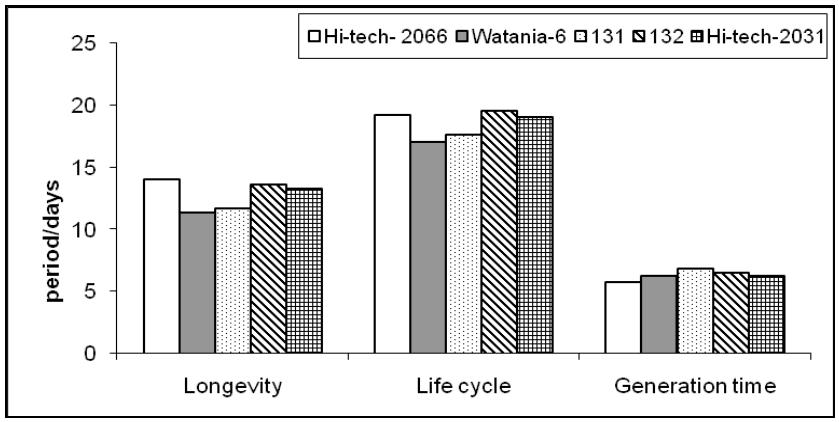


**Figure4.** *Longevity, life cycle and generation time of R. miadis on some corn hybrids.*

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