ROLE OF BIO- AND CHEMICAL FERTILIZERS ON THE POPULATION OF FOUR ARTHROPODS INFESTING TWO JERUSALEM ARTICHOKE CULTIVARS

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Abstract

The effect of bio-fertilizer (Nitrobein) on the infestation of the two Jerusalem artichoke cultivars (Local and Fuseau cultivars) by four arthropods which are *Tetranychus urticae* Koch, *Bemisia tabaci* Genn., *Aphis gossypii* Glover and *Thrips tabaci* Lind. during summer seasons of 2002 and 2003 at Barrage Horticultural Research Station was investigated. Nitrobein level of 8 kg/fed. with 75, 50 and 25 % of the recommended rates of nitrogen, phosphorus and potassium (RNPK) were used. The check control treatment was 100 % of the (RNPK) nitrogen (40 kg N/fed.), phosphorus (22.5 kg P_2O_5/fed.) and potassium (96 kg K_2O/fed.) without Nitrobein. Results showed that Fuseau cultivar was more infested by the four arthropods than Local cultivars. The least record of infestation was detected in treatment of Nitrobein + 75 % (RNPK) for both cultivars and both seasons, followed by Nitrobein + 50 % (RNPK). The highest infestation was recorded in the check treatment. The population of *T. urticae* and *B. tabaci* were highly recorded in June, while May was the month of high population of *A. gossypii* and *T. tabaci*. The begin of the season was characterized by the high population of the arthropods and declined steadily towards the end of the season.

INTRODUCTION

Jerusalem artichoke (*Helianthus tuberosus* L.) belongs to Family Astreaceae, its origin is Northern America. Tubers of Jerusalem artichoke is used as vegetables like potatoes, animal forage, inulin and ethanol production by fermentation (Sachs *et al.*, 1981). During the last few years, great attention has been given to increase cu..ivation of Jerusalem artichoke crop, more and more chemical fertilizers and insecticides are required, which resulted in increasing the total cost of production and causing environmental pollution particularly in the developing countries. Now, it becomes urgent to supplement or substitute the inorganic NPK with organic sources, particularly the biofertilizers which are of microbial origin. El-Hadad *et al.* (1993) declared that biofertilizers application is considered a promising alternate for chemical fertilizers under the local condition.

Nitrogen fertilization is a common practice to improve the growth and appearance of plants. As a result of fertilization plants have access to more nutrients and water. Fertilization-induced changes in plants may explain, in part, differences in

insect performance among treated plants. It is generally found that nitrogen fertilizers induces population increases of sap-sucking insects (McClure, 1980).

Several studies have shown that chemical fertilizers change the nutritive value of plants for phytophagous insect and help their establishment on new crops by accelerating insect population growth through changes in development and survival (Dowell and Steinberg, 1990).

Sunflower plant is the nearly plant to the Jerusalem artichoke are attacked by the two main insects *B. tabaci* and *A. gossypii* surveyed by Sattar *et al.* (1984), Theuri *et al.* (1987) and Nagaraju *et al.* (1997). They found that *A. gossypii* in Kenya caused crop losses by transmitting sunflower yellow blotch virus on sunflower. *B. tabaci* is a serious pest of most field crops. Quantification of plant damage and yield loss for Jerusalem artichoke, resulting from infestation by *B. tabaci, A. gossypii, T. urticae* and *T. tabaci*, is confounded by complex interactions. Few studies are taken in consideration the effect of biofertilizer on the population trend of some pests.

The objective of this study is to determine the effect of partial substitution of chemical N, P and K fertilizers by bio-fertilizer (Nitrobein) on the infestation of Jerusalem artichoke plant cultivars by the four arthropod cited before.

MATERIALS AND METHODS

A field experiment was carried out during the two successive growing seasons of 2002 and 2003 at Barrage Horticultural Research Station, Kalubia Governorate. Seed tubers of the two Jerusalem artichoke cultivars Local and Fuseau were planted on rows of one meter apart and in hills of 50 cm within the row. Planting dates were the beginning of April for the two seasons.

The experimental design used was a split plots with three replicates and the plot area was estimated 25 m^2 (5 rows of 5 m length and one meter width), precautions had been done to prevent contamination among fertilization treatments by separating each two treatments with an empty row. The main plots were occupied by the two cultivars, whereas the sub-plots were as follows :

T1 : check treatment (100 % RNPK), full recommended dose (40 N + 22.5 P_2O_5 + 96 K_2O kg/fed.).

T2 : 75 % (RNPK) + Nitrobein inoculation.

T3 : 50 % (RNPK) + Nitrobein inoculation.

T4 : 25 % (RNPK) + Nitrobein inoculation.

Soil was inoculated with the bio-fertilizer Nitrobein (a commercial name in Egypt), it is a biofertilizer containing live cells of efficient bacteria strains for N-fixation in cultivated soils. The rate of 8 kg/fed. mixed with wet soft soil (1 : 10 ratio) and

combined with NPK fertilizers. Calcium superphosphate (15.5 % P_2O_5) was applied once before planting during soil preparation, whereas ammonium sulphate (20 % N), as well as potassium sulphate (48 % K_2O), was added as two equal portions after 30 and 60 days from planting date.

Pest estimation :

All the agricultural practices were applied except chemical control (insecticides) was not applied to avoid effect on the pest populations. Samples were taken after 4 weeks from planting, weekly samples were picked up randomly from the plants of each cultivar and each treatment. The sample was of five leaves kept in separate paper bag till examination at laboratory to determine the population of *T. urticae* (moving stages), *B. tabaci* (nymphs and pupae), *A. gossypii* and *T. tabaci* (nymphs and adults) on the whole leaf.

Statistical analysis :

All the obtained data were statistically analysed for variance according to Snedecor and Cochran (1967), the mean values were compared at 5 % levels of L.S.D. for each season.

RESULTS AND DISCUSSION

1- Effect of cultivar :

Results in Tables 1 and 2 reveal that Jerusalem artichoke cultivar had a high significant effect on pest infestation during the two growing seasons. Fuseau cultivar was attacked more by the 4 studied pests compared with the local one, especially by *B. tabaci* (31.64 and 31.18 ind./leaf) followed by *A. gossypii* (9.25 and 8.26 ind./leaf) for both seasons, respectively. *T. tabaci* population was nearly the same for both cultivars. Also, the difference of *T. urticae* between them was slight (7.54 and 8.81 ind./leaf) during the first season and 5.58 and 6.65 ind./leaf during the second season for Local and Fuseau cultivars, respectively. This superiority of pest infestation on Fuseau cultivar could be attributed to the varietal differences between the two cultivars (leaf of local cultivars was more tuff than Fuseau leaf). The susceptibility of cultivar to the infestation by insect was studied by many investigators as Doss *et al.* (1997) on strawberry, El-Sayed (1997) on garlic, Abd-El-Malak *et al.* (2002) on sweet-potato and Mohamed and Salman (2002) on faba bean.

2- Effect of fertilizer :

Data in Tables 1 & 2 showed that fertilizer treatments were statistically of high significant effects on the infestation parameter during the two seasons. The highest average number of *T. urticae* (8.63 and 6.79 ind./leaf), *B. tabaci* (31.20 and 30.10 ind./leaf), *A. gossypii* (10.53 and 8.76 ind./leaf) and *T. tabaci* (11.93 ind./leaf) were recorded in the check treatment (T1) for both season except in the 2*nd*

season for *T. tabaci* where the high average number (8.83 ind./leaf) was recorded in (T3) treatment of Nitrobein + 50 % (RNPK). The lowest average numbers of pests were recorded in (T2) treatment of Nitrobein + 75 % (RNPK). This result agree with El-Shimi *et al.* (2002) who found that the bio-fertilizer Microbein + 75 % or 50 % of (RNPK) offer a high yield of strawberry and also a low infestation by *T. urticae, B. tabaci* and *M. persicae*. Many studies found that the high level of nitrogen fertilizer caused high infestation of pests as Gabr (1991), Bentz *et al.* (1995), Belaji and Veeravel (1997), Parihar and Upadhyay (2001) and Azeredo *et al.* (2002). Megahed (1994) recorded that the combination of nitrogen and phosphorus fertilizer affected negatively the population density of *B. tabaci*. Singh *et al.* (1997) deduced that the high level of nitrogen caused high infestation of aphid on brassica and mustard, while moderate level and combination with phosphorus gave lower of infestation. High nitrogen concentrations in the leaves of tomato resulted in a shorter generation time and doubling time to the population of *B. tabaci* in greenhouse, this was deduced by Berlinger and Wermelinger (2002).

3- Effect of interaction between cultivar and fertilizers :

The interaction showed high significant effect of fertilizers and cultivars on the population of the 4 sucking pests as in Tables 1 and 2 except in the second season of *T. tabaci* was not significant.

Population fluctuation of pests :

The population fluctuation of the four sap-sucking pests were illustrated in Fig. 1 for Fuseau cultivar and Fig. 2 for the local cultivar during the two seasons.

Generally, the first season was characterized by the high population of the 4 pests than the second season. The high recorded numbers of pests were detected at the beginning of the season then declined steadily till disappearance for some pests at the end of the season. This may be revealed to the presence of coccinellid and other predators of high population causing the drop in the pest population.

Two months were characterized by high pest population in June for *B. tabaci* and *T. urticae*, and in May for *T. tabaci* and *A. gossypii*.

Finally, results from the study reported here demonstrate that fertilization with Nitrobein + 75 % or 50 % of (RNPK) were the treatments of best results compared to the check one. Fertilization with high level of nitrogen should be avoided because it may accelerate pest population growth.

Table 1. Effect of N, P and K fertilizer rates and Nitrobein on the average numbers of *T. urticae* (moving stages), (nymphs & pupae) of *B. tabaci*, (nymphs & adults) of *A. gossypii* and *T. tabaci* (individuals)/leaf on two Jerusalem artichoke cultivars (Local and Fuseau), during 1*st* season, 2002.

Pest	*T. urticae*			*B. tabaci*			*A. gossypii*			*T. tabaci*		
Cultivar / Fertilizer	Local	Fuseau	Mean	Local	Fuseau	Mean	Local	Fuseau	Mean	Local	Fuseau	Mean
T1	8.00	9.26	8.63	29.86	32.66	31.26	9.40	11.66	10.53	11.33	12.53	11.93
T2	7.06	7.73	7.39	26.40	30.46	27.43	6.10	7.64	6.87	9.33	8.73	9.03
T3	7.46	9.06	8.26	27.60	31.66	29.63	6.93	7.86	7.39	9.86	10.86	10.36
T4	7.66	9.20	8.43	28.00	31.80	29.90	8.33	9.86	9.09	9.66	9.80	9.73
Mean	7.54	8.81	-	27.96	31.64	-	7.69	9.25	-	10.04	10.43	-
F-value of cultivar			89.05			97.62			170.37			12.43
L.S.D.			0.26			0.82			0.74			0.077
F-value of fertilizer			87.05			16.34			1355.92			437.30
L.S.D.			0.23			1.04			0.12			0.24
F-value of cv. x fert.			4.47			11.43			12.28			22.27
L.S.D.			0.46			2.36			0.36			0.47

Table 2. Effect of N, P and K fertilizer rates and Nitrobein on the average numbers of *T. urticae* (moving stages), (nymphs & pupae) of *B. tabaci*, (nymphs & adults) of *A. gossypii* and *T. tabaci* (individuals)/leaf on two Jerusalem artichoke cultivars (Local and Fuseau), during 2*nd* season, 2003.

Pest	*T. urticae*			*B. tabaci*			*A. gossypii*			*T. tabaci*		
Cultivar / Fertilizer	Local	Fuseau	Mean	Local	Fuseau	Mean	Local	Fuseau	Mean	Local	Fuseau	Mean
T1	6.53	7.06	6.79	28.80	31.40	30.10	7.26	10.26	8.76	10.13	11.53	8.73
T2	4.20	5.73	4.96	25.20	28.66	26.93	4.60	7.18	5.86	7.13	7.53	7.33
T3	5.60	6.86	6.23	27.00	30.13	28.56	6.46	7.46	6.96	8.73	8.93	8.83
T4	6.00	6.93	6.46	27.46	30.53	28.99	7.20	8.20	7.70	7.66	7.73	7.69
Mean	5.58	6.65	-	27.16	30.18	-	6.38	8.26	-	8.41	8.93	-
F-value of cultivar			454.60			1309.33			2364.33			268.00
L.S.D.			0.09			0.17			0.07			0.11
F-value of fertilizer			671.25			386.16			224.90			1422.50
L.S.D.			0.26			0.23			0.21			0.16
F-value of cv. x fert.			40.32			34.50			6.00			1.75
L.S.D.			0.37			0.46			0.42			-

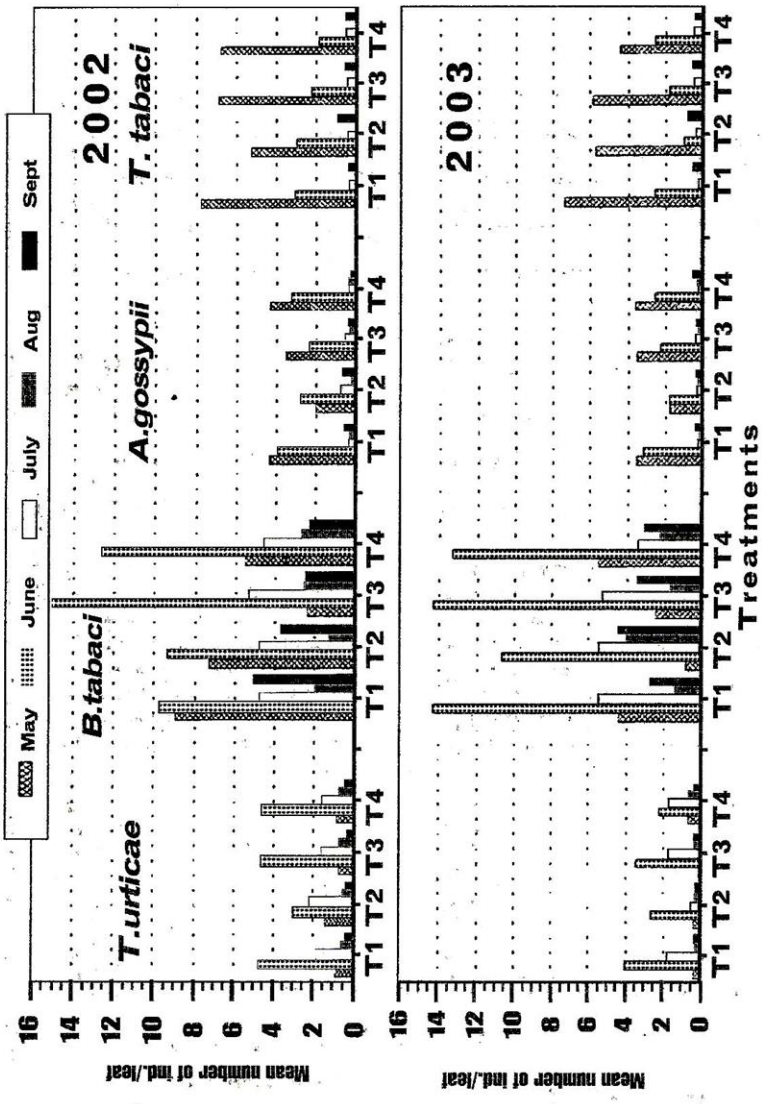

Fig.1. population fluctuation of four pests on "Local "Jerusalem artichoke cultivar Under four different fertilizer treatments during 2002 and 2003 seasons.

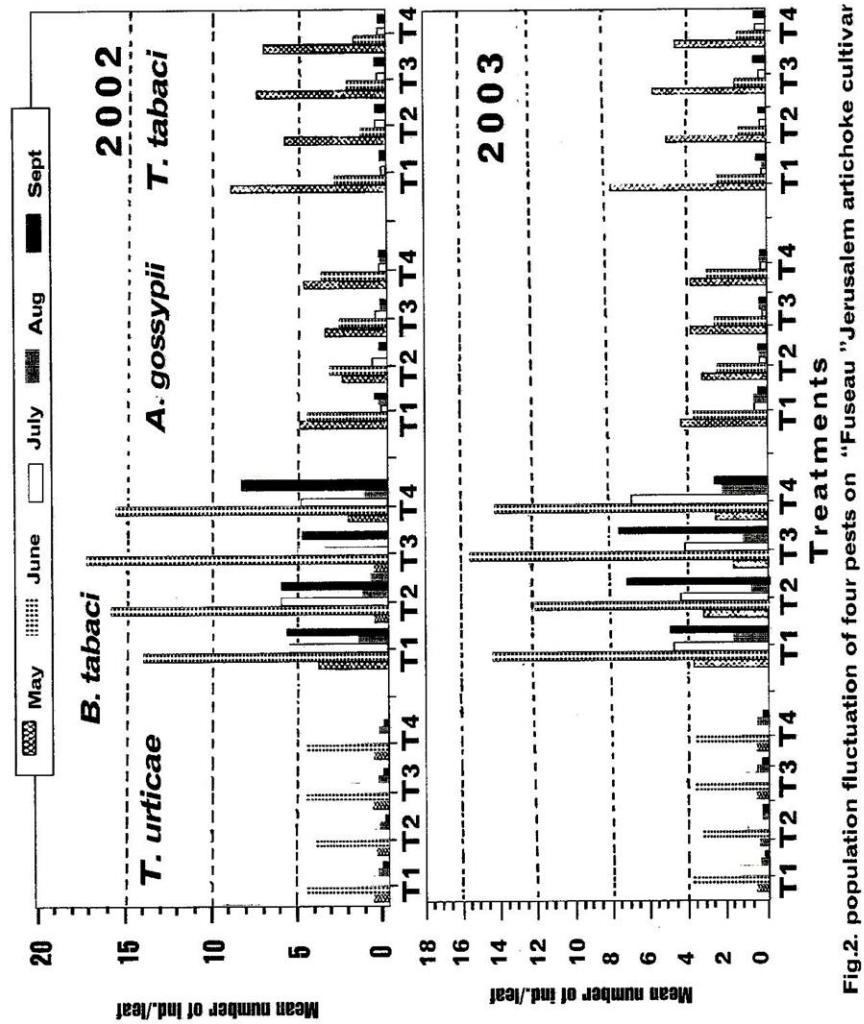

Fig.2. population fluctuation of four pests on "Fuseau "Jerusalem artichoke cultivar under four different fertilizer treatments during 2002 and 2003 seasons.

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دور الأسمدة الحيوية والكيماوية على تعداد أربعة من مفصليات الأرجل التى تصيب صنفين من نباتات الطرطوفة

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تم دراسة تأثير المخصب الحيوى "نيتروبين" على مدى إصابة صنفى الطرطوفة "البلدى" و "الفيوزا" بأربعة أنواع من مفصليات الأرجل وهى العنكبوت الأحمر العادى والذبابة البيضاء ومنّ القطن وتربس البصل خلال الموسم الصيفى عامى ٢٠٠٢ و ٢٠٠٣ فى محطة بحوث البساتين بالقناطر الخيرية. كان المعدل المستخدم من المخصب الحيوى النيتروبين هو ٨ كجم/فدان مع ٧٥ %، ٥٠ %، ٢٥ % من معدلات النيتروجين والفوسفور والبوتاسيوم الموصى بها. أما معاملة المقارنة بدون نيتروبين فقد تم التسميد بـــ [نيتروجين بمعدل (٤٠ وحدة نيتروجين للفدان)، الفوسفور (٢٢,٥ وحدة فو٢ أ٥/للفدان)، والبوتاسيوم ٩٦ وحدة بو٢ أ/للفدان)] .

أظهرت النتائج .أن صنف "الفيوزا" أعلى إصابة من الصنف "البلدى"، وكانت معاملة النيتروبين + ٧٥ % من معدلات التسميد الموصى به هى أقل المعاملات إصابة فى كلا الصنفين بالعنكبوت الأحمر، الذبابة البيضاء، منّ القطن والتربس طوال الموسمين، بينما كانت معاملة المقارنة هى الأعلى إصابة بجميع الافات المدروسة.إتسمت بداية الموسم بالتعداد الأعلى ثم بدأت تقل تدريجيا. وكان شهر يونيو هو الأعلى تعداداً بالعنكبوت الأحمر والذبابة البيضاء، بينما كان شهر مايو هو الأعلى تعدادا فى الإصابة بالتربس ومنّ القطن.