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Effect of potassium fertilization and organic nutrient (Reef Amirich) in the population density of *Bemisia tabaci* (Genn.) and *Thrips tabaci* (L.) on cucumber

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Abstract

A field study was conducted at the college of Agriculture, Baghdad University- Jadiriyah to investigate the effect of adding potassium fertilizer and organic nutrient (Reef Amirich) on the population density of two sucking pests of cucumber, cotton whitefly, *Bemisia tabaci* and onion thrips, *Thrips tabaci* during the spring season/2016. Results indicated that potassium sulphate (50, 100 and 150 kg/ha) and organic nutrient (0.8 and 1.6ml/l) reduced both the population density of *B. tabaci* and *T. tabaci* nymphs depending on the fertilizer level of the user, the treatment 150 kg/ha for the potassium fertilizer and 1.6 ml/L for organic nutrient was the highest among others when minimized density of nymphs by 1.62 nymphs of *B. tabaci*/disk leaf and 0.38 nymph of *T. tabaci* / disk leaf. suggesting a possible increase in cucumber resistance to this pest as a result of the treatments, and the result showed the infestation with *B. tabaci* was higher in the second half of May, the average number of nymph were 5.35 nymph/ disk leaf, while the highest number of *T. tabaci* was observed in the first half of May, the average number reached to 2.73 nymph/ disk leaf. The result showed the interaction treatment K150A1.6 was significant superior of percentage of K and increased of content in leaves of Fe, Cu and Zn.

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Introduction

The Cucurbitaceae includes about 118 genera and 825 species (Khan *et al.,* 2015). They are among the most widely grown and important vegetable crops in the world. Cucumber (*Cucumis sativus* L.) one of the most important economic vegetable crops belong to this family. This crop is attacked by a number of insect pests including cotton whitefly *Bemisia tabaci* (Homoptera: Aleyrodidae). Cotton whitefly is one of important insect pests in many regions of the world, with over 500 host plant species of 74 families (Perring, 2001; Stansly and Naranjo, 2010).

Onion thrips (*Thrips tabaci* L.) (Thysanoptera: Thripidae) is a polyphagous species and a serious pest of a wide range of economically important crops in many parts of the world .Onion thrips is a native to the Mediterranean region, which causes severe damage to various crops in Africa, Asia, Europe, North and South America, and Australasia (Mound, 1997;Boateng*et al.,* 2014).

The damage of the whitefly and onion thrips by sucking the sap from leaves and flower buds. Whitefly produces honey dew which facilitates the growth of fungi on leaves and reducing photosynthesis furthermore this pest transmit the virus disease to several crops (Yokomi *et al.*, 1995; Mc Auslane *et al.,* 1996; Larentzaki *et al.,* 2008).

There are many important and essential elements nutriticel for plant vegetables, some of these elements required by plants in large amount such as nitrogen and potassium. Potassium plays an important role in physiological activity and plant growth and reproduction. Potassium is one of the essential nutrients of the plant. The plant's need for this element may exceed all other nutrients at some stages of plant growth (Awad, 1987). Potassium has several functions, including the activation of many enzymes, such as Synthetase, Hydrogenase, and Transferase. Potassium is also collected in the guard cells, which act as the driving force of the opening and closing of the stents as this mechanism is related to the content of potassium and sugars (Krauss, 1993). As well as the regulation of the cytosolic voltage of the cells and stimulate the absorption of CO_2 by the stents and the formation of ATP (Mengel and Header, 1977, Hsiao and Lauchli, 1986). Organic fertilizer was also used to increase plant productivity one of these nutrients organic nutrient Reef Amirich Adding chemical fertilizers to the soil influences with the survival, development and reproduction of an insect (van Emden, 1966; Auclair, 1976). Pissarek (1983) noted that potassium plays a role in increasing the hardness of the cells of the plant and its tissues are difficult to attack and penetrated by insects and they are resistant to lodging, especially plant of field crops. It was reported that plant damage by insect is comparatively less in K applied plants due to reduced carbohydrate accumulation, elimination of amino acids (Baskaran *et al.,*1985), higher silica content and increase in the sclerenchymous layer (Dale,1988).

Copper caused toxic effects in the insect species, morphological abnormalities, egg sterility and decreased fecundity and when these insect larvae fed on contaminated with cupper (Habustova and Weismann, 2001). Alice *et al.* (2003) also recorded the low BPH population in plots treated by organic amendments. Due to the economic importance of the sucking insects and the lack of studies related to the effect of fertilizers on insects in the study area so the present study was conducted to assess the effects of Potassium and organic nutrient (Reef Amirich) fertilizer levels in cucumber, on the population density of *B. tabaci* and *Thrips tabaci* plant under field conditions.

Material and methods

Location and experimental design

An experiment based on randomized complete block design with 6 treatments and 9 plants for each treatment, each of them replicated three times was carried out in the vegetable field of Horticulture and Landscape Engineering Department, Agriculture College, University of Baghdad. Cucumber (Gazeer hybrid) was planted in area of 450 m^2.

Treatments

Each block, which has 6 treatments, was a combination of three application rates (50, 100, and 150 kg/ ha) of potassium sulfate fertilizer and two concentrations (0.8 ml/L and 1.6 ml/L) of foliar organic fertilizer (Reef Amirich) and Control check (without fertilization). Reef Amirich Contents 100 g/L amino acids, 60 g/ L organic substances, 5 g/L iron, 5 g/L Zink and 5 g/L copper.

Insect sampling

Samples were chosen randomly and regularly every week. Each sample consists of 5 leaves cut randomly from each experimental unit. Each sample was put in polyethylene bag and was taken to laboratory for counting the insect density. Density of *B. tabaci* nymphs and *T. tabaci* insects counted under dissecting microscopeusing2 square inch (disk leaf).

Estimation the nutritional elements of leaves

The percentage of nutritional elements (K, Fe, Cu and Zn) was estimated by taking the 4th and 5th leaves of the apical point of cucumber separately of each treatment. The leaves were washed with distilled water then dried in oven at 60°C and ground to fine powder. Amount of 0.2 g. of each powders was taken for determination the mineral concentrations after wet digestion analysis using concentrated sulfuric acid and hydrochloric acid (AL-Sahhaf, 1989).

The percentage of minerals estimated as followings:

Percentage of potassium estimated by Flame Photometer device (Page *et al.*, 1982).

Estimation Fe, Cu & Zn with Atomic Absorption Spectrophotometer (Al-Sahhaf, 1989).

Statistical analysis

Experiments were designed according to complete randomized block design. Analysis achieved by GenStat Discovery Issue 4 (2011). Results compared by using least significant difference test at 0.5 probability.

Results and discussion

Effect of Fertilizer sin the population of B. tabaci and T. tabaci nymphs in Cucumber

Results in Table (1) indicate that fertilizer used has a significant effect on reducing the population density of whitefly nymphs. Besides, there is a variation in decrease rate depending on the level of fertilizer used.

Table 1. Effect of different concentrations of k Fertilizer and organic nutrient in the population of *B. tabaci* nymphs in Cucumber.

K \ A		Date of samples collection							Mean
		5-5	12-5	19-5	26-5	2-6	9-6	16-6	
	0	4.87	4.98	4.53	5.35	5.20	4.94	4.88	4.96
0	0.8	4.95	4.63	4.36	5.00	4.90	4.73	4.36	4.70
	1.6	4.23	4.10	4.00	4.33	4.65	4.43	4.09	4.26
	0	4.43	4.00	3.77	4.27	4.06	4.00	4.00	4.07
50	0.8	3.63	3.67	3.37	4.00	3.94	3.25	3.11	3.56
	1.6	3.45	3.63	3.50	3.82	3.40	3.13	3.06	3.42
	0	3.00	3.43	3.30	3.90	3.80	2.65	2.50	3.22
100	0.8	2.53	2.33	2.00	2.72	2.45	2.15	1.83	2.28
	1.6	1.30	2.10	1.67	2.02	1.30	1.23	1.00	1.51
	0	1.97	2.60	2.53	2.93	2.36	1.13	1.65	2.16
150	0.8	1.77	2.00	1.97	2.55	2.10	1.87	1.43	1.95
	1.6	1.36	1.73	1.68	2.00	1.88	1.53	1.20	1.62
Mean		3.12	3.26	3.05	3.57	3.33	2.92	2.75	3.14

L.S.D(0.05) K=0.32 L.S.D(0.05) A=0.38 L.S.D(0.05) K× A=0.66.

The results indicate the treatment 150 kg/ha for the potassium fertilizer and 1.6 ml /L for organic nutrient was the highest among others when minimized density of nymphs by 1.62 nymphs/disk leaf .compared to 4.96 nymphs/disk leaf for control treatment.

The role of the minor elements (Fe, Cu, and Zn) in organic nutrient was obvious when decreased nymph population density up to 4.70 and 4.26 nymphs/disk leaf in the K0A0.8 and K0A1.6treatments, respectively, in the absence of potassium.

Table 2. Effect of different concentrations of k Fertilizer and organic nutrient in the population of *Thrips tabaci* nymphs in Cucumber.

K		Date of samples collection							Mean
A		5-5	12-5	19-5	26-5	2-6	9-6	16-6	
	0	2.73	2.20	2.00	2.06	1.73	1.66	1.57	1.99
0	0.8	2.43	2.00	1.63	1.86	1.53	1.43	1.36	1.74
	1.6	2.00	1.76	1.20	1.67	1.40	1.18	1.10	1.47
	0	2.53	2.00	2.03	1.43	1.30	1.39	1.00	1.67
50	0.8	2.00	1.87	1.23	1.08	1.00	0.80	0.73	1.24
	1.6	1.73	1.43	0.90	1.00	0.86	0.96	0.55	1.06
	0	1.67	1.40	1.30	1.23	1.30	0.96	0.90	1.25
100	0.8	1.50	1.34	1.16	1.20	0.90	0.83	0.66	1.08
	1.6	1.23	1.03	0.90	1.00	0.70	0.63	0.40	0.84
	0	1.30	1.10	1.00	0.70	0.76	0.50	0.18	0.79
150	0.8	1.00	0.90	1.03	0.66	0.53	0.40	0.00	0.64
	1.6	0.76	0.65	0.36	0.55	0.00	0.36	0.00	0.38
Mean		1.74	1.47	1.22	1.20	1.00	0.92	0.70	1.18

L.S.D (0.05)K=0.18 L.S.D(0.05) A=0.22 L.S.D (0.05) K× A=0.40.

Results in Table (2) showed the inverse proportion between the fertilizer level added and population density of thrips on plant leaves. The highest population intensity rate of thrips nymphs was 1.99 nymph/disk leaf for K0A0 control treatment.

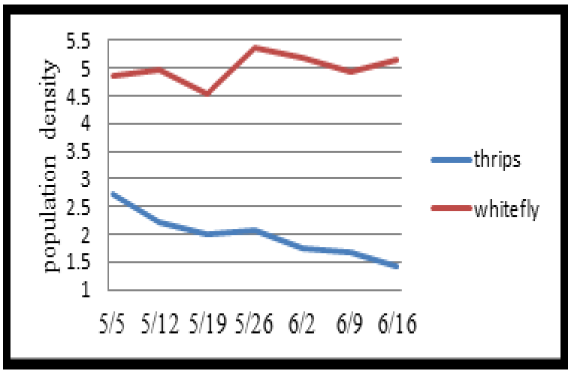

Fig. 1. The population density of the whitefly *B. tabaci* and onion thrips *T. Tabaci* nymphs in cucumber for the spring season 2016.

A decrease in the population density of thrips nymphs was noticed at the beginning of the increase Organic nutrient level, even without fertilizer potassium addition. Population density rates were 1.74 and 1.47 nymph/disk leaf for each K0A0.8 and K0A1.6 treatments, respectively. The population density rate dropped with increasing fertilizer level up to 0.38 nymph/disk leaf when the highest level of both organic nutrient and potassium fertilizer was used in K150A1.8 treatment.

Seasonal abundance of B. tabaci and T. tabaci nymphs in Cucumber

Fig. 1 shows the population density of *B. tabaci* nymphs appeared on cucumber plants at the beginning of seedling emergence and growth till the end of growing season. It reached highest peak in the second half of May, then gradually dropped at beginning of June to the end of planting season. The result shows that the infection of *T. tabaci* concurred with the beginning of seedling emergence. The maximum thrips density of 2.73 nymph/disk leaf was noticed in the first week of May, and then dropped till late June at the end of growing season.

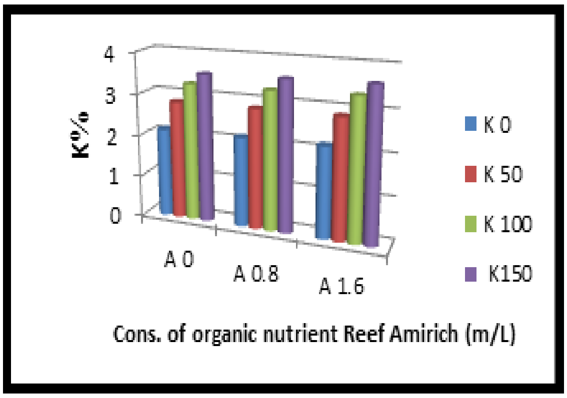

Fig. 2. Effect of potassium fertilizer and organic nutrient and interaction treatment in the cucumber leaves of potassium.

Leaves content of nutrients

The results in Fig. 2, 3, 4, and 5 indicate that the content of plant leaves of nutrients (K, Fe, Cu, and Zn) varied based on the concentration used for both potassium fertilizer and organic nutrient.

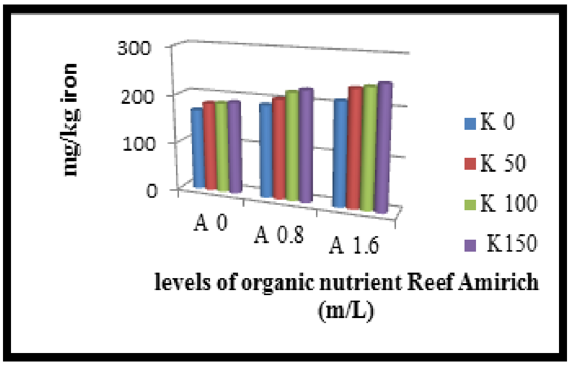

Fig. 3. Effect of potassium fertilizer and organic nutrient and interaction treatment in the cucumber leaves of iron.

Leaf analyses of nutrient elements content showed K150A1.8 interaction treatments was to the best among other combinations, when the high potassium iron, copper and zinc contents were measured. Results also showed that the lowest leaf content of the four elements was with K0A0 treatment.

Discussion

Result of this study had proved that there fertilizer used resulted in a significant reduction in the population density of *B. tabaci and T. tabaci* nymphs, These results are in agreement with Perrenound (1977), low density of the insect, may occur because potassium increases plant efficiency to resist the insect pests by activating and increasing enzymes. Increasing the stability and hardness of the cell wall as well. The role of the minor elements, Buzuk (1986) pointed that microelements especially Mn, Zn, Fe, and Cu increased alkaloids in plant tissues. Alkaloids contain toxic substances which protect plants from insect attack (Paechand and Tracey, 1955). Also, Ebaid and Mansour (2006) mentioned that Microelements (Zn, Mn, Fe, and Cu) had significant differences in the reduction of thrips population in cotton plants.

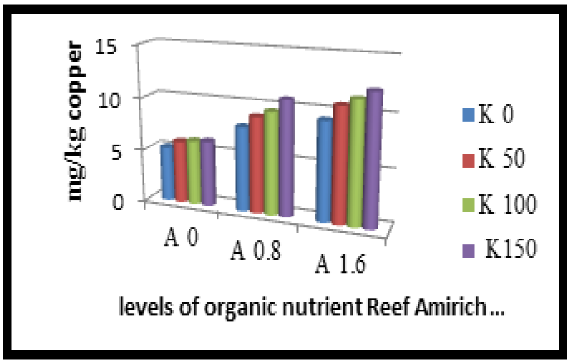

Fig. 4. Effect of potassium fertilizer and organic nutrient and interaction treatment in the cucumber leaves of copper.

The treatments with fertilizers are possibly related to an increase in the hardness of cell tissues of the plant, causing feeding difficulties. The nymphs may not be able to scrape the leaves to obtain enough nutrients, due to the direct physical impediment caused by the fertilizers accumulation in the cell walls of plants (Heine *et al.*, 2007). The damage by *Thrips palmi* nymphs on eggplant leaves showed a marked reduction after applications of fertilizer, the treatment with the organic mineral fertilizer alone decreasing the number of lesions in the plants by the nymphs, but the treatment with calcium silicate was more efficient than those with mineral fertilizer alone

(Almeida *et al.,* 2008). Ghallab *et al.* (2014) reported that the application K fertilizer and Microelements considerably reduced the mean population of white fly nymphs (0.51 and 0.24 nymphs/leaflet) respectively, compared to control (0.77 nymphs/ leaflet) on bean plants during 2012 season. The reduced of population density of thrips nymphs on cucumber treated with potassium fertilizer and organic nutrient can probably be attributed to the increase of the plant defense compounds, such as phenolics, lignin and phytoalexins.

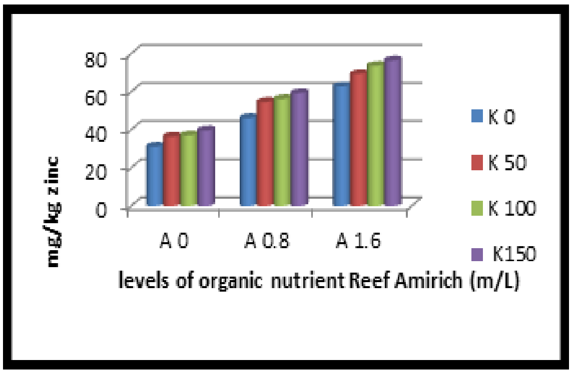

Fig. 5. Effect of potassium fertilizer and organic nutrient and interaction treatment in the cucumber leaves of zinc.

In relation to the seasonal presence of *B. tabaci* nymphs, these results differ from those found by Al-Jorany *et al.*(2013) when the population density of whitefly nymphs on five cucumber varieties. Was the highest during the first half of May in the fields at Abu Ghraib. This variation in results may be attributed to differences in geographical location and environmental conditions, especially the temperature during growing season. Similarly, Dent (1995) found there is many factors may affect population density of white fly on its host plants including weather, nitrogen (N) and potassium (K) levels, plant age and population densities of natural enemies. And the results of *T. tabaci* nymph conceded with Al-Joranyet *al.* (2013) who reported the highest population density of the thrips nymphs was during May and then dropped because of high temperature and leaf dehydration of most plants. They also indicated the control measures in early growth stages of plant are necessary to enable plant to obtain an economic crop production.

The data suggest that fertilization is necessary to increased cucumber crop resistance to sucking insects and increased yield because the better growth of treated plant by fertilizers which supported their survival. We can add fertilizers to plant alone or with some other management techniques for having a best integrated pest management for cucurbitaceous crops.

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