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RESPONSE OF POTATO (*Solanum tuberosum* L.) GROWTH, YIELD AND STORABILITY TO SOME ORGANIC MANURE RATES AND FOLIAR SPRAY OF SOME MACRONUTRIENTS: 1-VEGETATIVE GROWTH, YIELD AND YIELD COMPONENTS

EL-Sayed, Hala A.[*] ; A. H. A. El-Morsy[**] and H. M. B. EL-Metwally [**]
*** Veg. and Flori. Dept., Fac. of Agric., Mans. Univ., Egypt.**
**** Veg. Res. Dept., Hort. Res. Inst., Agric. Res. Center, Giza, Egypt.**

ABSTRACT

Two field experiments were conducted on potato (*Solanum tuberosum* L.) Spunta cv plants during the winter seasons of 2008/2009 and 2009/2010 at Kafre Meet Faris village near El-Mansoura, Dakahlia Governorate, Egypt, to study the effect of organic fertilizer rates (20, 30 and 40 m^3/fed) and some inorganic fertilizers (NPK) levels (100%, 75% and 50% from recommended dose), either alone or in combination with foliar spray with some macronutrients sources (Hi-Fertil 1 and Ferty More) on the plant growth, yield, and yield components.

The results showed that the plants fertilized with 40 m^3/fed. farmyard manure (FYM) followed by 30 m^3/fed. significantly increased plant stem length, number of leaves/plant, leaf area/plant and foliage dry weight/plant as well as average of tubers weight/plant and total yield.

Increasing the supplied NPK level up to 100% from recommended level caused significant increases in the most vegetative growth parameters.Also, tubers weight/plant, marketable yield and total yield were increased significantly.

Also, the results indicated that the plants sprayed with Hi-Fertil 1(19-19-19, NPK), had a significant effect in most vegetative growth parameters while, plants sprayed with Ferty More (5-3-43, NPK) resulted in significant increases in foliage dry weight/plant, tubers weight/plant, marketable yield and total yield.

In general, the best results were obtained by using 40 m^3 FYM, 50% NPK level and foliar spray with Ferty More (5-3-43, NPK) followed by the interaction among 40 m^3 FYM, 50% NPK level and foliar spray with Hi-Fertil 1(19-19-19, NPK). These treatments achieved increases in tubers weight/plant total yield and marketable yield as well as decreasing unmarketable yield. Therefore, these treatments could be recommended for raising productivity, improving quality of potato and will also decrease the pollution of environment under the conditions of El-Dakahlia Governorate.

Keywords: Potato, *Solanum tuberosum*, organic farming, farmyard manure, FYM, mineral fertilizers, NPK, foliar application, foliar fertilization, vegetative growth, yield.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is a major world food crop. Potato is exceeded only by wheat, rice, and maize in world production for human consumption. In Egypt, it has been generally cultivated for both local consumption and export.

Therefore, increasing potato yield and improving tuber quality are essential aims for both growers and consumers, but it usually depends on many factors especially that influence the plant growth throughout the growth period. Nitrogen, phosphorus and potassium nutrition are three of major factors affecting growth, yield and quality of potato. However, there are some problems which prevent the farmers to use sufficient amounts of nitrogen phosphorus and potassium, such as nutritional requirements of potato plants are quite high, the continuous increases in the costs of using chemical fertilizers and environment pollution problems.

Therefore, it has become essential using safe substitute or supplements for chemical fertilizers, reduce the costs of produced yield and environmental pollution as well as increase production and improve quality of potato. One of the ways is to use organic manures as a source of essential nutrients, increased nutrient supply and improved the efficiency of macronutrients as well as its ability to meet some micronutrients requirements such as Fe, Zn, Mn and Cu which were reflected on plant uptake and plant growth, in addition to positive effect on the environment and public health (Kolbe *et al*., 1995; EL-Nagar,1996). Several investigators reported that potato plants growth, yield and its quality as well as N, P, K, Fe, Zn, and Mn content in the plant tubers were affected by organic fertilization. In this respect, Abou-Hussein (1995), Abdel-Ati (1998), Arisha and Bardisi (1999); Abou-Hussein *et al.* (2002a and b), Awad *et al.* (2002) and Abd El-Kader (2002). Abou-Hussein *et al.* (2003) indicated that applying cattle manure combined with chicken manure increased tuber dry matter, total carbohydrates, specific gratify and potato tuber yield. In the same manner, Radwan and Tawfik (2004) reported that organic fertilization improved plant growth characters, yield and its quality and the content of Fe in potato tuber, El-Kassas *et al.* (2005) and El-Morsy *et al.* (2006) found that using chicken manure increased all vegetative growth characters, number of tubers/plant, average tuber weight, total tuber yield and chemical constituents in tubers.

Also, it is notable that, the other way is use the foliar fertilization. The foliar application is more economical than root fertilization due to the efficiency and lower cost. It is usually preferred because very small amounts of fertilizers are applied per feddan. It also reduces the number of passes of the applicant thereby reducing problem of soil compactness as well as less likely to result in ground water pollution. Foliar application of nitrogen (N), phosphorus (P) and potassium (K) maintains leaf nutrition in photosynthesis, enhances N, P and K content, carbon (C) balance and self-destructive mechanisms that have resulted in higher yields in crop plants (Boote *et al*., 1978), Increasing the yield due to foliar nutrient in different crops has been well documented previously (Singh *et al*., 1996 and Ali and Mishra, 2001).

Therefore, the main objective of the present study is to evaluate the effect of organic manure (FYM) rates, some inorganic NPK fertilizers levels, either alone or in combination with some sources of macronutrients foliar spray on the plant growth, yield and its components of potato plants under the conditions of El-Dakahlia Governorate.

MATERIALS AND METHODS

In two field trials, potato (*Solanum tuberosum* L.) Spunta cv plants were grown in clay soil during the two winter seasons of 2008/2009 and 2009/2010 at Kafr Meet Faris village near El-Mansoura, Dakahlia Governorate, Egypt, to study the effect of farmyard manure (FYM) rates and some inorganic fertilizers (NPK) levels, either alone or in combination with some sources of macronutrients foliar spray on the plant growth, yield and its components of potato plants. Tuber seeds were planted on 17th and 19th of October in the first and the second seasons, respectively.

Randomized samples were obtained from the experiment soil before the application of organic and chemical fertilization in both seasons of this study to determine the physical and chemical contents according to the standard method described by Jackson (1973). The obtained results are presented in Table (1).

Table (1): Physical and chemical analysis of the experimental soil.

Seasons	Physical properties (%)				Chemical properties					
	Clay	Silt	Fine sand	Coarse sand	Texture	O.M (%)	Total N (%)	Avail P (ppm)	Exch. K (ppm)	pH (1:2.5 w/v)
2008/2009	49.71	25.73	23.00	1.56	clay	1.90	0.13	7.15	215.00	7.90
2009/2010	49.93	25.88	22.47	1.72	clay	2.10	0.14	7.95	229.00	8.02

The experimental design was split-split plots in a randomized block design with three replicates. Organic fertilizer rates occupied the main plots which were subdivided to 4 sub plots each contained one of the mineral nutrients (NPK) levels, while, the foliar spray treatments with macronutrients were occupied the sub-sub plot. The sub-sub plot area was 17.5 m^2 (1/400 fed.) which contained 5 rows, each 5 m long and 0.7m width. The experiment included 27 treatments which were the combination among 3 rates of farmyard manure fertilizer (FYM), 3 levels of mineral nutrients (NPK) and 3 treatments of foliar spray of macronutrients including control treatment as follows:

Organic manure rates (main plots):

1- 20 m^3/fed. FYM (Control treatment).
2- 30 m^3/fed. FYM.
3- 40 m^3/fed. FYM.

Organic manure rates were distributed, spreaded and thoroughly mixed with the surface soil layer (0 - 20 cm) at preparing the soil before planting. The farmyard manure (FYM) used analysis was shown in Table (2) as follows:

Table (2): Chemical analysis of farmyard manure (FYM).

Macroelements (%)			Microelements (ppm)		
N	**P**	**K**	**Fe**	**Zn**	**Mn**
1.580	0.553	1.625	346	210	185

According to methods of (Jackson, 1973).

Mineral Fertilizers (NPK) levels (sub plots):

1- 100% NPK from recommended dose (180 Kg N + 75 Kg P_2O_5 + 96 Kg K_2O/fed.).
2- 75 % NPK from recommended dose (135 Kg N + 56.25 Kg P_2O_5 + 72 Kg K_2O/fed.).
3- 50 % NPK from recommended dose (90 Kg N + 37.5 Kg P_2O_5 – 48 Kg K_2O/Fed.).

Nitrogen was applied in the form of ordinary ammonium nitrate (33.5%N), phosphorus was applied in the form of calcium superphosphate (15.5% P_2O_5), and potassium was applied in the form of potassium sulphate (48% K_2O).

Ammonium nitrate and superphosphate were divided and applied at two equal doses with the first and second irrigation and potassium sulfate was added at two times before second and third irrigation.

Macronutrients foliar spray sources (sub-sub plots):

1- Control (untreated with macronutrients)
2- Hi-Fertil 1 (19-19-19, NPK).
3- Ferty More (5-3-43, NPK).

Hi-Fertil 1 and Ferty More were supplied as a foliar application at 45, 55 and 65 days after planting in the rate of 3 g/L. The control treatment was sprayed with tap water.

Hi-Fertil 1 and Ferty More are a commercial fertilizers locally produced by Egyptian Fertilizer development center, AL DELTA for fertilizer and chemicals industry, Egypt.

The other cultural practices were applied according to the instructions laid down by the Ministry of Agriculture, Egypt.

Data recorded and statistical analysis:

Vegetative growth characteristics:

A random sample of three potato plants were taken from each plot at 90 days after planting (DAP) to estimate the plant stem length, number of leaves/plant, leaf area/plant (according to the method of Koller, 1972), foliage fresh weight/plant and foliage dry weight/plant.

Yield and its components:

At harvest time, 105 days after planting (DAP), all tubers of plants of each sub-sub plots were dig up, weighted in kg and converted to total yield (tons/fed), graded to three classes according to tuber diameter, <30 mm, 30-60 mm, and >60 mm, then each grade was weighted separtely. Marketable yield including good shapes healthy tubers which from 30-60 mm and >60 mm, while, unmarketable yield of culls (offshape, blemished, green and diseased) and <30 mm in diameter. Also, average of tubers weight/plant was measured.

All data were subjected to the statistical analysis and means were compared using new L.S.D according to (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Plant growth characteristics:

Data presented in Table (3) show that stem length, number of leaves per plant, Leaf area and foliage fresh and dry weight were increased significantly with increasing FYM rates up to 40 m^3/fed in both seasons. These increases in all plant growth parameters may be related to the higher contents of macro-elements (NPK) in FYM (Table 2) and this led to an increase of the metabolism activity and consequently increasing of plant growth. These results are in agreement with those of Karadogan (1996), Abou-Hussein *et al.* (2002 b) Singh and Kushwah (2006). El-Sirafy *et al.* (2008) reported that plant vegetative growth parameters expressed as plant height, number of leaves, foliage fresh and dry weight were increased with increasing FYM rate.

Table (3): Vegetative growth characters as affected by FYM rates, NPK levels and macronutrients foliar spray sources during 2008/2009 (S1) and 2009/2010 (S2) winter seasons.

Characters	Stem length/plant (cm)		Number of leaves / plant		Leaf area (m^2)		Plant fresh weight (g)		Plant dry weight (g)	
Treatments	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
FYM rates:										
٢٠m^3	55.63	٥٧.٢٢	١٨.٦٣	١٩.٤٤	٠.٣٣	٠.٣٥	٢٢٧.٤٨	٢٢٨.٠٧	٢٥.٨١	٢٥.٣٣
3٠m^3	٦٠.٣٧	٦٠.٢٢	٢١.٤٤	٢٢.٣٧	٠.٣٥	٠.٣٧	٢٥٣.٢٢	٢٥٥.٧٤	٣٢.٥٢	٣٠.٤٨
4٠m^3	٦٣.٨٩	٦٢.٦٣	٢٣.٧٨	٢٤.٤١	٠.٣٨	٠.٣٩	٢٨٠.٧٨	٢٨٢.٠٧	٣٦.٥٦	٣٦.٢٢
LSD 5%	١.٦١	١.٨٥	١.٣٧	١.٠٩	٠.٠١	٠.٠١	٣.٨٩	٥.٤٩	٠.٢٣	٠.٢٨
NPK levels:										
١٠٠%	٦٢.٨١	٦٤.٤١	23.26	٢٤.١١	٠.٣٨	٠.٣٨	٢٧٦.٨٩	٢٧٢.١٩	٣٠.١٥	٢٨.٧٤
٧٥%	٥٩.٣٧	٥٩.٨٥	٢٠.٧٠	٢١.٧٠	٠.٣٥	٠.٣٦	٢٤٩.٠٠	٢٥٤.١١	٣١.٨٩	٣١.١٥
50%	٥٧.٧٠	٥٥.٨١	١٩.٨٩	٢٠.٤١	٠.٣٤	٠.٣٤	٢٣٥.٥٩	٢٣٩.٥٩	٣٢.٨٥	٣٢.١٥
LSD 5%	١.٧٩	١.٣٧	٠.٨٦	١.٠٦	٠.٠٠٤	٠.٠١	٢.٧٣	٢.٨٠	٠.٣٢	٠.٢٥
Foliar spray sources:										
Control	٥١.٨٥	٥٢.٥٢	١٨.٤١	١٨.٥٦	٠.٣٠	٠.٣٦	٢١١.٩٦	٢٠٤.٤٤	٢٦.١٩	٢٦.٧٨
Hi-Fertil 1	٦٧.٧٨	٦٨.٦٧	٢٤.٤٨	٢٥.٢٦	٠.٤١	٠.٤٢	٢٩٦.٩٣	٣٠٩.٧٨	٣١.٨٥	٣١.٠٠
Ferty More	٦٠.٢٦	٥٨.٨٩	٢٠.٩٦	٢٢.٤١	٠.٣٥	٠.٣٢	٢٥٢.٥٩	٢٥١.٦٧	٣٦.٨٥	٣٤.٢٦
LSD at 5%	١.٢٤	١.٠٧	٠.٦٥	٠.٦٢	٠.٠١	٠.٠١	٢.٣٩	٢.٦٣	٠.٣٥	٠.٢٣

As regard to the effect of NPK levels on vegetative growth, data in Table (3) indicated that increasing NPK level up to level one 100% NPK (180+75+96 unit/fed) recorded the highest values in plant height, number of leaves/plant, leaf area/plant and foliage fresh weight/plant in both seasons. While, the foliage dry weight/plant was reduced at plants received 100% NPK. These results may be related to the vital role of nitrogen, phosphorus and potassium nutrition as the major factors affecting growth such as nitrogen is a main constituent of many organic compounds in plants, phosphorus plays an important role in accumulation and release of energy during cellular metabolism and potassium plays a vital role for a normal cell division of plants (Gardener *et al*., 1985; Marschner, 1995 and Black, 1973). Several

investigators reported that, plant height, number of main stems, fresh and dry weight of plant foliage were significantly increased with increasing NPK level (Jasiwal, 1995; Rabie, 1996; Arisha and Bardisi, 1999; Sarhan *et al.,* 2004; Al-Moshileh and Moftah, 2005 and Abd El–Aal *et al.,* 2008).

Concerning the effect of foliar spray (NPK) on vegetative growth, data presented in Table (3) indicated that plant height, number of leaves/plant, leaf area/plant and foliage fresh and dry weight/plant significantly increased at the plants sprayed with Hi-Fertil 1 (19-19-19 NPK) in both seasons of study. These results may be related to the fact that these elements which can be readily absorbed by the leaves as a result of foliar spraying application and not lost through fixation, decomposition or leaching under unfavorable soils conditions (Doeing, 1986). Similar results were found by Joudu *et al.* (2001), Ayyub *et al.* (2006) and Al-Betar and Abdou (2010).

With respect to the effect of interaction between FYM rates and NPK levels, data presented in Table (4) showed that potato plants fertilized with 40 m^3 FYM rate and 100% NPK level resulted in the highest significant number of leaves/plant in both seasons, but, these increases in leaf area and plant fresh weight were significant in the first season only. On the other hand, the highest foliage dry weight/plant was obtained from plants received 50% NPK followed by 75% NPK under 40 m^3 FYM rate in both seasons. It is notable that, there were no significant differences between plant dry weight values when plants received 50% NPK or 75% NPK levels under application of 30 m^3 or 40 m^3 FYM rates in both seasons. In this respect, Abd El–Kader (2002) reported that potato plants fertilized with 30 m^3/fed farmyard manure and NPK level (90–85–170 kg/fed) resulted in the highest significant plant height, number of leaves/plant, foliage fresh weight/plant foliage dry weight/plant and leaf area/plant. Same results reported by Borin *et al.* (1987) Dorobantu *et al.* (1989) and El-Banna and Abd El-Salam (2000).

Also, data presented in Table (4) show that the interaction between FYM rates and foliar spray (NPK) had a positive significant effects on plant fresh weight and foliage dry weight/plant in both seasons. While, plant stem length and leaf area were affect significantly in the first season only and number of leaves/plant was affected in second season only. Data indicated also, plants treated by Hi-Fertil 1 as a macronutrient foliar spray source and fertilized with 40 m^3 FYM/fed gave the highest values of vegetative growth parameters followed by the same foliar spray source with 30 m^3 FYM/fed. in both seasons.

Regarding, the effect of interaction between NPK levels and foliar spray NPK on vegetative growth parameters, data in Table (4) indicated that this interaction had a positive significant effects on number of leaves/plant, plant fresh weight and plant dry weight in both seasons. While, the plant stem length was affected in the first season only. On the other hand, results also indicated that the highest record in plant dry weight was obtained from plants sprayed with Ferty More (5-3-43, NPK) and fertilized with 50% or 75% NPK levels in both seasons.

Table (4): Vegetative growth characters as affected by the interactions of FYM rates x NPK levels, FYM x macronutrients foliar spray sources and NPK levels x Foliar sources during 2008/2009 (S1) and 2009/2010 (S2) winter seasons.

Characters		Stem length/plant (cm)		Number of leaves / plant		Leaf area (M^2)		Plant fresh weight (g)		Plant dry weight (g)	
Treatments		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
FYM rates	NPK levels										
٢٠ m^3	100%	57.56	62.56	19.33	20.33	0.35	0.36	248.78	242.89	27.11	26.56
	75%	55.33	57.00	18.56	19.33	0.32	0.35	224.22	227.67	25.78	25.11
	50%	54.00	52.11	18.00	18.67	0.32	0.33	209.44	213.67	24.56	24.33
30 m^3	100%	63.67	64.44	24.11	24.67	0.38	0.39	271.11	273.67	30.33	27.89
	75%	59.44	60.00	20.44	21.44	0.35	0.36	251.89	254.56	32.67	30.89
	50%	58.00	56.22	19.78	21.00	0.34	0.35	236.67	239.00	34.56	32.67
40 m^3	100%	67.22	66.22	26.33	27.33	0.41	0.41	310.78	300.00	33.00	31.78
	75%	63.33	62.56	23.11	24.33	0.38	0.38	270.89	280.11	37.22	37.44
	50%	61.11	59.11	21.89	21.56	0.35	0.36	260.67	266.11	39.44	39.44
LSD 5%		N.S	N.S	2.78	3.18	0.02	N.S	16.01	N.S	6.78	7.51
FYM	Foliar spray sources										
٢٠ m^3	Control	49.44	50.11	16.22	17.56	0.27	0.29	181.67	179.78	21.67	23.11
	Hi-Fertil 1	62.44	65.33	21.67	21.78	0.40	0.40	269.00	285.00	24.44	24.33
	Ferty More	55.00	56.22	18.00	19.00	0.33	0.34	231.78	219.44	31.33	28.56
30 m^3	Control	53.89	51.78	18.22	18.44	0.31	0.32	214.67	207.89	27.00	26.56
	Hi-Fertil 1	67.89	69.78	24.56	25.67	0.41	0.42	291.11	302.33	32.89	31.33
	Ferty More	59.33	59.11	21.56	23.00	0.36	0.36	253.89	257.00	37.67	33.56
40 m^3	Control	52.22	55.67	20.78	19.67	0.33	0.34	239.56	225.67	29.89	30.67
	Hi-Fertil 1	73.00	70.89	27.22	28.33	0.43	0.43	330.67	342.00	38.22	37.33
	Ferty More	66.44	61.33	23.33	25.22	0.37	0.38	272.11	278.56	41.56	40.67
LSD 5%		7.79	N.S	N.S	3.66	0.03	N.S	19.88	19.93	4.05	4.38
NPK	Foliar spray sources										
100%	Control	53.56	56.33	19.33	19.78	0.33	0.34	226.11	218.33	25.00	26.00
	Hi-Fertil 1	71.22	73.56	27.11	28.00	0.43	0.43	335.44	338.78	29.56	28.33
	Ferty More	63.69	63.33	23.33	24.56	0.38	0.39	269.11	259.44	35.89	31.89
75%	Control	51.33	52.44	18.22	17.89	0.30	0.32	21011	205.22	26.22	26.89
	Hi-Fertil 1	68.22	68.44	23.78	25.00	0.41	0.42	285.89	304.89	32.44	31.67
	Ferty More	58.56	58.67	20.11	22.22	0.35	0.36	251.00	252.22	37.00	34.89
50%	Control	50.67	48.78	17.67	18.00	0.28	0.29	199.67	189.78	27.33	27.44
	Hi-Fertil 1	63.89	64.00	22.56	22.78	0.39	0.40	269.44	285.67	33.56	33.00
	Ferty More	58.56	54.67	19.44	20.44	0.34	0.35	237.67	243.33	37.67	36.00
LSD 5%		4.16	N.S	2.34	2.60	N.S	N.S	33.66	28.15	1.81	2.59

Concerning the interaction effect of the studied factors (organic manure (FYM), NPK levels and NPK foliar fertilization) on vegetative growth, data in Table (5) reveal that the highest values in the most vegetative growth parameters were obtained from plants fertilized by 40 m^3/fed FYM, 100% NPK level and sprayed with Hi-Fertil 1 (19-19-19 NPK). On the other hand, the interaction among 30 m^3/fed FYM, 100% NPK level and Ferty More (5-3-43 NPK) gave the highest values in plant dry weight as compared with other interactions in both seasons.

Table (5): Vegetative growth characters as affected by the interaction among FYM rates, NPK levels and macronutrients foliar spray sources during 2008/2009 (S1) and 2009/2010 (S2) winter seasons.

Characters / Treatments			Stem length/plant (cm)		Number of leaves / plant		Leaf area (M^2)		Plant fresh weight (g)		Plant dry weight (g)	
			S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
FYM	NPK	Foliar spray sources										
20 m^3	١٠٠%	Control	٥٠.٣٣	٥٧.٣٣	١٦.٣٣	١٨.٦٧	0.29	0.30	٢٠٤.٣٣	١٩٣.٦٧	22.33	24.00
		Hi-Fertil 1	63.67	68.67	22.33	22.67	0.41	0.42	295.67	303.00	26.00	25.67
		Ferty More	58.67	61.67	19.33	19.67	0.36	0.37	246.33	232.00	33.00	30.00
	75%	Control	50.00	50.00	17.00	17.67	0.27	0.31	175.67	179.00	21.33	23.00
		Hi-Fertil 1	62.67	66.33	21.33	21.67	0.40	0.40	268.67	285.33	24.67	24.00
		Ferty More	53.33	54.67	17.33	18.67	0.32	0.33	228.33	218.67	31.33	28.33
	50%	Control	48.00	43.00	15.33	16.33	0.25	0.26	165.00	166.67	21.33	22.33
		Hi-Fertil 1	61.00	61.00	21.33	21.00	0.39	0.39	242.67	266.67	22.67	23.33
		Ferty More	53.00	52.33	17.33	18.67	0.31	0.33	220.67	207.67	29.67	27.33
30 m^3	١٠٠%	Control	٥٧.٦٧	٥٤.٣٣	١٩.٦٧	١٩.٣٣	٠.٣٤	٠.٣٥	٢٢٢.٦٧	٢٢٥.٠٠	٢٥.٣٣	٢٥.٠٠
		Hi-Fertil 1	71.33	75.00	28.00	29.00	0.43	0.43	320.00	331.33	30.33	27.00
		Ferty More	62.00	64.00	24.67	25.67	0.38	0.39	270.67	264.67	35.33	30.67
	75%	Control	51.67	50.33	17.33	17.33	0.30	0.31	220.67	208.00	27.33	26.67
		Hi-Fertil 1	70.00	69.33	23.67	24.33	0.40	0.41	282.33	296.00	32.67	32.00
		Ferty More	56.67	60.33	20.33	22.67	0.35	0.36	252.67	259.67	38.00	34.00
	50%	Control	52.33	50.67	17.67	18.67	0.29	0.30	200.67	190.67	28.33	28.00
		Hi-Fertil 1	62.33	65.00	22.00	23.67	0.40	0.40	271.00	279.67	35.67	34.00
		Ferty More	59.33	63.00	19.667	20.67	0.34	0.35	238.33	246.67	39.67	36.00
40 m^3	١٠٠%	Control	٥٢.٦٧	٦٧.٣٣	٢٢.٠٠	٢١.٣٣	٠.٣٧	٠.٣٨	٢٥١.٣٣	٢٣٦.٣٣	٢٧.٣٣	٢٧.٠٠
		Hi-Fertil 1	78.67	77.00	31.00	32.33	0.46	0.45	390.67	382.00	32.33	31.33
		Ferty More	70.33	64.33	26.00	28.33	0.40	0.40	290.33	281.67	39.33	35.00
	75%	Control	52.33	57.00	20.33	18.67	0.32	0.33	234.00	228.67	30.00	31.00
		Hi-Fertil 1	72.00	69.67	26.33	29.00	0.43	0.44	306.67	333.33	40.00	39.00
		Ferty More	65.67	61.00	22.67	25.33	0.37	0.38	272.00	278.33	41.67	42.33
	50%	Control	51.67	52.67	20.00	19.00	0.30	0.31	233.33	212.00	32.33	32.00
		Hi-Fertil 1	68.33	66.00	24.33	23.67	0.40	0.41	294.67	310.67	42.33	41.67
		Ferty More	63.33	58.67	21.33	22.00	0.36	0.37	254.00	275.67	43.67	44.67
LSD at 5 %			٦.١٦	٧.٢٩	N.S	٣.٣٢	N.S	N.S	٣٢.٧٣	٢٢.١٥	٣.٤١	٣.٤٣

Yield and its components:

Data presented in Table (6) indicated that tuber weight/plant, marketable yield and total yield were increased significantly by application of FYM at 40 m^3/fed. in both seasons. These increases may be related to the higher contents of macro-elements (NPK) in FYM (Table 2) and this led to an increase of the metabolism activity, its led to increasing of plant growth (Table 3) consequently, increasing total yield. Suresh and Ramanathan (2001), Awad *et al.* (2002), Singh and Gupta (2005), Colla *et al.* (2005), El Morsy *et al.* (2006) and El-Dissoky (2008) reported that number of tuber plant, average tuber weight, marketable and total yield were significantly increased by application of farmyard manure.

Concerning the effect of NPK levels on yield and its components, data in Table (6) show that increasing NPK level up to 100% NPK level, recorded the highest values in total yield and its components in both seasons. Similar

results were obtained by Maier *et al*. (1994), Minhas and Sood (1994), Arisha and Bardisi (1999), Kushwah and Banafar (2003) and Abd El-Aal *et al.* (2008) indicated that the potato yield was increased with increasing NPK rate.

Regarding, the effect of macronutrients foliar spray sources on total yield and its components, data in Table (6) indicate that plants sprayed with Ferty More (5-3-43, NPK) followed by Hi-Fertil 1(19-19-19 NPK) produced the highest tubers yield/plant, marketable and total yield/fed. in both seasons of study. These results may be related to increasing the activity of plant metabolism, which reflected on tubers yield and enhance tuber quality. Similarly, Boliglowa and Dzienia (1999), Singh *et al.* (1996) and Ali and Mishra (2001) found that marketable tubers yield and total yield were significantly increased by foliar application of macronutrients.

Table (6): Total yield and its components of potato plants as affected by FYM rates, NPK levels and macronutrients foliar spray sources during 2008/2009 (S1) and 2009/2010 (S2) winter seasons.

Characters / Treatments	Tubers weight/plant (g)		Marketable yield (ton/fed.)		Unmarketable yield (ton/fed.)		Total yield (ton/fed.)	
	S1	S2	S1	S2	S1	S2	S1	S2
FYM rates:								
٢٠ m^3	428.63	٤٢٨.٧٨	١٢.٩٩	١٣.١٩	0.٩٠٣	0.٩٩٩	١٣.٨٩	١٤.١٩
3٠ m^3	٤٨٦.٠٧	٤٩٢.٣٣	١٣.٩٩	١٤.٢٢	0.٨١٤	0.٦٦١	١٤.٨١	١٤.٨٨
4٠ m^3	٥٣٣.٧٨	٥٣٨.٧٨	١٤.٧٧	١٤.٥٨	١.٢٦٨	١.٣٤٩	١٦.٠٣	١٥.٩٣
LSD at 5%	**٣.١٩**	**١.١٤**	**٠.٠٤**	**٠.٠٥**	**0.٣٢٥**	**0.٥١٤**	**٠.٠٤**	**٠.٠٥**
NPK levels:								
١٠٠%	٤٨٩.٣٤	٤٩٠.٦٣	١412.	١٤.٠٨	١.033	١.٠٥١	١٥.١٤	١٥.١٣
٧٥%	٤٨٠.٤٨	٤٨٨.٨٥	١٣.٩٥	١٣.٩٩	0.٩٨٥	0.٩٩٦	١٤.٩٣	١٤.٩٩
50%	٤٧٨.٦٧	٤٨٠.٤١	١٣.٦٩	١٣.٩٠	0.٩٦٧	0.٩٦١	١٤.٦٦	١٤.٨٦
LSD at 5%	**١.٧١**	**١.٢٠**	**٠.٠٤**	**٠.٠٢**	**0.٤١٤**	**0.٢٥٩**	**٠.٠٤**	**٠.٠٢**
Foliar spray sources:								
Control	٤٢١.٩٦	٤١٨.٦٧	١٣.٠٣	١٣.١٣	١.١٠٤	١.١٦٣	١٤.١٣	١٤.٢٩
Hi-Fertil 1	٤٩٢.٠٢	٤٩٩.٣٧	١٤.٠٥	١٤.١٤	١.٠٣٥	١.٠٤٦	١٥.٠٨	١٥.١٩
Ferty More	٥٣٤.٥٠	٥٤١.٨٥	١٤.٦٨	١٤.٧١	0.٨٤٧	0.٨٠٠	١٥.٥٢	١٥.٥٢
LSD at 5%	**١.٤٠**	**١.٤٥**	**٠.٠٤**	**٠.٠٢**	**0.٦٩٠**	**0.٤٥٩**	**٠.٠٤**	**٠.٠٢**

With respect to the effect of interaction between FYM rates and NPK levels, data in Table (7) showed that potato plants fertilized with 40 m^3 FYM rate and 50% or 75% NPK levels resulted in the highest significant tuber weight/plant and total yield. The values in both treatments were not significant differences with each other. These results were true during both seasons. Similar results were obtained by Singh *et al.* (1996) and Sadej *et al*. (2004).

Also, data presented in Table (7) showed that the interaction between FYM rates and macronutrients foliar spray sources had a positive significant effects on total yield and its components in both seasons. Data indicated that, plants sprayed with Ferty More (5-3-43, NPK) followed by Hi-Fertil 1 (19-19-19, NPK) and fertilized with 40 m^3 FYM/fed. gave the highest tubers weight/plant and total yield.

Table (7): Total yield and its components of potato plants as affected by the interactions of FYM rates x NPK levels, FYM x macronutrients foliar spray sources and NPK levels x Foliar sources during 2008/2009 (S1) and 2009/2010 (S2) winter seasons.

Characters		Tubers weight/plant (g)		Marketable yield (ton/fed.)		Unmarketable yield (ton/fed.)		Total yield (ton/fed.)	
Treatments		S1	S2	S1	S2	S1	S2	S1	S2
FYM rates	NPK levels								
٢٠ m³	100%	٤٦٢.٠٢	٤٦٢.٨٩	١٣.٧١	١٣.٥٣	0.٩٥٣	١.١٠٥	١٤.٦٦	١٤.٦٤
	75%	٤١٥.٨٩	٤٢٤.٨٩	١٢.٩٠	١٣.١٢	0.٩٠٤	0.٩٦٨	١٣.٨٠	١٤.٠٩
	50%	٤٠٨.٠٠	٣٩٨.٥٦	١٢.٣٥	١٢.٩١	0.٨٥٣	0.٩٢٥	١٣.٢٠	١٣.٨٤
3٠ m³	100%	٥١١.٦٧	٥١٥.٤٥	١٤.٥١	١٤.٨١	0.٧٩٣	0.٥٢٨	١٥.٣١	١٥.٣٣
	75%	٤٨٣.٧٨	٤٨٨.٠٠	١٤.١٠	١٤.١٣	0.٧٦٧	0.٦٩٠	١٤.٨٦	١٤.٨٢
	50%	٤٦٢.٧٨	٤٧٣.٥٥	١٣.٣٩	١٣.٧٠	0.٨٨٢	0.٧٦٤	١٤.٢٧	١٤.٤٧
4٠ m³	100%	٤٩٤.٣٣	٤٩٣.٥٦	١٤.١٣	١٣.٩١	١.٣٥٤	١.٥٢٢	١٥.٤٨	١٥.٤٣
	75%	٥٤١.٧٨	٥٥٣.٦٧	١٤.٨٥	١٤.٧٣	١.٢٨٤	١.٣٣١	١٦.١٣	١٦.٠٦
	50%	٥٦٥.٢٢	٥٦٩.١١	١٥.٣٣	١٥.١١	١.١٦٦	١.١٩٤	١٦.٤٩	١٦.٣٠
LSD at 5%		٧٢.٢٥	٧٠.٣٢	١.٩٣	١.٠٩	**0.١٩٩**	**0.١٣٣**	١.٧٨	٠.٩٩
FYM rates	Foliar spray sources								
٢٠ m³	Control	٣٧٣.٨٩	٣٧١.٥٦	١٢.٠٧	١٢.٤٣	0.٩٩٩	١.٠٨٤	١٣.٠٦	١٣.٥٢
	Hi-Fertil 1	٤٣٣.٨٤	٤٣٩.٠٠	١٣.٠٩	١٣.٤٠	0.٨٩١	0.٩٩٥	١٣.٩٩	١٤.٤٠
	Ferty More	٤٧٨.١٨	٤٧٥.٧٨	١٣.٨٠	١٣.٧٣	0.٨٢١	0.٩١٩	١٤.٦١	١٤.٦٥
3٠ m³	Control	٤٢٩.٨٩	٤٢٦.٥٦	١٣.٢٧	١٣.٤١	0.٧٩٤	0.٧٩٣	١٤.٠٦	١٤.٢٠
	Hi-Fertil 1	٤٩٤.٣٣	٥٠٣.٨٩	١٤.١٨	١٤.٤٠	0.٨٣١	0.٦٤٤	١٥.٠١	١٥.٠٥
	Ferty More	٥٣٤.٠٠	٥٤٦.٥٦	١٤.٥٥	١٤.٨٣	0.٨١٨	0.٥٤٥	١٥.٣٧	١٥.٣٨
4٠ m³	Control	٤٦٢.١١	٤٥٧.٨٩	١٣.٧٦	١٣.٥٣	١.٥١٨	١.٦١١	١٥.٢٨	١٥.١٥
	Hi-Fertil 1	٥٤٧.٨٩	٥٥٥.٢٢	١٤.٨٦	١٤.٦٢	١.٣٨٤	١.٤٩٧	١٦.٢٥	١٦.١٢
	Ferty More	٥٩١.٣٣	٦٠٣.٢٢	١٥.٦٨	١٥.٥٨	0.٩٠٢	0.٩٣٨	١٦.٥٨	١٦.٥٢
LSD at 5%		٢١.٣٥	٢٥.٥٨	٠.٣٥	٠.٥٥	**0.٤١٢**	**0.٤٥١**	٠.٢٤	٠.٢٢
NPK levels	Foliar spray sources								
100%	Control	٤٣٠.٤٤	٤٢٠.٢٢	١٣.٢٧	١٣.٣٣	١.١٣١	١.٢٣٥	١٤.٤٠	١٤.٥٧
	Hi-Fertil 1	٤٩٧.٣٩	٥٠٤.٥٦	١٤.٢٥	١٤.١٢	١.٠٦٣	١.١٢٧	١٥.٣٢	١٥.٢٥
	Ferty More	٥٤٠.١٩	٥٤٧.١١	١٤.٨٢	١٤.٨٠	0.٩٠٦	0.٧٩٣	١٥.٧٣	١٥.٥٩
75%	Control	٤١٤.٠٠	٤١٦.٤٤	١٣.٠٢	١٣.١٢	١.١١١	١.١٥١	١٤.١٣	١٤.٢٨
	Hi-Fertil 1	٤٩٦.١١	٥٠٦.٢٢	١٤.٠٥	١٤.١٤	١.٠٣٢	١.٠٢٣	١٥.٠٨	١٥.١٧
	Ferty More	٥٣١.٣٣	٥٤٣.٨٩	١٤.٧٨	١٤.٧١	0.٨١٣	0.٨١٤	١٥.٥٩	١٥.٥٢
50%	Control	٤٢١.٤٤	٤١٩.٣٣	١٢.٨١	١٢.٩٢	١.٠٦٩	١.١٠٢	١٣.٨٨	١٤.٠٣
	Hi-Fertil 1	٤٨٢.٥٥	٤٨٧.٣٣	١٣.٨٣	١٤.١٦	١.٠١٢	0.٩٨٦	١٤.٨٤	١٥.١٥
	Ferty More	٥٣٢.٠٠	٥٣٤.٥٥	١٤.٤٣	١٤.٦٤	0.٨٢١	0.٧٩٥	١٥.٢٥	١٥.٤٣
LSD at 5%		٢١.٢٠	٢٩.٥٩	٠.١٣	٠.١٦	**0.٥٨١**	**0.١٥٤**	٠.١٤	٠.١٣

Concerning the effect of the interaction between NPK levels and macronutrients foliar spray sources on total yield and its components, data in Table (7) indicated that the interaction had a positive significant effects on total yield and its components in both seasons. The highest total yield, tuber weight/plant and marketable yield were obtained from plants received 75 or 50 % NPK level and sprayed with Ferty More in both seasons. It is notable that, the differences between tubers weight/plant and total yield were not significant when plants sprayed with Ferty More and fertilized by 75% or 50% NPK levels in both seasons.

Regarding, the interaction effect of the studied factors (FYM rates, NPK levels and macronutrients foliar spray sources) on total yield and its components, data presented in Table (8) reveal that tubers weight/plant, marketable yield, unmarketable yield and total yield were affected by the three ways interactions, in both seasons. Generally, the highest tuber weight/plant and total yield were obtained from plants fertilized by 40 m^3/fed. FYM, 50% or 75% NPK levels and sprayed with Ferty More as a source of foliar NPK followed by the interaction among 40 m^3/fed. FYM, 50% or 75% NPK levels and sprayed with Hi-Fertil 1. The values in both treatments were not significant differences with each other. These results were true during both seasons. These results may be attributed to the favorable effect of the combination between the three factors of this study which results in good healthy of plant vegetative growth parameters (Tables 3, 4 and 5) consequently, increasing total yield.

Table (8): Total yield and its components of potato plants as affected by the interaction among FYM rates, NPK levels and macronutrients foliar spray sources during 2008/2009 (S1) and 2009/2010 (S2) winter seasons.

Characters			Tuber weight/plant (g)		Marketable yield (ton/fed.)		Unmarketable yield (ton/fed.)		Total yield (ton/fed.)	
Treatments			S1	S2	S1	S2	S1	S2	S1	S2
FYM	NPK	Foliar spray sources								
20 m^3	١٠٠%	Control	٤٠٩.٠٠	٣٩٣.٦٧	١٢.٨٥	١٢.٩٦	١.١٣٣	١.٢٢٦	١٣.٩٨	١٤.١٩
		Hi-fertil 1	٤٦٧.٨٥	٤٧٦.٠٠	١٣.٧٨	١٣.٦٧	0.٩٠٣	١.١٢٠	١٤.٦٨	١٤.٧٩
		Ferty More	٥٠٩.٢٢	٥١٩.٠٠	١٤.٤٩	١٣.٩٦	0.٨٢٣	0.٩٧٠	١٥.٣١	١٤.٩٤
	75%	Control	٣٥٥.٠٠	٣٦٤.٣٣	١١.٨٩	١٢.٣٠	0.٩٦٣	١.٠٥٠	١٢.٨٥	١٣.٣٥
		Hi-fertil 1	٤٢٢.٣٣	٤٣٨.٠٠	١٣.٠٥	١٣.٣١	0.٩١٦	0.٩٤٣	١٣.٩٧	١٤.٢٦
		Ferty More	٤٧٠.٣٣	٤٧٢.٣٣	١٣.٧٦	١٣.٧٤	0.٨٣٣	0.٩١٠	١٤.٥٩	١٤.٦٥
	50%	Control	٣٥٧.٦٧	٣٥٦.٦٧	١١.٤٦	١٢.٠٣	0.٩٠٠	0.٩٧٦	١٢.٣٦	١٣.٠١
		Hi-fertil 1	٤١١.٣٣	٤٠٣.٠٠	١٢.٤٦	١٣.٢٢	0.٨٥٣	0.٩٢٣	١٣.٣١	١٤.١٥
		Ferty more	٤٥٥.٠٠	٤٣٦.٠٠	١٣.١٤	١٣.٤٩	0.٨٠٦	0.٨٧٦	١٣.٩٤	١٤.٣٦
30 m^3	١٠٠%	Control	٤٤٠.٠٠	٤٣٢.٦٧	١٣.٨٧	١٤.٠٥	0.٦٣٣	0.٦٤٣	١٤.٥٠	١٤.٦٩
		Hi-fertil 1	٥٣٠.٣٣	٥٤٣.٠٠	١٤.٦٧	١٤.٩١	0.٨١٦	0.٥١٦	١٥.٤٩	١٥.٤٢
		Ferty more	٥٦٤.٦٧	٥٧٠.٦٧	١٥.٠٠	١٥.٤٧	0.٩٣٠	0.٤٢٦	١٥.٩٣	١٥.٨٩
	75%	Control	٤٣١.٣٣	٤٢٣.٠٠	١٣.٥٠	١٣.٤٤	0.٨٢٦	0.٨٣٣	١٤.٣٣	١٤.٢٧
		Hi-fertil 1	٤٩٢.٦٧	٤٩٦.٣٣	١٤.١٧	١٤.٢٨	0.٧٧٣	0.٦٥٠	١٤.٩٤	١٤.٩٣
		Ferty more	٥٢٧.٣٣	٥٤٤.٦٧	١٤.٦٢	١٤.٦٨	0.٧٠٣	0.٥٨٦	١٥.٣٢	١٥.٢٧
	50%	Control	٤١٨.٣٣	٤٢٤.٠٠	١٢.٤٣	١٢.٧٥	0.٩٢٣	0.٩٠٣	١٣.٣٥	١٣.٦٥
		Hi-fertil 1	٤٦٠.٠٠	٤٧٢.٣٣	١٣.٦٩	١٤.٠٢	0.٩٠٣	0.٧٦٦	١٤.٦٠	١٤.٧٨
		Ferty more	٥١٠.٠٠	٥٢٤.٣٣	١٤.٠٤	١٤.٣٤	0.٨٢٠	0.٦٢٣	١٤.٨٦	١٤.٩٧
40 m^3	١٠٠%	Control	٤٤٢.٣٣	٤٣٤.٣٣	١٣.٠٩	١٢.٩٨	١.٦٢٦	١.٨٣٦	١٤.٧٢	١٤.٨٢
		Hi-fertil 1	٤٩٤.٠٠	٤٩٤.٦٧	١٤.٣١	١٣.٧٩	١.٤٧٠	١.٧٤٦	١٥.٧٨	١٥.٥٣
		Ferty more	٥٤٦.٦٧	٥٥١.٦٧	١٤.٩٨	١٤.٩٦	0.٩٦٦	0.٩٨٣	١٥.٩٥	١٥.٩٤
	75%	Control	٤٥٥.٦٧	٤٦٢.٠٠	١٣.٦٦	١٣.٦٣	١.٥٤٣	0.٥٧٠	١٥.٢٠	١٥.٢١
		Hi-fertil 1	٥٧٣.٣٣	٥٨٤.٣٣	١٤.٩٣	١٤.٨٤	١.٤٠٦	١.٤٧٦	١٦.٣٤	١٦.٣٢
		Ferty more	٥٩٦.٣٣	٦١٤.٦٧	١٥.٩٥	١٥.٧١	0.٩٠٣	0.٩٤٦	١٦.٨٥	١٦.٦٥
	50%	Control	٤٨٨.٣٣	٤٧٧.٣٣	١٤.٥٣	١٣.٩٩	١.٣٨٦	١.٤٢٦	١٥.٩٢	١٥.٤٢
		Hi-fertil 1	٥٧٦.٣٣	٥٨٦.٦٧	١٥.٣٥	١٥.٢٤	١.٢٧٦	١.٢٧٠	١٦.٦٢	١٦.٥١
		Ferty more	٦٣١.٠٠	٦٤٣.٣٣	١٦.١٠	١٦.٠٨	0.٨٣٦	0.٨٨٦	١٦.٩٤	١٦.٩٧
LSD at 5 %			٣٩.٠٦	٣٣.١٦	٠.٥٧	٠.٤١	0.١٤٣	0.١٣٧	٠.٦٠	٠.٤١

CONCLUSION

From the results of this study, it could be concluded that, application 40 m^3/fed FYM + 50% NPK level with spraying the plants with Ferty More (5-3-43, NPK) or Hi-Fertil 1(19-19-19, NPK) are the recommended treatments for increasing potato yield, improving tuber quality of potato, lowering cost production (as a result of saving half of the added NPK-fertilizer) and will also decrease the pollution of environment under similar conditions to this work.

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إستجابة نمو ومحصول وقابلية تخزين البطاطس لبعض معدلات السماد العضوي والرش ببعض العناصر الكبرى:-

١- النمو الخضرى والمحصول ومكوناته.

هالة عبدالغفار السيد*، عبدالله حلمي على المرسى و حمادة ماهر بدير المتولى ****

*** قسم الخضر والزينة- كلية الزراعة- جامعة المنصورة - مصر**

**** قسم بحوث البطاطس والخضر خضرية التكاثر - معهد بحوث البساتين - مركز البحوث الزراعية ، الجيزة - مصر.**

نُفذت تجربتان حقليتان على نباتات البطاطس صنف اسبونتا فى قرية كفر ميت فارس بالقرب من المنصورة، محافظة الدقهلية خلال موسمى الزراعة الشتوية ٢٠٠٨/٢٠٠٩ و ٢٠٠٩/٢٠١٠ م وذلك لدراسة تأثير استخدام بعض معدلات سماد المزرعة (٢٠ م^3 ، ٣٠ م^3 و٤٠ م^3 للفدان) وبعض مستويات النتروجين والفوسفور والبوتاسيوم (١٠٠٪ ، ٧٥٪ و٥٠٪ من المعدل الموصى به للفدان) كل منها منفردُ أو مع الرش الورقى لنبات البطاطس ببعض مصادر العناصر الكبرى (كنترول، هاى فرتيل ١ و فيرتى مور) على النمو الخضرى، المحصول ومكوناته.

استخدم لاجراء التجربة تصميم القطاعات الكاملة العشوائية بنظام القطع المنشقة مرتين فى ثلاث مكررات وتم توزيع معدلات سماد المزرعة فى القطع الرئيسية و مستويات النتروجين والفوسفور والبوتاسيوم فى القطع الشقية وخصصت القطع التحت شقية لمعاملات الرش الورقى ببعض مصادر العناصر الكبرى.

ويمكن تلخيص النتائج المتحصل عليها فيما يلى:-

أوضحت النتائج أن التسميد البلدى بصفة عامة أثر معنوياً على صفات النمو الخضرى والمحصول ومكوناته. ولقد أدى استخدام ٤٠ م^3 للفدان من سماد المزرعة متبوعا بـ ٣٠ م^3 للفدان إلى زيادة فى طول النبات، عدد الأوراق للنبات، المساحة الورقية للنبات و الوزن الطازج للنبات. وكذلك أدى إلى زيادة معنوية للمحصول الكلى للفدان ومتوسط وزن الدرنات للنبات.

أوضحت النتائج أيضاً، أن زيادة السماد الكيماوى المستخدم حتى ١٠٠٪ من المعدل الموصى به للفدان أدى إلي زيادة معنوية في كل صفات النمو الخضري ماعدا الوزن الجاف للنبات، وكذلك زيادة متوسط وزن الدرنات لكل نبات، المحصول التسويقى و المحصول الكلي للفدان.

وتشير النتائج ان الرش الورقى للنباتات بالمصادر المختلفة للعناصر الكبرى ادى إلي زيادة معنوية في جميع الصفات المدروسة. معظم القياسات الخضرية زادت عند رش النباتات بمركب هاى فرتيل ١ (19-19-19 ، ن فو بو)، بينما أدي رش النباتات بمركب فيرتى مور (٥-٣-٤٣ ، ن فو بو) إلي زيادة معنوية في كل من الوزن الجاف لعرش النبات و المحصول الكلي و المحصول التسويقى و كذلك متوسط وزن الدرنات للنبات.

وعموما كان تأثيرالتفاعل بين العوامل الثلاثة المدروسة (معدلات السماد العضوى، مستويات التسميد الكيماوى والرش الورقى بمصادر العناصر الكبرى) واضحاً على جميع الصفات المدروسة. وكانت أفضل النتائج باستخدام ٤٠ م^{٣} للفدان من سماد المزرعة و التسميد الكيماوى بمستوى ٥٠٪ من الموصى به للفدان مع الرش الورقى بمركب الـ فيرتى مور ويليه التفاعل باستخدام ٤٠ م^{٣} للفدان من سماد المزرعة و التسميد الكيماوى بمستوى ٥٠٪ من الموصى به للفدان مع الرش الورقى بمركب هاى فرتيل ١، حيث أدى هذا التفاعل إلى زيادة فى وزن الدرنات للنبات والمحصول الكلى والمحصول التسويقى للفدان كما أدى إلى تخفيض المحصول غير التسويقى. ولذلك يمكن التوصية باستخدام هذه المعاملات، لرفع إنتاجية البطاطس وتحسين جودة الدرنات، وكذلك خفض تلوث البيئة تحت ظروف محافظة الدقهلية.

قام بتحكيم البحث

أ.د / السيد احمد احمد طرطوره — كلية الزراعة – جامعة المنصورة

أ.د / ناديه سعد شفشق — كلية الزراعة – جامعة بنها