



## Influence of Nitrogen Fertilization Levels on Population of the Piercing-Sucking Insect Pests on Cucumber Crop

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### Abstract

The present experiments were conducted in a cucumber (*Cucumis sativus L.*) field in Ibshwai, Fayoum governorate to evaluate the influence of nitrogen fertilization levels on the population abundance of the main piercing-sucking insect pests that attack cucumber crop during (2018 and 2019) seasons. The cotton aphid *Aphis gossypii* (Glover, 1877) followed by the cotton whitefly *Bemisia tabaci* (Gennadius, 1889) showed the largest average numbers at each nitrogen level. Meanwhile, the green sting bug *Nezara viridula* (Linnaeus, 1758), the cotton mealybug *Phenacoccus solenopsis* (Tinsley, 1898), the onion thrips *Thrips tabaci* (Lindeman, 1889) and the leafhopper *Empoasca decipiens* (Paoli, 1930) had the lowest average numbers in comparison with the other examined insect pests during the two seasons.

**Keywords:** cucumber, nitrogen levels, fertilizer, piercing-sucking insect pests

### 1. Introduction

Cucumber is one of the most important vegetable crops grown in Egypt that belonging to the cucurbit family and it was liable to infestation by many phytophagous pests such as the aphids, *A. gossypii* and the tomato whitefly, *B. tabaci* both species are among the most common and important insect pests of cucumber plants. In case of heavy infestation, these pests cause serious damage to plants, led to great reduction in the yield during the period of study. The tomato whitefly, *B. tabaci* and cotton aphid, *A. gossypii* were recorded as key piercing-sucking pests on cucurbit crops under the New Valley conditions [1]. Cucumber plants are attacked by many pests that cause direct and indirect damages that lead to a decrease in the yield [2, 3, 4, 5].

Fertilization is one of the most important agronomic practices which used extensively to increase the crop yield. However, the population density of piercing-sucking insects may significantly increase or decrease based on the rate of fertilization and the sort of the fertilizer. From the available

literature, a certain number of authors have investigated the relationship between the rates of nitrogen or potassium fertilizers and insect populations in wheat fields [6], in broccoli crop [7], in kidney bean [8], in tomato crop [9], in cotton plants [10], in eggplant [11].

The population growth rate of aphid *A. gossypii* increased by increasing nitrogen (10%) fertilization levels from 0 to 38 ppm and the nitrogen in the leaf content increased with increasing the fertilization level on Chrysanthemums plants [12]. examined the effects of leaf chemical composition and levels of leaf nitrogen and potassium, besides density of leaf trichomes in cucumber, on infestation intensity by *B. tabaci* biotype B. Foliar nitrogen negatively affect the whitefly nymphs infestation [13]. Nitrogen and carbohydrates impacted survival, growth and reproduction of insects [14]. Three levels of NPK fertilizer, along with the recommended level, were applied in the study. The results showed that the plots treated with 250 kg of nitrogen had the highest mean number of cotton aphid (*Aphis gossypii*), whitefly

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(*Bemisia tabaci*), and spiny bollworm (*Earias insulana*) in both seasons. However, these plots also yielded the lowest cotton yield. On the other hand, a decrease in the mean numbers of aphids, whiteflies, and spiny bollworms was observed when the nitrogen level was reduced to 100 kg, but it led to an increase in cotton yield. In terms of potassium fertilizer, an increase in its application resulted in a decrease in the population density of aphids, whiteflies, and spiny bollworms. However, for phosphorus fertilization, no significant correlation was found between different levels of phosphorus fertilizer and the population densities of the tested pests. Based on these findings, it can be concluded that nitrogen had the most significant effect on infestation rates. All levels of nitrogen fertilizer led to a significant increase in the number of pests compared to other fertilization methods [15].

## 2. Materials and methods

These experiments were conducted in an area of about 800 m<sup>2</sup>. This area was chosen and divided to 16 plots which considered as replicates (each replicate was 42 m<sup>2</sup>) cucumber crop during the season March sown date (2018 and 2019). Nitrogen fertilization (N) was used in three levels in the form of Urea 46% Nitrogen with levels of 100, 200, and 300 kg/fed. Untreated treatment of zero nitrogen level was considered as a control. The rate of phosphorus (P) in the form of Calcium superphosphate (P<sub>2</sub>O<sub>5</sub> 15%) with 150 kg/fed. and the rate of Potassium (K<sub>2</sub>O 24%) with 50 kg/fed were used. The amount of N fertilizer was supplied to the plants at three times; the first one was with cultivation, the second with the first irrigation, and the third one with the second irrigation. While, P fertilizer was supplied during the soil preparing for cultivation and all quantity of Potassium fertilization was added with at the time of the crop plantation. All recommended agricultural practices without pesticide treatments were applied throughout throughout both seasons of the study (2018 and 2019). For each nitrogen level, four replicates were used and distributed in a randomized complete block design.

### 2.1. Sampling techniques

Samples were taken two weeks after sowing date of cucumber and continued until the end of the season during the two years by two methods. In leaf sample method, twenty-five leaves were randomly

chosen from each plot every week. A total of 100 leaves were picked weekly from each Nitrogen level. In these methods, all stages of cotton aphid, nymphal and pupal stages of the cotton whitefly, nymphal stage of the cotton thrips, and nymphal and pupal stages of the cotton mealybug were recorded. In the sweep net method, 25 double strokes from each plot were weekly taken from the two diagonal directions (100 double strokes / Nitrogen level). By this method, the adult stage of the leafhopper species and nymphal and adult stages of the green sting bug were recorded. Samples were picked up in plastic bags to the laboratory for identification and counting.

### Statistical analysis

The results were analyzed by one-way ANOVA and means were separated by Duncan's Multiple Range Test (Duncan 1955). Analysis was conducted using CoStata software program.

## 3. Results and discussion

The results in Table (1) show the influence of nitrogen fertilization rates on the average number of the major piercing-sucking insects in cucumber plants growing in March sowing date during the first year (2018) in Fayoum governorate. It could be noticed that the largest average number for each insect pest in the current study was recorded in fields fertilized by 300 kg. The cotton aphid *A. gossypii* followed by the cotton whitefly, *B. tabaci* and the leafhopper *E. decedens* had the largest average numbers and presented by  $503.7 \pm 89.16$ ,  $436.1 \pm 95.77$  and  $253.7 \pm 41.75$  individuals/sample, respectively during the first year. On the other hand, the lowest average numbers for the investigated insects were in fields not received nitrogen fertilizer. The green sting bug *N. viridula* followed by the cotton mealybug *P. solenopsis*, the onion thrips *T. tabaci* and the leafhopper *E. decipiens* had the lowest average numbers and presented by  $22.5 \pm 4.97$ ,  $23.7 \pm 5.96$ ,  $51.8 \pm 11.60$  and  $57.2 \pm 13.28$  individuals/sample, respectively.

The data in Table (2) show the influence of nitrogen fertilization rates on the average number of the major piercing-sucking insect pests in cucumber plants growing in March sowing date during the second year (2019) in Fayoum governorate. Also, the largest average number for each insect pest in the current study was recorded in fields fertilized by 300 kg. The cotton aphid *A. gossypii* followed by the

cotton whitefly, *B. tabaci* and the green peach aphid *M. persicae* had the largest average numbers and presented by  $618.3 \pm 107.53$ ,  $508.2 \pm 117.17$  and  $211.4 \pm 31.80$  individuals / sample, respectively during the second year. Moreover, the lowest average number for the investigated insects was in fields not received nitrogen fertilizer. The green sting bug *N. viridula* followed by the cotton mealybug *P. solenopsis*, the onion thrips *T. tabaci* and the leafhopper *E. decipiens* had the lowest average numbers and presented by  $16.4 \pm 4.18$ ,  $34.1 \pm 7.56$ ,  $37.4 \pm 13.42$  and  $44.7 \pm 08.93$  individuals/sample, respectively.

Figure (1) shows the occurrence rate for the target insects on cucumber plants in relation to nitrogen fertilization levels during the two years (2018 and 2019). The occurrence rate of all insect pests was the largest in fields fertilized by 300 kg of nitrogen during the first and second years which presented by 34.4 and 32.9%, respectively. The nitrogen fertilization level of 200 kg per feddan came in the second rank and presented by 26.7 and 27.1 %, respectively. While, the lowest rate of occurrence for all insects was recorded in fields did not receive any nitrogen fertilization which presented by 17.3 and 18.0%, respectively.

**Table (1)**

Effect of nitrogen fertilization levels on the average number of the major piercing-sucking insects in cucumber fields during the first year (2018) in Fayoum governorate

Insect Pests	Nitrogen levels			
	zero kg	100 kg	200 kg	300 kg
<i>A. gossypii</i>	326.4 ± 63.48 d	385.3 ± 82.73 c	446.7 ± 86.13 b	503.7 ± 89.16 a
<i>M. persicae</i>	81.4 ± 19.24 d	107.3 ± 21.29 c	146.2 ± 28.35 b	197.1 ± 33.82 a
<i>B. tabaci</i>	286.2 ± 67.61 d	317.4 ± 83.43 c	374.2 ± 92.22 b	436.1 ± 95.77 a
<i>T. tabaci</i>	51.8 ± 11.60 d	87.3 ± 16.45 c	118.5 ± 19.97 b	163.4 ± 23.81 a
<i>P. solenopsis</i>	23.7 ± 05.96 d	39.4 ± 08.92 c	50.4 ± 11.96 b	72.6 ± 13.83 a
<i>E. decipiens</i>	57.2 ± 13.28 d	93.7 ± 24.27 c	121.1 ± 30.54 b	207.6 ± 31.29 a
<i>E. decedens</i>	89.3 ± 17.62 d	114.6 ± 18.91 c	162.9 ± 36.46 b	253.7 ± 41.75 a
<i>N. viridula</i>	22.5 ± 04.97 c	28.3 ± 06.21 c	33.5 ± 08.29 ab	37.6 ± 09.27 a

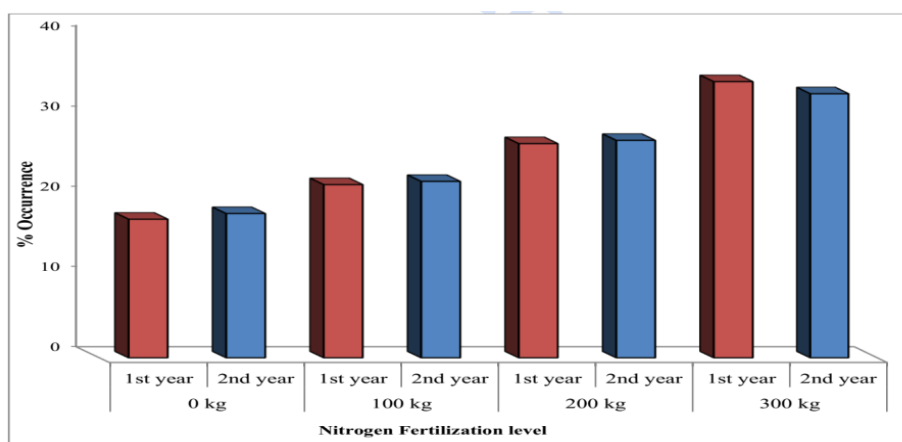
According to the various nitrogen fertilization levels, the average number for each insect in a row followed by the same letters are not significantly different at 5% level

**Table (2)**

Effect of nitrogen fertilization levels on the average number of the major piercing-sucking insects in cucumber fields during the second year (2019) in Fayoum governorate

Insect Pests	Nitrogen levels			
	zero kg	100 kg	200 kg	300 kg
<i>A. gossypii</i>	402.6 ± 68.19 d	461.2 ± 93.61 c	575.2 ± 102.6 b	618.3 ± 107.5 a
<i>M. persicae</i>	93.1 ± 18.34 d	123.7 ± 22.52 c	151.1 ± 27.49 b	211.4 ± 31.80 a
<i>B. tabaci</i>	356.7 ± 69.23 d	392.6 ± 92.41 c	447.2 ± 111.8 b	508.2 ± 117.2 a
<i>T. tabaci</i>	37.4 ± 13.42 d	53.1 ± 15.60 c	79.6 ± 18.97 b	98.3 ± 22.71 a
<i>P. solenopsis</i>	34.1 ± 07.56 c	51.6 ± 09.61 bc	69.5 ± 15.00 b	91.3 ± 13.92 a
<i>E. decipiens</i>	44.7 ± 08.93 d	82.4 ± 17.35 c	106.4 ± 28.89 b	169.8 ± 32.63 a
<i>E. decedens</i>	71.6 ± 16.11 d	105.9 ± 19.37 c	137.8 ± 32.79 b	199.2 ± 33.78 a
<i>N. viridula</i>	16.4 ± 04.18 c	21.3 ± 5.82 b	25.7 ± 06.90 ab	31.8 ± 08.91 a

According to the various nitrogen fertilization levels, the average number for each insect in a row followed by the same letters are not significantly different at 5% level



**Fig. (1):** The Occurrence rate for the major piercing-sucking insect pests in fields fertilized by varying nitrogen levels during the first (2018) and second (2019) years in Fayoum governorate

#### 4. Conclusions

The effect of nitrogen fertilization is very important on plants quality, affects population density of pests and therefore pest damage on plants. From previous results presented in Tables (1 and 2) and Fig. (1), it could be concluded that the cotton aphid *A. gossypii* followed by the cotton whitefly *B. tabaci* showed the largest average numbers at each nitrogen level. Meanwhile, the green sting bug *N. viridula*, the cotton mealybug *P. solenopsis* and the onion thrips *T. tabaci* had the lowest average numbers in comparison with other examined insect pests during the two years. Also, the rate of occurrence for the total number of all insects was increased by raising the nitrogen fertilizer levels from 0 kg per feddan to 300 kg per feddan during the two years. Moreover, the statistical analysis revealed that there were significant differences in numbers of each examined insect species between levels of nitrogen fertilization on kidney bean [8]. On tomato [9]. On wheat plants [16]. On eggplant [17]. Suggested that, with increasing the nitrogen fertilization rates caused a highly significant increasing in the population abundance of various piercing-sucking insects.

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