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GROWTH, YIELD, QUALITY AND STORABILITY OF POTATO (*Solanum tuberosum* L.) IN RESPONSE TO SOME FOLIAR APPLICATIONS OF GROWTH STIMULANTS

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ABSTRACT: *This study was carried out at Mehalet Menouf village, Algharbia Governorate during two seasons of 2011/2012 and 2013/2014. The aim of this study was to investigate the effect of six foliar applications of growth stimulants i.e., garlic extract, at 1 and 2ml/L., yeast extract at 2 and 5g/L, amino acids at 1.5 and 3g/L. seaweed extract at 1 and 2ml/L., humic acid at 1 and 2g/L and liquid potassium (K_2O) at 2 and 4 ml/L. on growth, yield, quality and storability of potato (Solanum tuberosum L.) cv. Flora. Each treatment was applied 6 times during the growing season in addition to spraying with tap water as a control treatment. The experimental design was a randomized complete block design with three replicates. Results indicated that foliar application of amino acids and liquid potassium, generally enhanced plant growth parameters,tuber yield and tuber physical properties. Also foliar application of yeast extract, seaweed extract and liquid potassium were the most effective treatments for yield and tuber physical characteristics. Moreover, liquid potassium treatment gave the lowest value for storage losses percentage. It could be concluded that, the best values of potato plants (growth, yield and quality) were obtained when adding amino acids, yeast extract, seaweed extract and liquid potassium as a foliar spraying.*

Key words: *Potato, yeast, garlic, seaweed extract, amino acids, humic acid, liquid potassium, plant growth, yield and chemical properties.*

INTRODUCTION

Potato (*solanum tuberosum* L.) belongs to Solanaceae family, it is the fourth important crop for human consumption after wheat, maize and rice crops. The area cultivated with potato was 381,000 Fed. with total production of 4265,000 Ton (AOAD, 2014). Recently, great attention has been focused on the possibility of using natural substances as a substitute for chemical fertilizers which have pollutant effects in the soil and plants.

Garlic is antibacterial and antifungal agent acting as an inhibitor for some diseases (Didry *et al.*, 1987, Cellini et al., (1996), and Yin and Tsoa, (1999). Singh and Shukla (1984) found that garlic extract was more effective compared to some antibiotics (penicillin, ampicillin, doxycycline, streptomycin and cephalexin) for controlling micro-organisms. Seham (2002) and Fayed (2014) showed that garlic extract increased vegetative growth characteristics of squash. Morsy *et al.* (2009) found an increase in the number of leaves/plant in cucumber plants when treated with garlic extract.

Foliar sprays of bread yeast or seaweed extracts are used for stimulating and

hastening plant growth, flowering and fruit set and consequently increasing early and total yield (El-Ghamriny *et al.*, (1999); El-Aidy *et al.*, (2002). Radwan (2003) and Ahmed *et al.,* (2011) found that spraying potato plants with yeast gave the highest values of growth characters compared with control. Seaweed extracts have significant effects on plant growth parameters and yield as reported by Kowalski *et al.* (1999) and Fawzy *et al.* (2012) on potato and garlic respectively. Jensen (2004) reported that seaweed extracts contain various micro elements (Cu, Zn, Mo, B, Co) in addition to macro elements as well as auxins, gibberellins and cytokinins, leading to significant increase in root growth, nutrients absorption and stem thickness

Amino acids are extremely important biological compounds that play central roles both as building blocks of proteins and as intermediates in metabolism (Aberg, 1961). The importance of amino acids came from their widely use for the biosynthesis of a large variety of non-proteinic nitrogenous materials, i.e, pigments, vitamins, coenzymes, purine and pyrimidine bases (Strove, 1986). Spraying of amino acids significantly increased all growth and yield aspects as reported by El-Shabasi *et al.,* (2005) and Tarek and hassan (2014) in garlic,El-Zohiri and Asfor, (2009) in potato and Fawzy *et al.,* (2012) on onion.

Humic substances are generated through organic matter decomposition and employed as soil fertilizers in order to improve soil structure and soil microorganisms (Halime *et al.,* 2011). The application of humates was tested as an approach to improve both the nutrient balance and plant vitality (Boehme *et al.,* 2005). Gad El-Hak *et al.* (2012) showed that green pod yield and its components of peas plants were markedly affected by humic acid.

Potassium has a crucial role in the energy status of the plant, translocation and storage of assimilates and maintenance of tissue water relation. Also, potassium improves size of fruit and stimulates root growth. It is necessary for the translocation of sugars and formation of carbohydrates. Abd El-Fattah *et al.,* (2002) and El-Morsy (2004) on garlic plant, found that application of potassium at 96 kg/fed. significantly increased all vegetative growth characters. On potato, Awad *et al.,* (2010) indicated that foliar application of potassium sulphate (1%) recorded the highest values of vegetative growth parameters.

Therefore, the aim of this study was to investigate the effect of foliar applications of some substances which have been known to promote growth in some crops, on growth, yield, quality and storability of potato crop.

MATERIALS AND METHODS

This study was carried out at a private farm in Mehalet Menouf village, Tanta, Algharbia Governorate, Egypt during two seasons of 2011/2012 and 2013/2014. The aim of this study was to investigate the effect of six foliar applications of growth stimulants each applied in two concentrations. n addition to control plants which sprayed only with tap water on growth, yield, quality and storability of potato *Solanum tuberosum* L. cv. Flora. Seed tubers were planted on December 23th and 20th in the first and second season, respectively.

The six foliar applications of growth stimulants i.e., garlic extract at 1 and 2 ml/L., yeast extract at 2 and 5 gm/L., amino acids at 1.5 and 3 gm/L., seaweed extract at 1 and 2 ml/L., humic acid at 1 and 2 gm/L., liquid

potassium at 2 and 4 ml/L. and control treatment.

The experiments were set up in a randomized complete block design with three replicates. Plants were sprayed with the treatments six times at 15 days intervals from planting date during the growing seasons. The plot area was 14.70 m^2 consisted of 3 rows, 7m length and 0.7m width. All agricultural practices were performed as recommended by Egyptian Ministry of Agriculture and were harvested after 125 days from planting.

Samples of nine potato plants were taken at 75 days after planting from each experimental plot to measure plant height (cm), number of leaves, number of main stems/plant, foliage fresh and dry weight/plant (g) and leaf area/plant (cm^2).Total tuber yield (ton/fed), number of tubers/plant and tuber weight/plant (g) and specific gravity (SG)(g/cm^3) were determined at harvesting time. Specific gravity was determined as:

$$SG = \frac{\text{Weight of tubers in air}}{\text{(weight in air) - (weight in water)}}$$

The contents of Nitrogen (N), Phosphorus (P) and potassium (K) were determined in the fourth leaf at 75 days from planting as well as in tubers at harvest time. Samples of potato tubers were dried at 70 °C until constant weight. N, P and K content were determined according to the methods described by Koch and McMeekin (1924), dry matter and starch content percentage were evaluated according to A.O.A.C (2000). Total carbohydrates of tubers were determined colorimetrically according to Dubois *et al.,* (1956). Total and reducing sugars were determined in dry matter of a random tuber samples according to Michel *et al.,* (1948). Total protein percentage in tubers was calculated as N ×6.25.

Potato tubers were harvested after 125 days and weighted, then it were divided into two parts, one of them was stored at Nawalla for 3 months. The Nawalla is a traditional Egyptian store for keeping potatoes at ambient temperature,this store was built from perforated mud bricks or normal bricks under shade, where potato are placed in piles (2.2m width, 5.2m length, and 1.5m height). The piles were covered with 30cm thickness rice straw (dusted with insecticide to protect tubers from light and insects. Piles were placed 50cm in between and 25 cm from Nawalla wall .It had upper and lower openings which was covered with meshes for protection and ventilation requirements.

The other part were kept at refrigerator at 4° c for 5 months. Tubers were weighted again at the end of these two periods to calculate weight lossand sprouting percentage.

Collected data were statistically analyzed by the analysis of variance (ANOVA) using the MSTATC computer software program adopted by Bricker, (1991). Data were analyzed by analysis of variances (ANOVA) one-way. Duncan's multiple range test was calculated for multiple mean comparisons at a significance level of 5%.

RESULTS NAD DISCUSSION

Vegetative characters

Data presented in Table (1) show that plant height, number of main stems/plant, number of leaves/plant, fresh weight of plant and leaf area/plant at 75 days after planting were significantly increased by foliar spraying with all tested treatments compared to the control, while dry weight of plant was not significantly increased, in both seasons.

Table 1: Effect of garlic extract, yeast extract, amino acids, seaweed extract, humic acid and liquid potassium on vegetative characters of potato during 2011/2012 and 2013/2014 seasons.

Treatments	Plant height (cm)		No. of Main stems/plant		No. of Leaves /plant		Plant fresh weight (g)		Plant dry weight (%)		Leaf area/ plant (cm^2)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Garlic extract 1ml/L.	36.4ab	47.56 c	2.67 d	3.00 gh	35.12d	39.99gh	188.55g	196.80gh	10.25	10.53	2617.63 ef	3105.55d
Garlic extract 2 ml/L.	37.99ab	47.00 c	2.93 c	2.93 hi	41.66c	43.99fg	193.66fg	206.58 fg	10.15	10.87	2602.00 f	3138.03cd
Yeast extract 2g/L.	37.63ab	46.85 c	3.17 b	3.55 bc	47.96ab	54.93bc	208.29bc	224.80 cd	10.15	11.39	2858.97cd	3200.99ab
Yeast extract 5g/L.	37.15ab	46.33 c	3.03bc	3.31 ef	46.25ab	48.44ef	202.99de	219.32 de	10.14	10.92	2762.37 de	3250.94ab
Amino acid 1.5ml/L.	38.92ab	48.40 c	3.45 a	3.46 cd	50.84ab	57.66ab	210.03ab	233.67 bc	10.25	11.08	2898.17 bc	3281.17ab
Amino acid 3ml/L.	42.15a	56.36ab	3.47 a	3.71 ab	52.21a	59.88ab	213.42ab	243.66 ab	10.16	11.37	3085.83 a	3317.90a
Seaweed extract 1ml/L.	36.55ab	48.52 c	3.10bc	3.41 de	49.58ab	52.27cd	204.44cd	221.59 de	10.14	10.99	2887.63 bc	3149.37cd
Seaweed extract 2ml/L.	41.99a	49.02 c	3.14 b	3.45 cd	51.15a	56.43ab	204.25cd	233.91 bc	10.15	11.14	2979.97 ab	3198.40ab
Humic acid 1g/L.	34.55bc	44.63cd	2.98bc	3.13 fg	43.96bc	49.70de	196.54 f	211.66 ef	10.20	11.10	2895.73 bc	3133.20cd
Hmic acid 2g/L.	37.85ab	50.26bc	2.99bc	3.17 fg	47.99ab	51.19cd	199.51ef	214.58 de	10.19	10.99	2972.23 ab	3184.50bc
Potassium 2ml/L.	42.96a	50.55bc	3.44 a	3.66 ab	49.77ab	57.07ab	204.78cd	236.09 bc	10.23	11.11	3048.57 ab	3198.70ab
Ppotassium 4ml/L.	41.39a	60.93 a	3.57 a	3.86 a	51.56a	62.08a	215.14 a	249.29 a	10.24	11.25	3084.20 a	3298.90ab
Control	31.96c	39.48 d	2.58 d	2.81 i	31.28d	36.99h	178.14 h	187.78 h	10.08	10.81	2569.57 f	3079.23d
F. test	*	**	**	**	**	**	**	**	N.S	N.S	**	**

Means followed by the same letter(s) within each column do not significantly differ using Duncan's multiple range test at the level of 5%.

The highest values of all vegetative growth parameters were obtained with amino acids and liquid potassium compared with other treatments. These results may be due to the increase in productivity of the photosynthetic areas.

The promotional effect of amino acids on plant development of potato plants may be due to the regulatory effects of certain amino acids on plant development through their influence on enhancing production of gibberellins in plant tissues (Waller and Nowaki, 1978). Moreover, amino acids are the starting materials for the synthesis of alkaloids and various products of secondary metabolisms (Strove, 1986). El-Nabarawy (2001) illustrated that the importance and role of amino acids in synthesizing processes of chlorophyll and enzymes that are very important for growth and protein synthesis.Bidwell (1980) stated that amino acids are known as building blocks of proteins, regulators of metabolism, transport and storage of nitrogen.

The enhancement effect of potassium on vegetative growth may be due to the promotion of the translocation of newly synthesized photosynthesis as well as a beneficial effects on the metabolism processes which reflected on plant growth.These results are in agreement with Abd El-Aal *et al.* (2010) on squash, and Fawzy *et al.,* (2012) on onion, who reported significant effect of amino acids in the enhancement of vegetative growth parameters. Also, Ghoname *et al.* (2007) on onion, and Awad *et al.,* (2010) on potato found that K application positively affected growth parameters.

Yield and tuber physical characteristics

The results presented in Table (2), show that the effect of growth stimulants was significant for all traits in the second season compared to control treatment whereas in the first season, it exhibited significant values only for total yield/fed. Generally, the highest values was recorded by liquid potassium, amino acids and seaweed extract. The positive effect of foliar application treatments on total yield may be attributed to the effect of these substances on some physiological processes such as photosynthesis, metabolism, translocation of carbohydrates, nutrients uptake, glycolysis (Russell, 1973), and tricarboxylic acid cycle as the main source of respiratory and activation of many enzymes, which in turn accelerated and increased plant growth, that might finally increase total yield of potato plant. The positive effects of applying active yeast extract and seaweed extract were attributed to its own contents of different nutrients, high percentage of protein, large amounts of vitamin B and natural plant growth regulators such as cytokinins (Glick, 1995 and Fathy and Farid, 1996); physiological roles of vitamins and amino acids in the yeast and seaweed extract which increased the metabolic processes role and levels of endogenous hormones, i.e., IAA and GA3 (Chaliakhyan, 1957 and Sarhan and Abdullah, 2010) which may promoted the vegetative growth characters which in turn reflected on increasing the tubers yield and enhancing the tubers quality. These results coincide with those obtained by Ghoname *et al.*, 2010 on sweet pepper, El-Tohamy (2008) on eggplant, who found significant positive effect of either seaweed or yeast.

Chemical components

Data presented in Tables 3 and 4 show that tubers content of nitrogen and protein %

Table 2: Effect of garlic extract, yeast extract, amino acids, seaweed extract, humic acid and liquid potassium on yield and physical characteristics of potato tubers during 2011/2012 and 2013/2014 seasons.

Treatments	No. of tubers/plant		Weight. of tubers/plant (g)		Average weight. of tuber (g)		Total yield/ fed. (Ton/fed.)		Dry weight. of tubers (%)		Specific gravity (g/cm^3)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Garlic extract 1ml/L.	10.00	4.9 bc	533.33	417.60 g	53.38	180.42 ab	9.08 f	9.49 g	16.87	18.94 cd	0.93	1.30 bc
Garlic extract 2 ml/L.	9.20	5.5 abc	540.00	446.34 f	67.18	156.42 cd	9.88 cd	9.39 g	16.91	18.94 cd	0.97	1.21 bc
Yeast extract 2g/L.	8.53	5.80 abc	633.33	474.87 de	94.92	147.96 cd	10.44 bc	10.57 de	16.90	19.09 ab	0.96	1.27 bc
Yeast extract 5g/L.	10.87	6.1 ab	640.00	462.20 ef	58.63	163.34 bc	10.06 cd	9.91 fg	17.03	18.96 cd	1.00	1.17 cd
Amino acid 1.5ml/L.	9.87	6.00 abc	483.33	506.60 ab	53.07	158.74 bc	10.85 ab	11.18 bc	16.99	19.12 ab	0.96	1.39 ab
Amino acid 3ml/L.	10.13	6.20 ab	540.00	513.37 ab	55.53	154.79 cd	11.12 ab	11.76 ab	17.07	19.15 a	0.93	1.23 bc
Seaweed extract 1ml/L.	10.60	5.47 abc	613.33	495.07 bc	64.41	122.48 f	9.63 de	10.67 cd	16.99	19.11 ab	0.96	1.21 bc
Seaweed extract 2ml/L.	8.40	5.53 abc	633.33	509.30 ab	75.53	141.39 de	10.82 ab	10.43 ef	17.04	19.09 ab	0.98	1.49 a
Humic acid 1g/L.	9.00	5.80 abc	676.67	484.87 cd	99.40	130.32 ef	10.51 ab	10.84 cd	16.93	19.01 bc	0.94	1.25 bc
Hmic acid 2g/L.	10.73	5.53 abc	550.00	499.20 ab	55.65	168.37 bc	10.85 ab	10.75 cd	16.99	19.03 bc	0.96	1.06 d
Potassium 2ml/L.	7.40	6.67 a	836.67	510.80 ab	127.22	157.57 cd	11.03 ab	11.28 bc	17.10	19.09 ab	0.98	1.22 bc
Ppotassium 4ml/L.	11.00	6.47 a	486.67	518.70 a	47.64	142.32 de	11.17 a	12.29 a	17.12	19.11 ab	0.99	1.06 d
Control	11.53	4.60 c	660.00	452.33 f	70.53	199.74 a	9.27 ef	8.59 h	16.87	18.86 d	0.98	1.16 cd
F. test	N.S	*	N.S	**	N.S	**	**	**	N.S	**	N.S	**

Means followed by the same letter(s) within each column do not significantly differ using Duncan's multiple range test at the level of 5%.

Table 3: Effect of garlic extract, yeast extract, amino acids, seaweed extract, humic acid and liquid potassium on chemical components of leaves and potato tubers during 2011/2012 and 2013/2014 seasons.

Treatments	N % in leaves		N % in tubers		P % in leaves		P % in tubers		K% in leaves		K % in tubers	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Garlic extract 1ml/L.	4.20	2.80	2.44 a	1.62	0.40	0.47 a	0.19 ab	0.21	3.86 ab	3.64	2.61 ab	1.57
Garlic extract 2 ml/L.	3.27	2.71	2.02 ab	1.51	0.41	0.48 a	0.23 a	0.23	3.67 ab	4.06	2.60 ab	1.47
Yeast extract 2g/L.	3.27	2.80	1.21 c	1.69	0.44	0.47 a	0.15 b	0.24	3.31 bc	2.69	2.15 bc	1.35
Yeast extract 5g/L.	4.48	2.80	2.06 ab	1.60	0.44	0.50 a	0.19 ab	0.22	3.87 a	3.29	2.40 ab	1.25
Amino acid 1.5ml/L.	2.52	2.52	1.95 ab	1.66	0.43	0.49 a	0.16 b	0.20	2.75 d	3.77	2.27 ab	1.35
Amino acid 3ml/L.	2.61	2.52	1.88 ab	1.52	0.42	0.49 a	0.15 b	0.22	3.39 b	3.47	2.11 cd	1.25
Seaweed extract 1ml/L.	2.61	2.80	1.81 b	1.62	0.43	0.49 a	0.19 ab	0.21	3.27 bc	3.61	1.83 de	1.37
Seaweed extract 2ml/L.	4.29	2.80	1.76 bc	1.68	0.47	0.47 a	0.16 b	0.20	3.65 ab	4.69	1.80 de	1.49
Humic acid 1g/L.	3.36	2.89	1.87 ab	1.53	0.46	0.42 b	0.19 ab	0.23	3.55 ab	6.27	1.66 e	1.51
Hmic acid 2g/L.	4.01	2.61	2.04 a	1.67	0.45	0.41 b	0.20 ab	0.20	2.93 cd	6.31	1.98 cd	1.27
Potassium 2ml/L.	3.17	2.80	1.90 ab	1.68	0.45	0.43 b	0.17 b	0.22	2.83 d	3.00	2.64 a	1.69
Ppotassium 4ml/L.	3.73	2.80	1.98 ab	1.69	0.45	0.40 b	0.24 ab	0.22	3.52 ab	4.71	2.63 ab	1.25
Control	3.08	2.80	1.56 bc	1.43	0.42	0.43 b	0.20 ab	0.22	2.53 d	5.66	2.34 ab	1.51
F. test	N.S	N.S	*	N.S	N.S	**	*	N.S	**	N.S	**	N.S

Means followed by the same letter(s) within each column do not significantly differ using Duncan's multiple range test at the level of 5%.

Table 4: Effect of garlic extract, yeast extract, amino acids, seaweed extract, humic acid and liquid potassium on chemical components of potato tubers during 2011/2012 and 2013/2014 seasons.

Treatments	Starch %		Protein %		Total carbohydrate (%) leaves		Total carbohydrate (%) tubers		Total sugars %		Reducing sugars %	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Garlic extract 1ml/L.	13.05	12.88	15.23 a	10.12	20.83 cd	21.93 bc	28.25 ab	20.63 c	2.80 a	1.78	0.13 cd	0.12 hi
Garlic extract 2 ml/L.	12.81	12.82	12.63 ab	9.44	18.59 d	20.74 cd	25.89 cd	25.96 ab	2.83 a	1.70	0.13 de	0.12 gh
Yeast extract 2g/L.	12.93	13.15	7.58 c	10.56	24.17 ab	25.20 bc	35.92 a	29.19 ab	2.30 bc	1.59	0.14 bc	0.14 cd
Yeast extract 5g/L.	12.99	12.90	12.89 ab	9.98	21.62 cd	22.85 bc	30.26 ab	28.25 ab	2.59 ab	1.47	0.14 bc	0.13 f
Amino acid 1.5ml/L.	12.93	12.93	12.17 ab	10.36	25.41 ab	23.80 bc	33.78 b	30.27 a	2.43 ab	1.55	0.14 bc	0.15 b
Amino acid 3ml/L.	12.99	12.83	11.75 ab	9.50	25.63 ab	23.20 bc	29.03 ab	30.62 a	2.26 bc	1.47	0.15 a	0.16 a
Seaweed extract 1ml/L.	12.81	12.85	11.31 b	10.13	22.56 bc	29.96 a	29.75 ab	25.99 ab	2.02 cd	1.58	0.14 cd	0.14 ef
Seaweed extract 2ml/L.	13.05	12.79	10.98 bc	10.48	23.38 bc	21.63 bc	29.05 ab	26.44 ab	1.96 cd	1.69	0.13 cd	0.14 de
Humic acid 1g/L.	12.81	12.95	11.69 ab	9.56	24.17 ab	26.45 ab	28.53 ab	22.99 bc	1.85 d	1.74	0.12 fg	0.13 g
Hmic acid 2g/L.	12.81	13.02	12.77 ab	10.46	21.55 cd	22.68 bc	24.27 cd	25.81 ab	2.17 bc	1.47	0.13 ef	0.13 f
Potassium 2ml/L.	13.11	13.29	11.88 ab	10.48	27.58 ab	23.52 bc	26.25 bc	28.81 ab	2.81 a	1.91	0.14 bc	0.15 bc
Ppotassium 4ml/L.	12.87	12.96	12.40 ab	10.58	29.55 a	23.63 bc	24.92 cd	28.77 ab	2.87 a	1.47	0.15 ab	0.15 b
Control	12.69	13.12	9.73 bc	8.94	21.55 cd	18.16 d	18.55 d	20.65 c	2.55 ab	1.73	0.12 g	0.11 i
F. test	N.S	N.S	*	N.S	**	**	**	*	**	N.S	**	**

Means followed by the same letter(s) within each column do not significantly differ using Duncan's multiple range test at the level of 5%.

were significant in the first season with the highest values recorded by garlic extract (1ml/L.) as well as humic acid (2g/L.)

For leaves content of phosphorus, data values were significant in the second season for leaves content of phosphorus with highest values were achieved by garlic, yeast, Amino acids and seaweed extract while it was significant in the first season for tuber content of phosphorus with highest values for garlic extract.

leaves content of Potassium was significant in the first season and the highest value was recorded by yeast extract, while liquid potassium (2ml/L.) recorded highest value of tubers content of potassium in the first season.

Carbohydrates contents in leaves was significant in the second season with highest values recoded by seaweed extract 1ml/L. while Carbohydrates content in tubers was significant in both seasons with highest values recorded by seaweed 1ml/L. as well as amino acids.

Total sugars content was significant in the first season, and amino acids treatment was the most effective treatment since it gave the highest value.

Concerning reducing sugars, it was significant in the second season, and highest values were recorded by amino acids 3ml/L. treatment

Storability

Data presented in Figure (1), indicates that liquid potassium application was the most effective treatment for reducing the losses percentage of tubers during either nawalla storage or refrigerator storage since it gave the lowest values for the two seasons of experiment.

From the previous results it could be concluded that liquid potassium had significant effect on total weight loss and sprouting percentage of potato tubers in both seasons.

This simulative effect may be due to the role of potassium on production of enzymes activity and enhance in the translocation of assimilate and protein synthesis (El-Desuki, *et al.* 2000 and Ali and Taalab, 2008).

These results were in line with the findings of El-Mansi *et al.* (1985), El-Sayed (1999) and Hameda *et al.*, (2012) on garlic bulbs, Mahmoud (1999), Oukal (1999) who found that adding of potassium decreased the weight loss percentage of onion bulbs during storage duration and Awad *et al.*, (2010) on potato who found that the lowest weight loss and sprouting percentage were recorded with foliar application of potassium 1%.

CONCLUSIONS

In general, foliar application of amino acids at 3 g/l, yeast extract at 5g/l, seaweed extract and liquid potassium at 2ml/L. can be recommended for improving growth, yield, and quality of potato. Also, foliar application of liquid potassium can be used for improving storability of potato tubers under the conditions of the experiment.

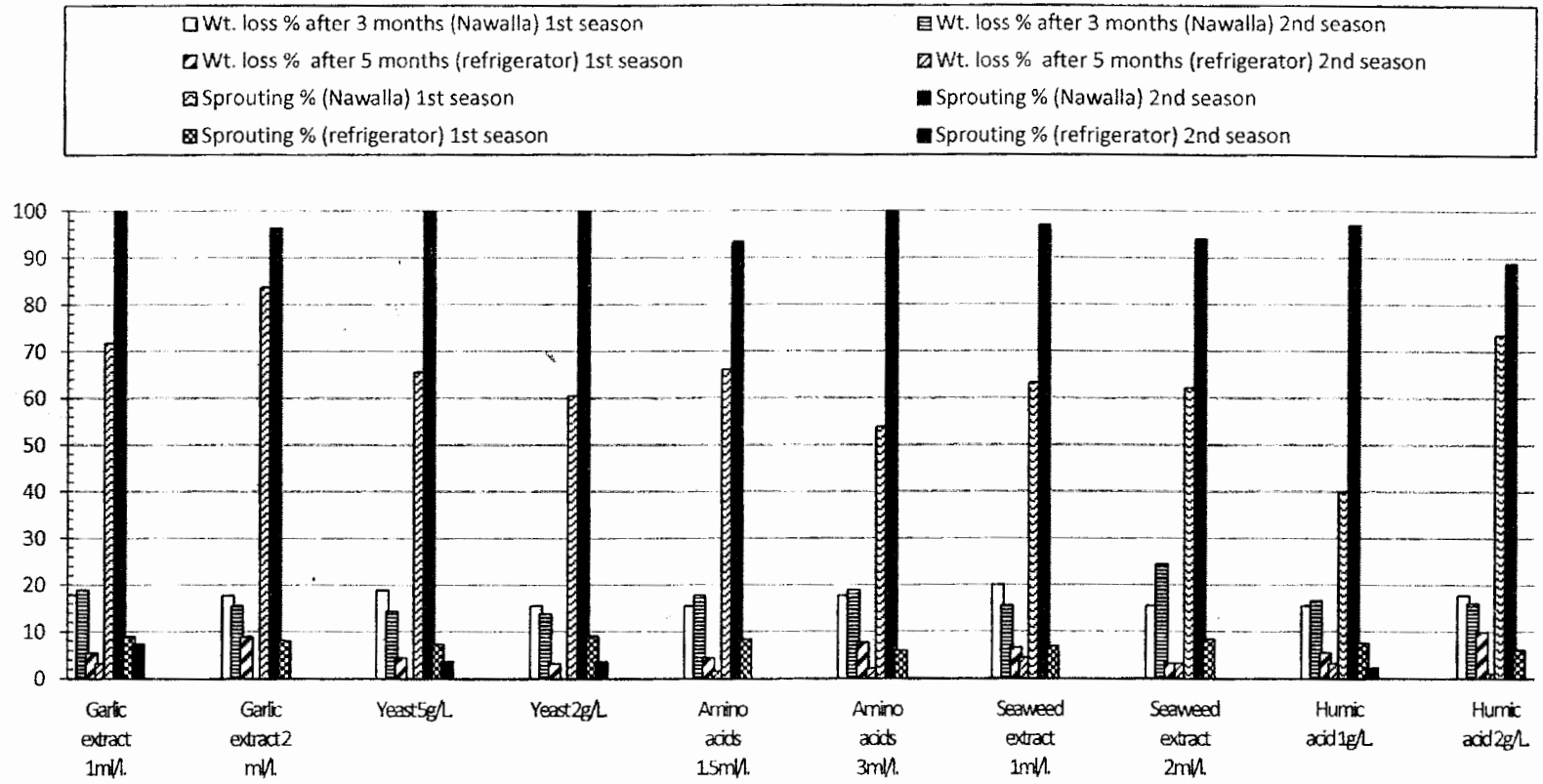

Figure 1: Effect of garlic extract, yeast extract, amino acids, seaweed extract, humic acid and liquid potassium on storability of potato tubers during 2011/2012 and 2013/2014 seasons.

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تاثير بعض معاملات الرش الورقى على النمو والمحصول والجودة والقدرة التخزينية لمحصول البطاطس

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الملخص العربى

تم دراسة تاثير الرش الورقى ببعض محفزات النمو على نمو وانتاجية وجودة الدرنات والقدرة التخزينية لنبات البطاطس صنف فلورا ومن اجل تحقيق ذلك تم تصميم تجربة حقلية بقرية محلة منوف مركز طنطا بمحافظة الغربية وذلك بنظام القطاعات الكاملة العشوائية واستخدم فى التجربة ستة محفزات للنمو (تركيزين من كل منهما) وهى مستخلص الثوم، الخميرة، الاحماض الامينية، مستخلص الطحالب البحرية، حمض الهيوميك والبوتاسيوم السائل بالاضافة الى الرش بماء الصنبور كمعاملة كنترول ثم اخذت بعض القياسات الخضرية،قياسات على محصول الدرنات، الصفات الفيزيائية للدرنات وبعض المكونات الكيميائية لكل من الاوراق والدرنات. وحللت النتائج احصائيا باستخدام البرنامج الاحصائىM-stat وعند وجود فروق معنوية بين متوسطات المعاملات تمت المقارنة بين المتوسطات باستخدام طريقة اختبار دنكن متعدد المدىعند مستوى معنوية ٥ %.

أظهرت النتائج وجود فروق معنوية فى بعض صفات النمو الخضرى والمحصول. وكانت معاملات الأحماض الأمينية و مستخلصات الخميرة والطحالب البحرية والبوتاسيوم السائل هى أفضل المعاملات فى تحقيق أفضل نتائج وذلك على حسب الصفة. بينما كان تفوق البوتاسيوم السائل واضحا حيث قلل من الفقد فى الوزن نتيجة التخزين .

عموما يمكن التوصية باستخدام معاملات الرش الورقى باضافةً البوتاسيوم السائل (٢و٤سم^3/لتر) والاحماض الامينية (٣ جم/لتر) والطحالب البحرية (٢ سم^3/لتر) ومستخلص الخميرة (٢و٥ جم/لتر) فى تحسين صفات النمو الخضرى والمحصول وايضا تحسين القدرة التخزينية لدرنات البطاطس.