The Impact of Spraying with Different Concentrations o Seaweed Extract under Different Levels of Mineral NPK Fertilizers on Sweet Potato (*Ipomoea batatas* (L.)) Plants

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Received on: 21/9/2015 *Accepted: 1/11/2015*

ABSTRACT

Two field experiments were carried out at the Agriculture Experimental Station Farm (Abies region), Fa Agriculture, Alexandria University; during the two summer seasons of 2013 and 2014. The objective of this stud assess the response of sweet potato plants (Abies cv.) to the spraying with three concentrations of seaweed extrac 0.75% and 1%), as well as a control treatment (spraying with distilled water) under, varying NPK levels of fertilizer (25%, 50%, 75% and 100 % of the recommended rate, in addition to a control treatment, witho application) and their interactions on vegetative growth characters , yield and its components as well as on some c compositions characters of tuber roots. The results revealed that the gradual increases of NPK fertilizer lev accompanied with significant increases on sweet potato growth, yield and its components as well as the c composition of tuber roots. Spraying of sweet potato plants with seaweed extract at the concentration of 0.75' positive response on the all studied traits, in both growing seasons. Generally, the most efficient treatment com which gave the best sweet potato growth, yield and tuber roots chemical compositions, was the application mineral fertilizer, at the rate of 75% of the recommended, with seaweed foliar spray at the concentration of 75% regard, it is possible to reduce the NPK mineral fertilization by 25%, through using a foliar spray of 0.75% extract concentration without compromising the production value of the sweet potato plants, concerning the quar quality of tuber roots.

Key words: Sweet potato, *Ascophyllum nodosum* extract, Minimizing NPK mineral fertilizers.

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) which belongs to the family Convolvulaceae is becoming the most widely distributed root crop in most developing countries. It is grown in almost all soil types in most parts of the tropics and warm temperature regions. Moreover, it is an excellent source of complex carbohydrates, high antioxidants, vitamins (A and B) , starch and nutrients (Woolfe, 1992). Sweet potato is widely used in Egypt as a popular human food, green foliage and unmarketable roots are used as a raw material in many industries such as starch and alcohol.

Plant nutrients are essential for the production of crops and healthy food for the worlds' expanding population. Fertilization is one of the most reliable factors to provide plant nutritional requirements. Among the different nutrients, nitrogen (N), phosphorus (P) and potassium (K) are highly required by plants so are called macronutrients. NPK play so many vital roles in physiological and biochemical processes in plants. The use of chemical fertilizer, organic fertilizer or bio-fertilizer has its advantage and disadvantage in the context of nutrient supply, crop growth and environmental quality (Sadek, 2000). Sweet potato plant's response to fertilization, in general, and to nitrogen and potassium particularly; where, these two elements have been recognized as a vital step in step the tuber roots yield of sweet potato (Pu *al.;*1982; Hammett *et al.;*1984; Kamel *et a* Feleafel, 2001; Abd El Fattah *et al.*,20 Mansour *et al.;*2002). Application of the level of P (100% P_2O_5) enhanced mean va vine length, leaves number and vine fresh also, increased root quantity and quality Abdel-Razzak, *et al.;*2013).

Many studies in the past three decad found wide application in modern agriculture use of marine macroalgae (seaweeds) as a fe The most commonly used seaweed is the seaweed (*Ascophyllum nodosum*). Seaweed which are now available commercially lab Maxicorp (Sea born), Algifert (Marinure), GA 14, Seaspray, Seasol, SM3, Cylex ,Sea and Acadian (Jeanin *et al.;*1991). These p are used as a whole or finely chopped pc algal manure or aqueous extracts. The seaweeds as manure in farming practices ancient and common practice among the l and also practiced in Britain, France, Spair and china.

Seaweeds contain all the trace eleme plant growth hormones required by plants. reported that seaweed manure is rich in pot but, poor in nitrogen and phosphorus in com to the farm manure (Tay *et al.;*1987). There are many plant growth hormones, regulators and promoters available to enhance yield attributes (Crouch and Van Staden; 1992 and 1993). Seaweed liquid fertilizers will be useful for achieving higher agricultural production, because of the extract contents. Seaweed extracts have been reported to stimulate the growth and yield of plants (Zamani *et al.;*2013), develop tolerance to environment stress (Zhang and Schmidt, 2000 and Zhang *et al.;*2003) and increase nutrient uptake from the soil (Verkleij; 1992; and Turan and Köse, 2004). Crouch and Van Staden, (1994) reported that liquid extracts, obtained from seaweeds, have been used in modern agriculture and gained importance as foliar sprays to many crops; including various grasses, cereals, flowers and vegetable species.

In recent years, the use of seaweeds in modern agriculture has been investigated by many researchers. Yield and nutritional quality of okra fruits, significantly increased (20.47%) by a liquid seaweed fertilizer (LSF) spray (2.5%), as reported by Zodape *et al.;* (2008). Addition seaweed extracts led to improving the productivity of seed yield and the percentage of protein in broad bean plants (Jasim and Obaid; 2014). Also, application of seaweed extracts recorded significant increases in the percentages of nitrogen , total soluble solids and protein content of potato tubers (Sarhan; 2011 and Haider *et al.;*2012) and led to improve most vegetative growth and fruiting characters of both cucumber and garlic (Obaid *et al.;*2011 and Fawzy *et al.;*2012). While, using seaweed extracts with strawberry crop did not reflect any significant difference on yield and biological yield characters (Prokkola and Kivijärvi; 2007).

Therefore, the goal of this study aimed to determine the impact of foliar spraying of seaweed extracts, as an organic fertilizer, under different levels of mineral NPK fertilizer on growth and yield of sweet potato plants. A special attention was also directed to study the possibility of reducing the rates of the mineral fertilizers NPK, through using some different concentrations of seaweed extracts to maximize the yield and quality of sweet potato tuber roots.

MATERIALS AND METHODS

Two field trials were carried out at the Agriculture Experimental Station Farm, Faculty of Agriculture, Alexandria University; at Abies. A. R. E. during the summer seasons of 2013 and 2014. This study was conducted to evaluate the effect of foliar spraying of brown seaweed extracts (*Ascophyllum nodosum*), under some different levels of inorganic fertilizers (NPK) on sweet potato plants growth, yield and its components of tubers quality as well as some chemical constituents of tuber roots.

Preliminary to each experiment, soil s from surface layers (0 - 30 cm) of the exper area were taken at random and prepared to a according to the procedures described by *al.;* (1982). The results of soil analyses are sl Table (1).

Seaweed Extracts Source.

Ascophyllum nodosum extracts are argua most widely used and researched seaweed sp agriculture (Senn, 1987). Seaweed extract from *Ascophyllum nodosum* (Acadian) was this study, ordered from Arman Sabz Adlin Tehran, Iran. The chemical composition of extract powder is shown in Table (2).

Experimental Design.

The experimental treatments were arran a split-plot system in a randomized co blocks design (R.C.B.D.), with three replic Each replicate contained twenty trea representing all possible combinations amo five levels of NPK fertilizer (0%, 25%, 50% and 100% of the commercially recommende and the four seaweed extract concentration 0.5%, 0.75% and 1%) . The recommended le NPK fertilizers for sweet potato comn production are (20 kg N, 96 kg K_2O and P_2O_5 / fed.). Each sub-plot consisted of four 4 m long and 0.7 m wide. The main plots assigned to represent the five levels of fertilizer; while, the four concentrations of se extract were randomly distributed in the sul of each main plot. A guard row was left v planting to separate each two adjacent sub-pl

Experimental Work.

The most famous Egyptian sweet pota cultivar 'Abies', distinguished with a purple s sweet orange-flesh, was used in this study potato vine cuttings of 20 cm length were pla 30 cm within rows, on the 5^{th} of may, in the f the second seasons. The experimental units r the assigned levels of phosphorus fertilizer form of calcium super phosphate (15.5% before planting and those of NK, in the fo ammonium sulfate (20.5% N) and potassium (48.5% K_2O), respectively. N fertilizer was side-dressed to the soil in three diverse in after 3, 7 and 10 weeks from planting. The c K fertilizer were equally applied after 3 and from planting. The foliar spraying of the d concentrations of seaweed extract were pr three times; after 3, 6 and 9 weeks from p All other cultural practices such as irrigati weeding were uniform for all the experiment

Data Recorded:

Vegetative growth characters: Four plan randomly picked up from each sub- plot, two before harvesting (around 100 days from plan

Table 1: Some soil physical and chemical properties of the experimental sites of the two s seasons of 2013 and 2014.

Properties	Physical				Chemical					
Seasons	**Sand %**	**Silt %**	**Clay %**	**Texture**	**pH**	**E.C. ds.m-¹**	**O.M %**	**N ppm**	**P ppm**	**K ppm**
2013	32.34	23.5	44.0	Clay loam	8.04	1.29	1.12	176.00	35.18	500.00
2014	33.17	22.1	43.8	Clay loam	8.16	1.26	2.43	163.72	32.41	459.00

Table 2: The Chemical Composition of Acadian marine plant extract powder from *Ascop nodosum.*

Physical data:	
NPK and mineral (ash)	45 % - 55 %
Moisture	Max 10%
Alganic acid	Min 10%
Mannitol	Min 4 %
Amino acid	Min 4 %
Other organic matter derived from seaweed	Min 20 %
Guaranteed minimum analyses:	
Total nitrogen (N)	0.8 – 1.5 %
Available phosphoric acid (P_2O_5)	1 - 2 %
Soluble potash (K_2O)	17 – 22 %

to measure the following characters: vine length plant^{-1} (cm), number of branches plant^{-1} and number of leaves plant^{-1}.

Tuber roots yield and its components: At harvesting stage (at 120 days from planting), a sample of four plants, from each sub -plot, was randomly chosen to record the following characters: number of tuber roots plant^{-1}, total tuber roots yield (kg) plant^{-1}, marketable tuber roots yield (%) and total tuber roots yield fed^{-1} (ton).

Chemical composition of tuber roots: A random sample of five uniform roots from each sub-plot was carefully washed with distilled water, then weighted and prepaired for some tuber roots chamical analyses. Total carotene as β-carotene (mg 100 g^{-1} fresh weight) was measured, according to Witham, *et al.* (1971). Total sugars %, starch% and carbohydrates % were determined, following the standard methods of association of official analytical chemists (A.O.A.C., 1995).

Statistical Analyses:

All obtained data were statistically analyzed according to the used experimental design, using the computer program Co-Stat Software (2004). The comparisons among the means of the various treatments were achieved, using Duncan's multiple range tests, at 0.05 probability level (Steel and Torrie; 1980).

RESULTS AND DISCUSSIONS

The results regarding the influence of seaweed extract concentrations, varying levels of mineral NPK fertilizer, and their interactions on the vegetative growth characters, roots yield and its components, and chemical constituents o potato tuber roots (Abies cv.) are shown in (3 – 5).

Vegetative growth characters.

Regarding the influence of NPK f levels, data in Table(3), clearly, reflected sig increments in all studied growth characters c potato plants due to NPK application, comp the control treatment. The detected increase growth characters, in both seasons, were g corresponding to the increase in NPK However, it was generally noticed that insig differences were detected in all studied characters due to increasing the applied NP from 75% to 100%, in both seasons. These could probably be generally explained on t that the available NPK content in the exper soil area was apparantly low (Table 1), reflected the detected high response to the in supplies of these nutrients. The obtained res in harmony with those reported by Kame (1990), Feleafel (2001), Mansour *et al.* (20 Abdel-Razzak *et al.* (2013); who concluded best plant growth of sweet potato plan attained by the plants that receive commercially recommended rates of fertilizers; in addition to the agreement w outcome of Arisha and Bardisi (1999) on th crop. It was also reported by Sadek (2002) El- Fattah *et al.*(2002), that the applicatio fertilizer increased gradually and significa traits of vine growth of sweet potato Moreover, Schenk (1996) stated that N is th constituent of numerous products of plant metabolism.

Some positive responses of sweet potato plants to the foliar application of seaweed extract concentrations were noticeable for studied vegetative growth characters (Table, 3). However, the detected increments in vine length, in both seasons, due to seaweed extract application were insignificant . On the other hand, the application of 0.75% and 1.0% concentrations increased significantly the number of branches per plant, in both seasons; whereas, the use of concentration number of leaves per plant, rel the untrated plants, but only in the first These results, generally agreed with the finc Kowalski *et al.* (1999), Sarhan (2011) and H *al.* (2012); who noticed the effect of s seaweed extracts on increasing the ve growth of potato crop. A possible explana the increased plant growth, due to using s extracts, is that the extracts contain auxins,

Table 3: Mean of vegetative growth characters of sweet potato plants 'Abies' cv. as affected b levels, seaweed extract (SWE) concentrations and their interaction, during 2013 an summer seasons.

Characters		Vine length Plant^{-1}		No. of branches plant^{-1}		No. of leaves plant^{-1}	
Treatments		2013	2014	2013	2014	2013	2014
NPK %							
0 %		117.41 *D	117.08 C	3.41 C	3.75 C	122.33 D	152.58 D
25 %		156.91 C	165.33 B	4.58 B	4.33 B	165.33 C	178.91 C
50 %		168.58 B	167.75 B	4.83 AB	4.75 B	185.16 BC	191.75 B
75 %		181.58 A	175.33 AB	5.17 AB	5.42 A	204.50 AB	206.08 A
100 %		183.67 A	183.58 A	5.25 A	5.42 A	214.91 A	211.58 A
SWE Cons.							
0 %		156.60 A	158.73 A	4.2 B	4.33 B	169.33 B	180.80 A
0.50 %		162.93 A	157.53 A	4.33 B	4.20 B	177.26 AB	191.13 A
0.75 %		162.80 A	167.53 A	5.00 A	5.23 A	185.53 A	190.53 A
1.0 %		164.14 A	163.47 A	5.16 A	5.13 A	181.66 AB	190.26 A
NPK% X SWE Cons.							
NPK 0 %	0 %	111.00 e	108.67 e	3.29 d	3.33 e	102.67 h	136.00 g
	0.50 %	122.67 e	124.33 de	3.33 d	3.33 e	136.67 fg	165.67 ef
	0.75 %	119.33 e	118.33 e	3.67 d	4.00 c-e	125.33 gh	163.67 e-g
	1.0 %	116.67 e	117.00 e	3.33 d	4.33 b-e	124.67 gh	145.00 fg
NPK 25%	0 %	138.67 de	141.33 cd	4.00 cd	3.67 de	165.33 d-f	169.33 d-f
	0.50 %	163.67 b-d	162.67 bc	4.00 cd	4.00 c-e	168.33 c-e	182.00 c-e
	0.75 %	162.00 cd	174.33 ab	5.00 a-c	5.00 a-d	166.00 d-f	176.00 de
	1.0 %	163.33 b-d	183.00 ab	5.33 ab	4.67 a-e	161.67 ef	188.33 a-e3
NPK 50%	0 %	161.00 cd	167.33 b	4.33 b-d	4.00 c-e	161.67 ef	174.67 de
	0.50 %	175.33 a-c	159.67 bc	4.00 cd	3.67 de	181.00 b-e	200.00 a-d
	0.75 %	162.67 cd	181.33 ab	5.34 ab	5.67 ab	194.33 a-d	183.67 b-e
	1.0 %	175.33 a-c	162.67 bc	5.33 ab	5.67 ab	203.67 ab	208.67 a-c
NPK 75%	0 %	180.00 a-c	178.33 ab	4.33 b-d	5.00 a-d	199.33 a-c	209.67 a-c
	0.50 %	175.67 a-c	165.33 b	5.00 a-c	5.00 a-d	196.33 a-d	197.00 a-d
	0.75 %	194.67 a	184.00 ab	5.67 a	6.00 a	206.33 ab	219.00 a
	1.0 %	176.00 a-c	173.67 ab	5.67 a	5.67 ab	203.00 ab	198.67 a-d
NPK 100%	0 %	192.67 ab	198.00 a	5.00 a-c	5.67 ab	217.67 a	214.33 ab
	0.50 %	177.33 a-c	175.67 ab	5.33 ab	5.00 a-d	204.00 ab	211.00 a-c
	0.75 %	175.33 a-c	179.67 ab	5.00 a-c	5.67 ab	222.67 a	210.33 a-c
	1.0 %	189.33 a-c	181.00 ab	5.67 a	5.33 a-c	215.33 a	210.67 a-c

* Values followed by similar letter (s), within a comparable group of means, do not significantly differ, using D multiple range test, at 0.05 level.

gibberellins, and precursors of ethylene, betaine and cytokinins, which are present and potentially involved in enhancing plant growth responses (Crouch and Van Staden; 1993).

The results concerning the effect of the first-order interaction between the two studied main factors are presented in Table (3). Generally , some positive significant interaction effects on mean values of vine length plant^{-1} (cm), number of branches plant^{-1}, and number of leaves plant^{-1} were noticed in both growing seasons. It is apparent the addition of NPK fertilizers at the rates of 75% with the foliar spray with 0.75% of seaweed extracts led to marked increases on the mean values of all above mentioned characters. The favorable influences of seaweed extract application on the studied vegetative growth characters appeared to be in a general agreement with the results obtained by Crouch and Van Staden, (1993); who indicated that the growth characteristics; like plant height, fresh weight and leaf area; of *Arachis hypogaea* were enhanced due to the seaweed liquid fertilizers (SLFs) treatments individually as well as along with chemical fertilizers.

Tuber roots yield and its components.

The results of the effects of NPK fertilizer levels, seaweed extract concentrations and their interactions on the tuber roots yield and its components of sweet potato are listed in Table (4). Regarding the influences of NPK fertilizer levels, the results reflected clearly that the mean values of the characters; number of tuber roots plant^{-1}, yield plant^{-1} (kg), marketable yield (%) and total yield fed^{-1} (ton); increased generally by increasing the NPK level up to 75% level. Most of the detected increments were found significant in all characters of root yield and its components, in both growing seasons. However, the application of the highest level (100% NPK) did not result in a further significant increase in the mean values of the four previously mentioned characters. Only one exception was recorded in the character total tuber roots yield fed^{-1} (ton), which gave significantly a higher mean value at 100% NPK than that of 75% NPK, in the two studied seasons. These results reflected a general correspondence with those obtained by Arisha and Bardisi (1999) on potato plants.

Positive responses of sweet potato plants to foliar application of seaweed extract concentrations were noticed on tuber roots yield and its components characters. Among the foliar spray of seaweed extract treatments, the highest mean values of number of tuber roots plant^{-1}, tuber roots yield plant^{-1} (kg), marketable tuber roots yield (%) and total tuber roots yield fed^{-1} (ton) were generally recorded for the level of 0.75% foliar spray with insignificant mean values from those of 1.0% foliar spray, during the two successive seasons. These results refelected similar trends to those repo Kowalski, *et al.* (1999), Sarhan (2011) and H *al.* (2012), who studyied the effect of s seaweed extracts on increasing the product potato crop.

The results concerning the effect of th order interaction between the two studie factors are presented in Table (4). The int had a positive and significant effects on mea of number of tuber roots plant^{-1}, tuber roo plant^{-1} (kg) , marketable tuber roots yield (total tuber roots yield fed^{-1} (ton), in both g seasons. Generally, it was that the addition fertilizer at the rate of 75% NPK with 0. seaweed extract led to marked increases mean values of the four mentioned characte favorable influences of seaweed extracts app on tuber roots yield and its components c related to the vital role of seaweed extracts growth stimulants on the increase of the ava of nutrient supply, improving the efficie macro-elements as well as its ability to me micro-elements requirements of the cr mentioned by Sridhar and Rengasamy (20 2012), who studied the possibility of s seaweed extracts to reduce the required am NPK as a mineral fertilization for both the and pepper plants.

Tuber roots chemical composition.

Concerning the results of the effects fertilizer levels, seaweed extract concentrati their interactions on the tuber roots quality c potato, viz. total sugars(%), sta carbohydrates (%) and carotene (mg 100 g weight); are listed in Table (5). The results that using different levels of NPK mineral f of the commercially recommended rate significant increments on the mean values sugars, starch, carbohydrates and carotene c in both seasons. Among the various used le NPK fertilizers, the two highest one (75% N 100% NPK) produced significantly highe values for all above mentioned characte insignificant differences between the tw levels. The results of Purcell *et al*. Hammett *et al*. (1984), Kamel *et al*. Feleafel (2001) and Mansour *et al.*(2002), ge refelected similar trends to those obtained present study. These investigators observ sweet potato plant's responsed to fertiliza general; and to N and, K in particular, th recognized as a vital step in stepping up th roots yield of sweet potato.

Regarding the main effect of seaweed concentrations, the results showed that inc the concentration of seaweed extract significant increases on the mean values sugars, starch, carbohydrates and carotene co

Table 4: Mean of root yield and its components of sweet potato plants 'Abies' cv. as affected b levels, seaweed extract (SWE) concentrations and their interaction, during 2013 and summer seasons.

Characters		Number of tuber roots plant^{-1}		Total tuber roots yield (kg) plant^{-1}		Marketable tuber roots yield (%)		Total tuber root yield Fed^{-1} (ton)	
Treatments		2013	2014	2013	2014	2013	2014	2013	2014
NPK %									
0 %		1.42 *D	1.25 D	0.29 D	0.34 D	57.88 C	59.48 D	1.53 E	1.73 E
25 %		2.58 C	2.75 C	0.87 C	0.80 C	82.18 B	81.28 C	5.00 D	4.94 D
50 %		4.32 B	4.17 B	1.39 B	1.32 B	86.84 AB	85.16 B	8.18 C	8.00 C
75 %		5.33 A	5.00 A	1.66 A	1.83 A	90.80 A	90.39 A	11.38 B	11.29 B
100 %		5.25 A	5.10 A	1.73 A	1.80 A	90.85 A	91.95 A	12.56 A	12.31 A
SWE Cons.									
0 %		3.46 B	3.27 C	0.96 C	1.12 C	73.98 B	78.19 B	6.56 D	6.60 C
0.50 %		3.60 AB	3.40 BC	1.12 B	1.22 B	81.84 A	82.44 A	7.27 C	7.30 B
0.75 %		4.10 A	3.87 AB	1.30 A	1.22 A	84.49 A	83.01 A	8.36 A	8.15 A
1.0 %		4.00 A	4.10 A	1.37 A	1.31 A	89.53 A	82.97 A	8.72 A	8.56 A
NPK% X SWE Cons.									
NPK 0 %	0 %	0.67 d	0.67 d	0.18 j	0.28 i	30.76 e	47.62 i	0.29 j	0.39 k
	0.50 %	1.67 c	1.00 ef	0.23 j	0.24 i	63.12 d	67.94 g	1.44 i	1.84 j
	0.75 %	1.67 c	2.00 de	0.35 j	0.42 hi	64.87 d	61.27 h	2.02 hi	2.01 j
	1.0 %	2.00 c	2.00 de	0.38 j	0.38 hi	72.76 cd	61.09 h	2.34 h	2.68 ij
NPK 25 %	0 %	2.67 bc	2.67 cd	0.68 i	0.57 gh	75.15 b-d	77.44 ef	3.37 g	3.45 i
	0.50 %	2.67 bc	3.00 cd	0.83 hi	0.92 ef	78.56 a-c	76.75 f	5.00 f	4.62 h
	0.75 %	2.33 c	2.33 d	0.93 g-i	0.73 fg	86.61 ab	84.66 b-d	5.78 e	5.68 g
	1.0 %	2.67 bc	3.00 cd	1.03 f-h	0.97 e	88.42 ab	86.32 a-d	5.87 e	6.01 fg
NPK 50 %	0 %	3.67 b	3.67 bc	1.20 eg	1.07 de	82.37 a-c	82.49 d-f	6.99 d	6.80 ef
	0.50 %	3.67 b	3.67 bc	1.18 eg	1.22 cd	87.09 ab	83.49 c-e	7.15 d	7.28 e
	0.75 %	5.00 a	4.33 ab	1.55 b-d	1.40 c	89.42 a	87.14 a-d	8.57 c	8.69 d
	1.0 %	5.00 a	5.00 a	1.63 a-c	1.60 b	88.49 ab	87.53 a-d	10.03 b	9.26 cd
NPK 75 %	0 %	5.33 a	5.00 a	1.41 c-e	1.61 b	89.61 a	90.56 a-c	9.73 b	10.09 bc
	0.50 %	5.00 a	4.33 ab	1.66 a-c	1.84 a	89.73 a	92.49 a	10.37 b	10.38 b
	0.75 %	5.67 a	5.33 a	1.94 a	1.83 a	91.45 a	92.31 a	12.78 a	12.28 a
	1.0 %	5.33 a	5.33 a	1.92 a	1.78 ab	92.45 a	90.24 a-c	12.65 a	12.41 a
NPK 100 %	0 %	5.33 a	5.00 a	1.33 a-c	1.88 a	92.02 a	92.87 a	12.45 a	12.27 a
	0.50 %	5.00 a	5.00 a	1.67 a-c	1.86 a	90.72 a	91.54 ab	12.41 a	12.42 a
	0.75 %	5.67 a	5.33 a	1.73 ab	1.70 ab	90.15 a	89.69 a-c	12.65 a	12.13 a
	1.0 %	5.00 a	5.00 a	1.90 a	1.75 ab	90.50 a	89.68 a-c	12.74 a	12.45 a

* Values followed by similar letter (s), within a comparable group of means, do not significantly differ, using D multiple range test, at 0.05 level.

but, with insignificant differences between the two high concentrations (0.75% and 1.0%), in the two growth seasons. These results could be attributed to the effect of seaweed extract concentrations on increasing the absorption of nutrients and on photosynthesis process, that led to more accumulation of metabolites in reproductive organs; which, in turn, improved the potato tuber quality (Gawish *et al.;* 1994 and Haider, 2012). The results illustrated also that the mean values of the four studied characters under 0.5% concentration of seaweed extract were not high enough to differ significantly from those of the control treatment; in the first season, 2013.

The differences between the mean value contents of total sugars, starch, carbohydra carotene appeared to be significantly influe the interaction effects between the different l NPK fertilizer with the different concentra seaweed extract, in the two seasons combinations between the each of concentrations of the seaweed extract; 0.5% and 1.0%; with NPK mineral fertilization of 100%, did not reflect any significant differe the mean values of the four studied cha during the two seasons.

The results, generally, illustrated that the addition of NPK fertilizer, as 75% of recommended rate, combined with spraying seaweed extract, at 0.75% resulted in the highest mean values in all the above mentioned treats. These results reflected the general trends of the finding of Gawish *et al.*(1994) and Haider (2012).

CONCLUSIONS

From the mentiend results, it could be concluded that the tuber roots yield and its components of sweet potato were significantly enhanced in response to the application of NPK fertilizer, as 75% of the commercially recommended rate, in combination with spraying seaweed extract, at the concentration of 0.75%. Accordingly, the negative impact of using NPK mineral fertilizer could be reduced by 25%, as a result of using a seaweed extract natural alternatives to replace one fourth of the mineral fertilization, without any prejudice to the value of the quantity and quality of sweet potato crop.

~~**1- Yield/ vine:**~~

~~Data in Table (1) clearly show that spraying clusters of Early sweet grapevines with GA_3 at 10 to 40 ppm or Sitofex at 2.5 to 10 ppm was significantly effective in improving the yield relative to the check treatment. The promotion on the yield was accompanied with increasing concentrations of each plant growth regulator. Using GA_3 at 10 to 40 was significantly preferable than using Sitofex at 2.5 to 10 ppm in improving the yield. A slight and unsignificant promotion on the yield was attributed to increasing concentrations of GA_3 from 20 to 40 ppm and Sitofex from 5 to 10 ppm. The maximum yield was produced on the vines that received one spray of GA_3 at 40 ppm but the best treatment from economical point of view was the application of GA_3 at 20 ppm (since no measurable promotion on the yield was recorded between 20 and 40 ppm of GA_3). Under such promised treatment, yield/ vine reached 13.6 and 14.0 kg during both seasons, respectively. The control vines produced 9.1 and 9.6 kg during 2013 and 2014 seasons, respectively. The percentage of increase on the yield due to application of GA_3 at 20 ppm over the check treatment reached 49.5 and 45.8 % during both seasons, respectively. The beneficial effects of GA_3 on the yield might be attributed to their positive action on increasing cluster weight. The promoting effects of GA_3 on the yield was supported by the results of Dimovska *et al.*, (2011) and Abu- Zahra and Salameh (2012) on different grapevine cvs.~~

~~The results regarding the beneficial effects of Sitofex on enhancing the yield are in harmony with those obtained by Juan *et al.* (2009); Abdel- Fattah *et al.*, (2010) and Al- Obeed (2011).~~

~~**2- Harvesting date:**~~

~~It is clear from the data in Table (1) that and Sitofex treatments had significantly del the harvesting date of Early Sweet grapevine than the control treatment. The degree of de on harvesting date was correlated to the inc the concentrations of both GA_3 and Sitofex GA_3 significantly delayed harvesting comparing with using Sitofex. In concentrations of GA_3 from 20 to 40 p Sitofex form 5 to 10 ppm failed to show sig delay on harvesting date. A cons advancement on harvesting date was obse untreated vines the great delay on harvesti was observed on the vines that received GA ppm during both seasons. GA_3 and Sitofe shown by many authors to retard the rel ethylene and the disappearance of pigments chlorophylls and carotenoids and onest of r start. Also they were responsible for prolong maturity stages Nickell (1985). These regarding the delaying effect of GA_3 and Sit harvesting date were in harmony with obtained by Wassel *et al.*, (2007), Kasser (2011), Abu- Zahra and Salameh (2012) and *et al.* (2012).~~

~~**3- Cluster weight and dimensions:**~~

~~It is evident from the data in Table treating clusters with GA_3 at 10 to 40 Sitofex at 2.5 to 10 ppm was signi accompanied with enhancing weight, leng width of cluster relative to the control treatm~~

The promotion was significantly associate
increasing concentrations of GA_3 and Sitofex
GA_3 was significantly favourable than using
in this respect. The maximum values were r
on the vines that received one spray of GA
ppm. Meaningless promotion was detecte
increasing concentrations of GA_3 from 20 to
and Sitofex from 5 to 10 ppm. The untreate
produced the minimum values during both s
The positive action of GA_3 on cluster wei
dimensions might be attributed to its essen
on stimulating cell division and enlargem
cells, the water absorption and the biosynth
proteins which will lead to increase berry
Dimovska *et al*., (2011); Abu- Zahra and S
(2012) and Dimovska *et al*., (2014).

The previous essential role of CPPU on
weight was attributed to its higher con
cytokinin when applied to plants (Nickell, 19

4- Shot berries %:

Data in Table (2) obviously reve
percentage of shot berries in the clusters o
Sweet grapevines was significantly controll
spraying GA_3 at 10 to 40 ppm or Sitofex at 2
ppm relative to the check treatment. Using G
preferable than using Sitofex in reduci
percentages of shot berries. There was a

reduction on the percentage of shot berries with increasing concentrations of GA_3 and Sitofex. There was a slight reduction on such unfavourable phenomenon with increasing concentrations of GA_3 form 20 to 40 ppm and Sitofex from 5 to 10 ppm. The minimum values of shot berries (7.3 and 6.9 % during both seasons, respectively) were recorded on the clusters harvested from vines treated with GA_3 at 40 ppm. The maximum values of shot berries (12.0 & 12.5 %) during both seasons were recorded on the untreated vines during both seasons. The reducing effect of GA_3 on shot berries might be attributed to its important role on enhancing cell division and the biosynthesis of proteins Nickell, (1985). These results were supported by the results of wassel *et al*. (2007) and Abu Zahra and Salameh (2012).

5- Fruit quality:

Data in Tables (2, 3 & 4) clearly show that spraying clusters with GA3 at 10 to 40 ppm or Sitofex at 2.5 to 10 ppm significantly was accompanied with enhancing weight, longitudinal and equatorial of berry, total acidity%, proteins % and percentages of P, K and Mg and T.S.S. %, reducing sugars %, T.S.S. / acid and total carotenoids relative to the check treatment. The effect either increase or decrease was associated with increasing concentrations of each auxin. Using GA_3 significantly changed these parameters than using Sitofex. A slight effect was recorded on these quality parameters with increasing concentrations of GA_3 from 20 to 40 ppm and Sitofex from 5 to 10 ppm. From economical point of view, the best results with regard to fruit quality were observed due to treating clusters with GA_3 at 20 ppm. Untreated vines produced unfavourable effects on fruit quality. These results were true during both seasons. The effect of GA_3 on increasing berry weight and dimensions might be attributed to its effect in promoting cell division and enlargement of cells, water uptake and the biosynthesis of proteins Nickell (1985). These results were in concordance with those obtained by Williams and Ayars (2005) and Dimovska *et al*., (2014).

The higher content of Sitofex from cytokinins surly reflected on enhancing cell division and the elongation of berries Nickell (1985). These results were in agreement with those obtained by Abu-Zahra (2013) and Retamales *et al*. (2015).

CONCLUSION

Treating Early Sweet grapevines once when the average berries reached 6mm with GA_3 at 20 ppm was responsible for promoting yield and fruit quality.

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الملخص العربى

رش تركيزات مختلفة من مستخلصات الأعشاب البحرية تحت مستويات مختلفة من الأسمدة المعدنية (ن- فو- بو) على نباتات البطاطا الحلوة

رش حامض الجبريليك والسيتوفكس فى تحسين المحصول وجودة حبات العنب الايرلى سويت فى منطقة المنيا- مصر

مختار منصور دوس، سناء مرسى العربى، محمد أحمد عبد الفتاح وأميرة عبد الحميد هلالى

قسم الخضر- كلية الزراعة – جامعة الإسكندرية

محمد على مجاور عبادة، ماهر خيرى يواقيم، بسام السيد عبد المقصود بلال

قسم بحوث العنب – معهد بحوث البساتين- مركز البحوث الزراعية- الجيزة- مصر

يت هذه الدراسة بمحطة البحوث الزراعية بمنطقة أبيس، والتابعة لكلية الزراعة- جامعة الإسكندرية، خلال ن الصيفيين لعامي 2013 و2014. وتهدف الدراسة إلى تقييم مدي استجابة نباتات البطاطا(صنف أبيس) كيزات مختلفة من مستخلصات الاعشاب البحرية بمعدلات مختلفة (0.5%، 0.75% و 1.0%)، بالإضافة لة المقارنة(صفر % الرش بالماء المقطر) وذلك مع مستويات مختلفة من السماد المعدنى(ن- فو- بو)، وذلك

، نسب مختلفة(25%، 50%، 75% و100 %) من المعدل الموصى به فى الإنتاج التجارى للمحصول،
؛ إلى معاملة المقارنة(بدون إضافة سماد من ن– فو– بو)، وكذلك تقييم تأثير التداخل بينهم على صفات النمو
، المحصول ومكوناته وكذا بعض الصفات الكيميائية لجذور البطاطا المتدرنه.

اظهرت النتائج بصورة عامة أن الإضافات التدريجية لمستويات السماد المعدنى(ن– فو– بو) قد أدت إلى
معنوية على نمو نباتات البطاطا وكذلك على المحصول ومكوناته. كما أظهرت النتائج أن رش نباتات البطاطا
ص الأعشاب البحرية بتركيز 0.75% قد أدى إلى استجابة إيجابية على جميع الصفات موضع الدراسة خلال
النمو. وعموما، فإن التوافق بين تأثيرات المستويات المختلفة من العاملين المدروسين قد أظهرت أن المعاملة
التى أعطت أفضل نمو خضرى للنباتات وأعلى محصول كلى من الجذور الدرنية– وكذلك مكونات المحصول–
م لمحتويات الجذور من التراكيب الكيماوية المدروسة، أتضح أنها المعاملة العاملية التى تشمل إضافة الأسمدة
(ن– فو– بو) بمعدل 75% من الكميات الموصى بها فى الإنتاج التجارى للمحصول، وذلك مع الرش الورقى
بمستخلص الأعشاب البحرية بتركيز 0.75%.

ن ذلك يتضح أن الرش الورقى بمستخلص الأعشاب البحرية بتركيز 0.75%، يؤدى إلى تقليل إستخدام التسميد
(ن– فو – بو) بمعدل 25% من الكميات التى تستخدم فى الإنتاج التجارى مع المحافظة على النمو الخضرى
كذلك الإنتاج للجذور الدرنية، كما ونوعا.

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