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Effect of Organic and Bio-Fertilizers on Yield Quality and Insect Infestations of Sweet Potato Plants in Upper Egypt

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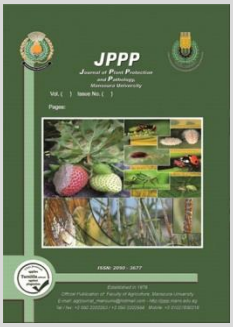

ABSTRACT

Field experiments were conducted at private farm at Sohag, Egypt, during the two successive summer seasons of 2018 and 2019, to study the response of sweet potato plants to soil-applied of organic manure (at rates of 0, 5, 10, 15 and 20 ton/fed.) and bio-fertilizer application (without or with *Azotobater* sp.) on growth, yield parameters and damage rates due to insect infestations. The obtained results indicated that, organic manure at rate 20 ton/fed was recorded the maximum increase in vegetative parameters i.e, the main stem length, No. of branches/plant, weight and dry matter% of vines, yield and its contents i.e., No., weight of storage roots/plant and dry matter percentage of storage roots compared with rate zero ton/fed., organic manure. Also, the same treatment gave significant increases in storage roots of N%, P%, K%, protein% and damage rates in leaves and roots as compared with other treatments in two seasons.Data assured that all studied parameters were affected significantly by adding *Azotobater* sp. expect, No. of branches and roots/plant, percentage of dry matter in branches, P, K, damage rates of leaves and roots in both seasons.The rate of 20 ton/fed (organic manure) with bio-fertilizer gave the highest values of the most studied characters except, total yield in the second season compared other treatments. While, the treatments zero ton/fed., organic manure without bio-fertilizer gave lowest values at all studied traits in both seasons.

Keywords: Organic, organic manure, bio-fertilizers, sweet potato plants, Upper Egypt.

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is one of most popular vegetables crop in Egypt. It has been cultivated for both human food consumption; moreover the vines are used for animal feed. For increasing its total productivity to meet the overpopulation, that could be achieved through increasing cultivated area especially on reclaimed soil. The continuous increase in the costs of chemicals fertilizers and environmental pollution problems restrict the addition at sufficient amount. Thus, it has become essential to use untraditional fertilizers substitutes or supplements for chemical fertilizers.

Several investigators found that using bio-fertilizers gave the best results in many vegetables. Quote, EL-Gamal, (1996) studied response at potato in the newly reclaimed area to minerals Nitrogen fertilizer levels and Nitrogen fixing bio-fertilizer, Halex-2. He found that increasing N application rate or inoculation with Halex-2 resulted in taller plants with higher leaf N content, dry matter and total yield where increasing with application of bio-fertilizer by increasing in addition rats. Kamla, (1999) found that tuber yield of potato was highest with increasing bio-fertilizers. El-Banna *et al*., (2001) studied the effect of bio-organic fertilization on potato; they found that application of organic manure led to signification of increase in plant height, foliage fresh weight/plant, total tube yield weight and number tuber/plant. Badway *et al*., (2007) found that in the sweet potato the 100% N level with biogen fertilizer gave the best results in most characters. Moreover, the NPK uptake in the sweet potato plants increase by increasing the organic manure rates (Abd- Hakeem and Fekry, 2014)

Soils rarely have sufficient nutrient for crops to reach their potential yield. Applying organic fertilizers without prior knowledge of their properties may cause yield decline under low addition or pollute the environment with excessive application. Understanding the nutrient variability and release pattern of organic manure is crucial to supply plants with sufficient nutrients to achieve optimum productivity, while also rebuilding soil fertility and ensuring protection of environmental and natural resources. Many researchers reviews have indicated that, sweet potato produced with organic practices are healthier than sweet potato produced with using conventional methods. Sood *et al.*, (1994) found that the tuber yield and dry matter increased significantly with application of organic mature on potato. Singh *et al*., (1996) found that the addition of 15ton FYM + 100Kg P_2O_5 was more effective on tuber potato yield than using FYM alone. Ashour and Sarhan, (1998) studied that in potato plant application of organic with each other or with inorganic fertilizers increasing yield, weight and number of potato tubers. Abou El-Salehein *et al*., (1999) reported that in potato plants application of chicken manure significantly increased tuber weight and total yield. El-Banna and Abd-El-Salam, (2000) indicated that tuber potato weight increased with increasing organic manure. Awad *et al*., (2002) studied the effect of used farm yard manure in potato fertilizers, the result indicated that the application of

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organic manure induced significant increases in vegetables growth, tuber weight, tuber dry matter and percentage of starch. The plant weight, foliage fresh and dry weight, number and weight of tuber/ plant and total tuber were increased due to FYM application (Abd-El-kader, 2002 and Al-Esaily, 2017).

Numerous insect species including leave defoliators and root feeders were recorded as pests of sweet potato causing serious damage, these pests belonging to various members of Lepidoptera, Thysanoptera, Orthoptera, and Hemiptera and spider mites (Chalfant, *et al.* 1990, Amies *et al*., 1996 and Ekman and Lovatt, 2015). Leaf defoliators are important pests attack vegetative growth of sweet potato, Hendawy *et al.*, (2017) recorded four lepidopteran pests attack sweet potato, *Agrius convolculi* (L.), *Spodoptera littoralis* (Biosd), *Autographa gamma,* (L.) and *Spodoptera exigua* Hb.

The main objective of the current study was to investigate the response vegetative growth, total yield, some chemical contents and the related pest infestation of sweet potato plants (cv. Abees) to organic manure and bio-fertilizers applications.

MATERIALS AND METHODS

The present investigation was carried out during the two successive seasons of 2018 and 2019 in a private farm (reclaimed soil), Sohag Gov., of Egypt. The objective of this study was determined the effect of organic manure (cattle manure) at rates of 0, 5, 10, 15 and 20 ton/feed.) and or without application of bio-fertilizers (Biogen) contains *Azotobater* sp. a nitrogen fixing bacteria at rate of 2Kg/fed., on vegetables parameters, yield and its components and insect infestation of sweet potato (Abees cv.) under newly reclaimed soil. Organic manure rates were broadcasted and incorporated during the soil preparation, while bio-fertilizers applications were 60 days transplanting. The physical and chemical properties of experimental soil are presented in Table (1). Organic manure analysis as shown in Table (2).

Table 1. Soil characterization for the sandy experimental site.

Season	Sand%	Silt%	Clay%	$CaCo_3$	Total N %	P (ppm)	K (mg/100g)	Organic minor %	PH (1:1)
2018	88.3	6.7	5.3	31.13	0.05	3.35	0.30	0.09	8.03
2019	89.8	7.2	3.0	29.45	0.06	3.43	0.33	0.07	8.01

Samples of the soil were obtained from 0.30 cm soil surface

Table 2. Chemical analysis of the used organic manure (cattle manure).

Organic	Organic matter	PH	N%	P%	K%
manure	36.89	7.02	0.67	0.55	0.69

The experiment design was split-plot with three replicates. The organic manure rates were assigned randomly in main plot, while bio-fertilizer applications were applied the sub-plot. Each experimental plot was 12 m^2 (4×3.5m) 4m long and 70cm wide of row. The planting date was on 23th April in both seasons at 25cm spacing on one ridge of rows. The experimental units received Amonum nitrate 33.5% at rate 40 kg/fed., Calcium super phosphate 15.5% at rate 45Kg P_2O_5/fed. was added at soil preparation while Potassium was applied in form of Potassium sulfate with 72 Kg of (48% K_2O) fed. to equal rates at 30 and 60 days from transplanting. All other recommended agro-managements required for sweet potato production were plasticized whenever it was necessary.

Recorded data:

During the tow experimental seasons the following data were recorded as follow:

Vegetative character: At 100 days after transplanting, five plants were randomly taken from each replicate to determine, the main stem length (cm), number for branches/plant, weight of vines/plants (Kg) and percentage of dry matter in branches.

Yield and quality: Sweet potato were harvest on 4th and 7th on September 2018-2019 seasons, respectively, total yield per plot recorded and converted to total yield/fed.(ton), number of storage roots/plant, weight storage roots/plant(g) and percentage of dry matter in storage roots.

Storage roots constituents: Samples of 5 cured srorage roots of sweet potato were taken to determine the percent of Nitrogen, Phosphorus and Potassium following methods described by Kock and Mc Meekin (1924), Brown and Lilleland (1946) and Murphy and Rily (1962), respectively.

Insect examination: forty five leaves were chosen from each plot of experiment (picked up from top, middle and base of sweet potato plants) in paper bags then transfer to the laboratory to count damage according to the size of eaten part of the leaf, the damage was measured as a percentage of the leaf area destroyed by pests, the cumulative damage caused by the defoliator larvae was estimated by scoring the damage (0 to 5) of each of 45 randomly chosen leaves, rate of damage was calculated according to the formula given by Kasopers (1965).

$$\% \text{ Damage} = \frac{\text{Sum of } (n \times v)}{Z \times N}$$

Where;

N = Total number of collected leaves/tubers.
Z = Score of the highest category (5).
n = No. of leaves/tubers for each category.
v = Score of each category.

Samples were picked up fortnightly. Mean percentages of damage for the first three inspections was recorded as early season inspection, the mean of the following three inspections were calculated as late season inspection, finally the last inspection was recorded as pre-harvest inspection. Also, damage in roots was calculated as the same way, but number of examined sample was 50 roots/plot.

Statistical analysis: Data were statistically analysis using split-plot design, and LSD at 0.05 level was used to compare the means of all data of the two seasons as mentioned by Gomaz and Gomaz (1984).

RESULTS AND DISCUSSION

Vegetables growth parameter:

In conformity with the date recorded in Table (3) the values of growth traits substantially increased by increasing the organic manure fertilizer up to 20 ton fed. in

both seasons. In this respect, the organic manure at rate of 20 ton/fed was recorded the highest volume of the main stem length (cm), No. of branches/plant, fresh weight of vines/plant (Kg) and percentage of dry matter in branches compared without adding organic manure. While, addition of bio-fertilizer was effected significantly in main stem length and fresh weight of vines/plant and insignificantly in No. of branches/plant and percentage of dry matter in branches for both study seasons (Table 3).

The interaction between organic manure and bio-fertilizers are illustrated in Table (4).

Data indicated that, significantly effect in all growth vegetative characters was observed expect percentage of dry matter in branches in 2019 season. From the same table, the rate of 20 ton/fed.

With bio-fertilizer was given the best vegetables growth parameters in both seasons.

The increased in vegetative growth characters of sweet potato to plant by increasing thee rates of organic manure addition may be due to increasing the nutritional elements in rooting zone and consequently the absorption of more nutrients. The response of sweet potato plants as well as other crops to organic manure was studied by many authors, Ali and Abdel-Mouty (2000), Soloman *et al*., (2002). Lairon, (2009) and Mohamed (2009) also, application the bio-fertilizer in sweet potato production gave the best result for vegetative characters and these results agree with those reported by Saber and Gomaa (1993), El-Banna and Tolba (2000), Badawy *et al.,* (2007) and Abou-El-Khair *et al*., (2009).

Table 3. Effect of organic manure and bio-fertilizer on vegetative growth characters of sweet potato plants during 2018 and 2019 seasons.

Characters	First season				Second season			
	The main stem length (cm)	No. of branches/ plant	Fresh weight of vines/Plant (Kg)	% of dry matter in branches	The main stem length (cm)	No. of branches/ plant	Fresh weight of vines/Plant (Kg)	% of dry matter in branches
Effect of organic fertilizers								
0 (ton/fed.)	93.01	14.77	1.066	12.30	86.375	12.37	0.892	11.98
5 (ton/fed.)	96.58	15.41	1.301	12.96	103.73	13.30	1.163	12.36
10 (ton/fed.)	111.19	15.87	1.464	13.19	106.00	14.70	1.247	12.53
15 (ton/fed.)	122.41	17.14	1.537	13.31	115.23	15.30	1.346	12.61
20 (ton/fed.)	123.06	17.30	1.569	13.34	118.63	15.67	1.411	12.63
$L.SD_{(0.05)}$	2.31	1.05	0.132	0.31	2.03	0.95	0.109	0.25
Effect of bio-fertilizers application								
Without	107.40	15.88	1.353	12.95	100.53	14.08	1.170	12.36
With	111.10	16.15	1.422	13.08	111.46	14.41	1.253	12.48
$L.SD_{(0.05)}$	3.01	NS	0.061	NS	4.13	NS	0.066	NS

Table 4. Effect of the interaction between organic manure and bio-fertilizer on vegetative growth characters of sweet potato during 2018 and 2019 seasons.

organic fertilizers	bio-fertilizers	First season				Second season			
		The main stem length (cm)	No. of branches /plant	Fresh weight of vines/ Plant (Kg)	% of dry matter in roots	The main stem length (cm)	No. of branches /plant	Fresh weight of vines/ Plant (Kg)	% of dry matter in roots
0 (ton/fed.)	without	90.31	14.67	1.004	12.13	81.36	12.13	0.811	11.89
	with	95.71	14.87	1.131	12.47	91.39	12.60	0.973	12.07
5 (ton/fed.)	without	93.73	15.27	1.241	12.89	97.33	13.07	1.132	12.25
	with	99.42	15.60	1.361	13.03	110.13	13.53	1.193	12.46
10 (ton/fed.)	without	108.94	15.80	1.429	13.15	102.56	14.60	1.216	12.46
	with	113.43	15.39	1.499	13.23	109.43	14.80	1.278	12.59
15 (ton/fed.)	without	121.35	16.76	1.531	13.27	109.15	15.20	1.302	12.59
	with	123.47	17.33	1.543	13.35	121.31	15.40	1.389	12.62
20 (ton/fed.)	without	122.66	17.00	1.562	13.33	112.23	15.60	1.391	12.61
	with	123.46	17.60	1.576	13.34	125.03	15.73	1.431	12.64
$L.SD_{(0.05)}$		4.62	2.031	0.167	0.37	4.09	1.06	0.313	NS

Yield and its components:

In respect of yield and its components, data in Table (5) showed clearly that, total yield, number of storage roots /plant, mean root weight and percentage of dry matter in storage roots were affected significantly by organic manure fertilization. The maximum increase was obtained by the rate of 20 ton/fed. for both study seasons. Adding 5, 10, 15 and 20 ton/fed. organic manure/ fed. increased total yield by 13.96, 23.37, 32.93 and 38.05%, respectively in the first season as well as 19.23, 30.73, 37.31 and 39.20%, respectively in the second season compared with the control treatment (zero ton/fed. organic manure) . On the other hand, data in the same table indicated that, addition of bio-fertilizer was effected significantly in total yield and mean root weight and insignificantly in number of storage roots /plant and percentage of dry matter in storage roots for both study seasons.

Data presented in Table (6) cleared that, the effect of interaction between organic manure and bio-fertilizers on yield and its components, data showed that, significant differences between treatments were detected for all parameters. The organic manure at rate 20 ton/fed. was recorded the highest values when the planets received by bio-fertilizer expet total yield in second season. On the other hand, organic manure at rate zero ton/fed. without bio-fertilizer showed the minimum values of all studied trites in both seasons.

The obtained results recorded the closed similarity with those has been claimed by Abd-El-Salam and Shams (2012), Abd-El-Hakeem and Fekry (2014), Shehata *et al.*, (2014). Beneficial effect of organic fertilizer on yield and its contents in expected to improve the physical, chemical conditions of soil and increase clustering. In this connection, the possibility could be provide a substantial modification of physical soil preparation such a bulee density and aeration which of treated solubility, absorption a reliability of nutrients (Tester 1990), and production of hamate is a result of improving the microbial activity, with could possibly exchange for absorbed anions such as phosphate Saker *et al.*, (1992). This might activate the different physiological process which reflected on the increase of number of leaves, leaf area plant, fresh and dry weights of leaves/plants and total yield.

Table 5. Effect of organic manure and bio-fertilizer on yield and its components of sweet potato during 2018 and 2019 seasons.

Characters	First season				Second season			
	Total yield (fed.)	No. of roots /plant	Mean root weight (g)	% of dry matter in roots	Total Yield (fed.)	No. of roots /plant	Mean root weight (g)	% of dry matter in roots
Effect of organic fertilizers								
0 (ton/fed.)	9.497	4.47	132.6	22.48	8.125	3.99	110.6	21.62
5 (ton/fed.)	10.823	5.00	158.1	23.12	9.688	4.57	139.7	22.41
10 (ton/fed.)	11.716	5.54	166.5	24.40	10.622	5.00	158.6	23.80
15 (ton/fed.)	12.790	6.17	171.8	25.26	11.175	6.04	170.4	24.16
20 (ton/fed.)	13.111	7.42	182.7	25.21	11.310	6.00	172.3	24.34
L.SD(0.05)	0.267	1.03	4.7	0.53	0.109	0.35	4.2	0.75
Effect of bio-fertilizers application								
Without	11.381	5.59	158.7	23.96	10.027	4.95	147.7	23.06
with	11.791	5.85	165.9	24.23	10.333	5.28	152.8	23.47
L.SD(0.05)	0.279	NS	5.2	NS	0.212	NS	4.5	0.31

Table 6. Effect of the interaction between organic manure and bio-fertilizer on yield and its components of sweet potato during 2018 and 2019 seasons.

organic fertilizers	bio-fertilizers	Frist season				Second Season			
		Total yield (fed.)	No. of roots /plant	Mean root weight (g)	% of dry matter in roots	Total yield (fed.)	No. of roots /plant	Mean root weight (g)	% of dry matter in roots
0 (ton/fed.)	without	9.363	4.33	121.6	22.31	7.931	3.90	107.9	21.22
	with	9.631	4.60	143.6	22.64	8.318	4.07	113.2	22.01
5 (ton/fed.)	without	10.612	4.93	156.3	23.03	9.462	4.53	136.3	22.13
	with	11.033	5.07	159.9	23.21	9.913	4.60	143.1	22.68
10 (ton/fed.)	without	11.535	5.47	163.1	24.03	10.431	4.93	157.2	23.61
	with	11.896	5.60	169.8	24.77	10.812	5.07	159.9	23.99
15 (ton/fed.)	without	12.403	6.07	170.4	25.21	10.998	5.47	167.4	24.01
	with	13.177	6.27	173.1	25.31	11.316	6.60	173.3	24.31
20 (ton/fed.)	without	13.006	7.13	182.3	25.20	11.313	5.93	169.9	24.31
	With	13.216	7.70	183.1	25.21	11.306	6.07	174.6	24.37
$L.SD_{(0.05)}$		0.299	1.33	9.7	1.47	0.331	0.49	7.1	1.22

Storage roots constituents:

Data tabulated in Table (7) showed that the level of NPK in the storage roots of sweet potato increase with increasing the level of organic manure fertilizer and the results were more significant when 15 and 20 ton/fed. were added to the soil in both seasons. Organic manure fertilizer showed higher effect on increasing the level of NPK in storage roots of compared with (zero organic manure) in both seasons, Moreover data in Table (7) revealed that, the percentage of N in storage roots significantly increased when the plants were fertilized bio-fertilizer in the same time insignificantly effect on the percentage of P and K in storage roots in both seasons.

Table 7. Effect of organic manure and bio-fertilizer on storage roots constituents of sweet potato during 2018 and 2019 seasons.

Characters	Frist season				Second season			
	N%	P%	K%	Protein%	N%	P%	K%	Protein%
Effect of organic fertilizers								
0 (ton/fed.)	1.25	0.220	1.65	7.81	1.08	0.208	1.60	6.75
5 (ton/fed.)	1.42	0.239	1.75	8.88	1.30	0.236	1.66	8.13
10 (ton/fed.)	1.48	0.266	1.89	9.25	1.45	0.289	1.75	9.06
15 (ton/fed.)	1.61	0.323	1.96	10.06	1.57	0.310	1.80	9.81
20 (ton/fed.)	1.71	0.333	1.98	10.69	1.64	0.316	1.84	10.25
$L.SD_{(0.05)}$	0.09	0.025	0.06	0.77	0.08	0.046	0.06	0.58
Effect of bio-fertilizers application								
Without	1.44	0.269	1.83	9.00	1.37	0.27	1.71	8.57
with	1.54	0.275	1.86	9.63	1.44	0.28	1.74	9.00
$L.SD_{(0.05)}$	0.07	NS	NS	0.55	0.06	NS	NS	0.44

The results in Table (8) cleared that, the interaction between the organic manure levels and bio-fertilizer showed the best percentage of N, P and K in storage roots when organic manure at rate 20 ton/fed. with bio-fertilizer addition in both seasons compared by zero organic manure application without bio-fertilizer in two seasons. Similar findings were reported by El-Sawy (2011), AL-Afifi *et al.*,(2016) and Al-Esaily (2017).

Table 8. Effect of the interaction between organic manure and bio-fertilizer on storage roots constituents of sweet potato during 2018 and 2019 seasons.

organic fertilizers	bio-fertilizers	Frist season				Second season			
		N%	P%	K%	Protein%	N%	P%	K%	Protein%
0	without	1.13	0.213	1.63	7.06	1.03	0.203	1.59	6.44
(ton/fed.)	with	1.36	0.226	1.67	8.50	1.13	0.212	1.61	7.06
5	without	1.38	0.236	1.73	8.63	1.23	0.231	1.63	7.69
(ton/fed.)	with	1.46	0.241	1.76	9.13	1.36	0.240	1.69	8.50
10	without	1.43	0.263	1.86	8.94	1.41	0.287	1.73	8.81
(ton/fed.)	with	1.52	0.269	1.91	9.50	1.48	0.291	1.76	9.25
15	without	1.57	0.323	1.93	9.81	1.53	0.307	1.79	9.56
(ton/fed.)	with	1.64	0.333	1.99	10.25	1.60	0.313	1.81	10.00
20	without	1.69	0.328	1.98	10.56	1.63	0.313	1.83	10.19
(ton/fed.)	With	1.73	0.337	1.98	10.81	1.65	0.319	1.84	10.31
L.SD$_{(0.05)}$		0.21	NS	NS	1.31	0..17	NS	NS	1.07

Damage in leaves and storage roots of sweet potato caused by insect infestation:

Data demonstrated in Table (9) indicated that, the effect of organic manure addition (0, 5, 10, 15 and 20 ton/fed), the effect of add Bio-fertilizer to organic manure or not and the interaction between two adds on leaf defoliator according to the formula of Kasopers (1965).

Table 9. Effect of organic manure levels and bio-fertilizes on damage percentage duo to pest infestations of leaves and storage roots in sweet potato plants, in 2018 and 2019 seasons.

Period	Organic manure	First season				Second season			
		Bio-fertilizer		Mean	LSD	Bio-fertilizer		Mean	LSD
		without	With			without	With		
early season infestation	0 ton/fed.	0.2082 b	0.2100 b	0.2091 B	0.01277	0.2181 b	0.2131 b	0.2156 B	0.01286
	5 ton/fed.	0.1773 c	0.1741 c	0.1757 C		0.1823 cd	0.1810 d	0.1816 D	
	10(ton/fed.	0.1782 c	0.1810 c	0.1796 C		0.1828 cd	0.1855 cd	0.1841 D	
	15 ton/fed.	0.1923 bc	0.2023 b	0.1973 B		0.1941 cd	0.2009 bc	0.1975 C	
	20 ton/fed.	0.2617 a	0.2612 a	0.2614 A		0.2571 a	0.2621 a	0.2596 A	
	mean	0.2029 A	0.2063 A	LSD for interaction= 0.01883		0.2069 A	0.2085 A	LSD for interaction=	
	LSD	NS				NS		0.01879	
Late season infestation	0 ton/fed.	0.4372 c	0.4145 d	0.4259 B	0.04068	0.4662 c	0.4435 d	0.4549 B	0.04072
	5 ton/fed.	0.3261 efg	0.2961 h	0.3111 C		0.3551 efg	0.3252 h	0.3401 C	
	10(ton/fed.	0.3197 fg	0.3125 gh	0.3161 C		0.3488 fg	0.3415 gh	0.3451 C	
	15 ton/fed.	0.3401 e	0.3383 ef	0.3392 C		0.3692 e	0.3674 ef	0.3683 C	
	20 ton/fed.	0.5134 a	0.4943 b	0.5038 A		0.5424 a	0.5234 b	0.5329 A	
	mean	0.3873 A	0.3711 A	LSD for interaction= 0.01882		0.4163 A	0.4002 A	LSD for interaction=	
	LSD	NS				NS		0.01877	
Pre-harvest season infestation	0 ton/fed.	0.5061 b	0.4653 c	0.4857 B	0.05745	0.4993 b	0.4585 c	0.4789 B	0.05753
	5 ton/fed.	0.4177 d	0.4218 d	0.4197 C		0.4109 d	0.4150 d	0.4129 C	
	10(ton/fed.	0.3810 e	0.3796 e	0.3803 C		0.3741 e	0.3728 e	0.3735 C	
	15 ton/fed.	0.4150 d	0.4095 d	0.4123 C		0.4082 d	0.4027 d	0.4054 C	
	20 ton/fed.	0.6000 a	0.6082 a	0.6041 A		0.5932 a	0.6013 a	0.5973 A	
	mean	0.4640 A	0.4569 A	LSD for interaction= 0.01901		0.4571 A	0.4501 A	LSD for interaction=	
	LSD	NS				NS		0.0189	
mean season infestation	0 ton/fed.	0.3489 b	0.3341 b	0.3415 B	0.01286	0.3646 b	0.3470 b	0.3558 B	0.01259
	5 ton/fed.	0.2741 cd	0.2632 d	0.2686 D		0.2890 cde	0.2762 e	0.2826 D	
	10(ton/fed.	0.2678 d	0.2657 d	0.2668 D		0.2812 de	0.2791 e	0.2802 D	
	15 ton/fed.	0.2875 c	0.2902 c	0.2888 C		0.2997 cd	0.3011 c	0.3004 C	
	20 ton/fed.	0.4179 a	0.4107 a	0.4143 A		0.4274 a	0.4226 a	0.4250 A	
	mean	0.3192 A	0.3128 A	LSD for interaction= 0.0189		0.3324 A	0.3252 A	LSD for interaction=	
	LSD	NS				NS		0.01885	
root infestation	0 ton/fed.	0.4080 c	0.3800 d	0.3940 B	0.04068	0.2947 e	0.3227 d	0.3087 B	0.05753
	5 ton/fed.	0.3587 ef	0.3707 de	0.3647 B		0.3573 c	0.3680 c	0.3627 B	
	10(ton/fed.	0.3707 de	0.3507 f	0.3607 B		0.3360 d	0.3280 d	0.3320 B	
	15 ton/fed.	0.3707 de	0.3560 ef	0.3633 B		0.3627 c	0.3680 c	0.3653 B	
	20 ton/fed.	0.5427 a	0.4920 b	0.5173 A		0.5760 a	0.4733 b	0.5247 A	
	mean	0.4101 A	0.3899 A	LSD for interaction= 0.01879		0.3853 A	0.3720 A	LSD for interaction=	
	LSD	NS				NS		0.01884	

Data show significant differences between rates of damage in leaves and roots affecting by organic manures rates, as the rate of 20 ton/fed of organic manure caused the highest damage rate insignificantly differ with the other rates for leave damage in all plant development stages and also the same trend was observed in tuber damage in both study seasons. Also it was observed that, zero organic manure treatments were came in the second significant level with significant differences with other treatments for leave damage and insignificantly for roots damage in both study seasons. However, Bio-fertilizer has no significant effect in damage rates of leaves in all plant development stages or root tubers in both study seasons.

As for interaction between organic manure levels and Bio-fertilizer addition, data in Table (9) indicated that, organic manure at rate of 20 ton/fed was recorded the highest damage rates with significant differences with other treatments except adding bio-fertilizer to the same level for early season, pre-harvest and mean season. In late season and damage storage roots, the addition of bio-fertilizer to organic manure reduced the damage rates significantly in most organic manure levels.

Leave damage can resulted in many leave defoliators, which were mentioned in survey studies in worldwide including Egypt. In earlier study, Hendawy et al., (2017) was surveyed four lepidopteran pests attack sweet potato, Agrius convolculi (L.), S. littoralis, A. gamma and S. exigua, these pests can cause leaf defoliation in sweet potato. Ames, et al. (1996) found that S. litura, and gryllotalpids as the major damaging pests in sweet potato fields for leaves and roots respectively.

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تأثير التسميد العضوي والحيوي علي جودة المحصول والإصابة بالحشرات على نباتات البطاطا فى صعيد مصر

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أجريت هذه الدراسة خلال موسمي صيف عام ٢٠١٨-٢٠١٩ بمزرعة خاصة بمحافظة سوهاج (أراضي حديثة الاستصلاح) لدراسة تأثير التسميد العضوي والحيوي على النمو والمحصول ومكوناته ومعدل الإصابة الحشرية لاوراق وجذور البطاطا، وقد استخدمت خمس معدلات من التسميد العضوي وهي ٠ و ٥ و١٠ و ١٥ و٢٠ طن/فدان مع أو بدون إضافة المخصب الحيوي بيوجين . وقد أوضحت النتائج المتحصل عليها من هذه الدراسة ان المعدلات المختلفة من التسميد العضوي كان لها تأثيرًا معنويًا على صفات النمو الخضري مثل طول النبات وعدد ووزن الأفرع الطازجة مع زيادة معدلات التسميد العضوي حتى ٢٠ طن للفدان وكذلك صفات المحصول وعدد الجذور لكل نبات ومتوسط وزن الجذر ومحتوى الجذور من المادة الجافة أيضا محتوى الجذور من النتروجين والفسفور والبوتاسيوم وكذلك البروتين مقارنة بعدم اضافة السماد العضوي والسماد الحيوى التى سجلت اقل القيم لكل الصفات التى درست في كلا موسمي الدراسة . كما تأثرت الإصابات الحشرية سواء تلك التي علي الاوراق او تلك التي سببت اصابة للجذور الدرنية حيث كان أعلي معدل اصابة للأوراق أو الدرنات عند التسميد العضوي بأعلي معدل تسميد عضوي (٢٠ طن/فدان) بينما حققت معدلات ١٠ و١٥ طن للفدان اقل اصابة للاوراق بالنسبة لمتوسط الموسم في حين أن جميع المعاملات بالنسبة لاصابة الجذور لم تسجل فروق معنوية لمعدلات التسميد الاقل من ٢٠ طن/فدان لكلا موسمي الدراسة . وقد أظهرت إضافة المخصب الحيوي بيوجين زيادة إيجابية لمعظم الصفات المدروسة خاصة كمية المحصول والنسبة المئوية للمادة الجافة للجذور ومحتوى الجذور من النيتروجين والبروتين، في حين لم يكن لإضافة التسميد الحيوي بيوجين تأثيرمعنوي على صفة عدد الأفرع وعدد الدرنات لكل نبات ومحتوى الجذور من عنصري الفوسفور والبوتاسيوم. وعلي الجانب الاخر, لم يكن هناك فروق معنوية نتيجة اضافة المخصب الحيوي بالنسبة لمعدل الاصابات الحشرية لكلا من الاوراق او الجذور . ومن دراسة التفاعل بين معدلات التسميد العضوي والمخصب الحيوي أعطت المعاملة التي استخدم فيها معدل ٢٠ طن/فدان سماد عضوي مع المخصب الحيوي أعلى القيم لكل الصفات محل الدراسة معدا صفة المحصول فى الموسم الثانى التى أعطى فيها السماد العضوي بمعدل ١٥طن/فدان أعلى قيمة لهذه الصفة مع السماد الحيوى فى الوقت الذى سجلت فيه نباتات البطاطا اقل القيم عند عدم اضافة السماد البلدى والمخصب الحيوى .