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Productivity and Quality of Sweet Potato Roots Affected by Organic Fertilization and Some Environmentally Friendly Nutrients

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ABSTRACT

The Gharbeya Experimental Farm, El-Gemmeiza, Agric Res. Station (ARC) (Middle Delta, Egypt) conducted a field experiment over the course of two consecutive summer seasons in 2023 and 2024 to investigate the effects of compost rates as organic manure (zero and 5 ton/feddan.) and some stimulants as foliar spray (seaweed extract, fulvic acid, yeast extract, and lithovit at 2ml of each) as well as their interactions on the growth, leaf pigments, yield, and tuber roots quality of sweet potato (Beauregard cv.) under clay soil conditions. Fertilizing sweet potato plants grown in clay soil with compost as organic fertilizer at a rate of 5 tons/fed. and spraying with fulvic acid or yeast extract at a rate of 2 milliliters per liter increased the length of the plant, the number of branches and leaves per plant, the fresh weight of the shoots and the dry weight of the plant; it also increased the concentrations of chlorophyll a, b, and total chlorophyll (a+b) in the leaf tissues of sweet potato; weight of tuber root, marketable and total yield per feddan ; and the total sugars and starch content in the tuber roots.

In this regard, the conjunction between compost at a rate of 5 tons/fed. and spraying with yeast extract at 2 ml/liter recorded a relative increase in the total yield by 50.58%, followed by adding compost and foliar spray with fulvic acid at a concentration of 2 ml/liter, which recorded a relative increase of 47.0% as an average for the two seasons compared to the control treatment (0 compost + spraying with water).

KEYWORDS: Sweet potato, compost, fulvic acid, yeast extract, lithovit and yield.

1. INTRODUCTION

Ipomoea batatas (L.), or sweet potatoes, are a staple diet for people all over the world. Because of their high carbohydrate content, they are a vital source of energy. Numerous micronutrients, such as B vitamins, vitamin C, folate, potassium, phosphorus, and magnesium, are also present in them. Also, polyphenols found in sweet potatoes have hepatoprotective, anti-inflammatory, anti-cancer, and antidiabetic properties (Hu *et al*. 2016).

A lot of focus has been placed on using organic fertilizers to increase soil fertility, decrease nutrient losses, and lessen plant and soil contamination from mineral fertilizers. Furthermore, organic fertilizers were thought to be effective soil conditioners and providers of plant nutrients. The addition of organic matter can lower soil pH, increase the availability of major and minor nutrients, and improve all other aspects of the soil, including fertility (Tahoun *et al*., 2000).

Regarding this, fertilizing sweet potato plants with organic manure such as compost , farmyard manure or chicken manure had significant enhancing the growth of plant parameters, productivity and tuber roots quality (Naqib *et al*., 2016, Al-Esaily, 2017, Still , 2019, Zhao *et al*., 2020, Fernandes *et al*., 2021, Mohamed and El-Gepaly (2021), Li *et al*., 2022, Wang *et al*., 2022, Antonious, 2023 and Dong *et al*., 2023).

Seaweed extract, fulvic acid, yeast extract, and lithovit are examples of natural stimulants. Accordingly, seaweeds have been identified as a potential biostimulant to enhance the growth and yield of numerous crops across the globe because they contain a variety of microelements (Cu, Zn, Mo, B, and Co) and all trace elements and plant growth regulators, including auxins, gibberellins, and cytokinins, in varying amounts, despite being low in nitrogen, phosphorus, and potassium (Zhang and Ervin 2008). Similarly, fulvic acid has the ability to attract water molecules and help move nutrients like calcium, magnesium, iron, copper, and zinc to plant roots (Malan, 2015). Additionally, fulvic acid resembles the plant hormone auxin, which is in charge of starch metabolism and aids in potassium absorption (Priya *et al*., 2014). Furthermore, yeast has a stimulatory effect on plants and extracts a natural source of cytokinins. It is one of the best sources of protein, particularly vital amino acids, minerals, and trace elements, and it helps to promote the growth of plants (Mahmoud *et al.*, 2013). Additionally, when leaves are moist with dew at night, lithovit particles, which are present in a thin layer on their surface, often penetrate. Furthermore, lithovit contains nano-Mg, a nutrient that is vital for plant growth and is involved in numerous physiological processes in plants, including sugar synthesis, starch translocation, photosynthesis (Mg is the main component of the chlorophyll molecule), and regulation of nutrient uptake. Additionally, it functions as a phosphorus carrier in plants, an enzyme activator, and a component of several enzymes (Allison *et al*., 2001).

The growth, productivity, and tuber roots quality of plants were significantly impacted by the application of several stimulators (Doss *et al*., 2015 on sweet potato, Rizk *et al*., 2018 , Al- Bayati and Al-Quraishi 2019, Garai *et al.*, 2021, Mbuyisa *et al*., 2023 and Saleh *et al*., 2024 on potato as for seaweed extract). As for fulvic acid effect (Saif El-Deen *et al*., 2011, Abd- All *et al*., 2017, El- Metwaly, 2021 and Duan *et al., 2024* on sweet potato. The effect of yeast extract (El-Tohamy *et. al.* , 2015 and Abo EL-Fadl *et al.*, 2017 on sweet potato, Fouda , 2021 , Suliman *et al*., 2021 , Al-Zaidi and Al-Jumaili, 2022 on potato). Concerning the response to lithovit (Farouk, 2015 on potato, Abdelghafar *et al.,* 2016 on onion, Merwad *et al.* ,2018 on garlic and Salama and Haggag 2024 on potato.

In order to achieve good yield and the best tuber root quality, the primary goal of the current study was to examine how sweet potato plants responded to organic fertilization and foliar spray with some environmentally friendly nutrients like seaweed extract, fulvic acid, yeast extract, and Lithovit.

2. MATERIALS AND METHODS

The Experimental Farm in the Gharbeya Governorate's El-Gemmeiza Agric Res. Station (ARC) (Middle Delta, Egypt) conducted a field experiment over the course of two consecutive summer seasons in 2023 and 2024 to investigate the effects of compost rates and some stimulants as foliar spray as well as their interactions on the growth, leaf pigments, productivity, and the quality of sweet potato tuber roots (Beauregard cv.) grown in clay soil conditions.

The experimental soil's physical and chemical characteristics were as follows: it was clay loam soil with an average texture across two seasons, 1.09% organic matter, 8.02 pH, 1.03 mmhos/cm EC, 62.74 available N, 10.91 available P, and 237 available K as mg/kg soil.

Ten treatments were used in the experiment, which involved the interaction of two composts (zero to five tons per fed.) as organic fertilizer with four stimulants (fulvic acid, seaweed extract, yeast extract, and lithovit) in addition to water spraying as a control. Each of these treatments was put up in a split plot design with three copies. The stimulants were dispersed at random in the subplots, whereas the compost rates were organized in the main plots.

The area of the experimental unit was 12.6 m². It has three ridges that are each 6 meters long and separated by 70 centimeters. Two lines were used to determine yield, while one ridge was utilized to measure the morphological and chemical characteristics. Beauregard cultivar stem cuttings, about 20 cm in length, were transplanted on the third top of slope ridges at 25 cm apart on 25 and 28 April in 2023 and 2024 seasons, respectively.

In both growing seasons, the plants were sprayed four times with a manual pressure sprayer at a rate of 2 ml/L each of numerous stimulants, such as fulvic acid, seaweed extract, yeast extract, and lithovit, 45, 60, 75, and 90 days after transplantation. The different stimulants used in this work were obtained from Technogene Chemical Company in Dokki Giza.

In accordance with Morsi *et al*. (2008), yeast extract was made from active dry yeast (*Saccharomyces cerevisiae*), mixed in water, and then sugar was added at a 1:1 ratio. The mixture was then left in a warm environment for 24 hours to facilitate reproduction. Table (A) displays the results of the activated yeast extract chemical analysis.

Table A. Yeast extract chemical analysis

Mineral mg/100g dry weight		**Vitamins mg/100g dry weight**	
Total N	7.23	**Vit.B$_1$**	2.23
P_2O_5	51.68	**Vit.B$_2$**	1.33
K_2O	34.39	**Vit. B$_5$**	19.56
MgO	5.76	**Vit.B$_6$)**	1.25
CaO	3.05	**Vit. B$_7$**	0.09
SiO_2	1.55	**Vit. B$_8$**	0.26
SO_2	0.49	**Vit. B$_9$**	4.36
NaCl	0.30	**Vit B$_{12}$**	0.15
Fe	0.92	**Nicotinic acid**	39.88
Co	67.8	**Pamino benzoic acid**	9.23
Pd	438.6	**Carbohydrates**	23.2
Mn	81.3	**Glucose**	13.33
Zn	335.6		
Total amino acids	28.6		

The National Research Center (NRC, Giza, Egypt) Algae Production Station generated the algae extract. The primary components of the algal extract were 2057 ppm Fe, 699 ppm Zn, 751 ppm Mn, 89 ppm Cu, 50.56% crude protein, 9.83% crude fiber, 7.98% N, 2.71 % P, and 0.66 % K.

According to Carmen *et al*. (2014), lithovit is utilized as a product that contains calcium carbonate (80%), magnesium carbonate (4.6%), and iron (0.75%) as nanoparticles (Ca, Mg, and Fe).

Nitrogen, P and K were added at the rate of 40, 45 and 72 kg/fed. in the form of ammonium sulphate , calcium superphosphate potassium sulphate, respectively. When preparing the soil, a third of N, K_2O, and all P_2O_5 were applied. Two-thirds of the remaining N and K_2O were added again, 45 and 75 days after planting. Normal agricultural procedures were conducted as they are customarily done in the district.

2.1. Data Recorded

At 100 days following planting in the two seasons (2023 and 2024), a random sample of nine plants from each treatment (three plants from each replication) was selected to measure the following parameters:

Length of the vine (cm), both branches and leaves number per plant, as well as fresh and dry weight of the shoots (leaves + stems) per plant (g).

2.Leaf Pigments

Using the technique outlined by Wettestein (1957), a random sample was collected from the fourth upper leaf on the main stem during the two seasons under investigation in order to measure the levels of carotenoids and chlorophyll a and b at 100 days after transplanting.

3. Yield and its components

Every tuber root from each treatment was divided into two grades at harvest time: marketable and non-marketable roots, which was 125 days following planting. The total yield per faddan (ton) was then calculated by weighing the tuber roots. Tuber roots that weigh between 100 and 250 g are considered marketable, whilst those that weigh less than 100 g or more than 250 g are considered non-marketable. Additionally, the average weight of the tuber roots and their diameter were calculated.

4. Quality of tuber roots at harvest

Using the two techniques outlined by A.O.A.C. (2018), Dry matter analysis was used to determine the proportions of nitrogen, phosphorous, and potassium in tuber roots. Starch content (%): The A.O.A.C. (2018) technique was used to determine this. Total sugars (%): This was calculated using both of the methods Forsee (1938) described.

2.2. Statistical Analysis:

Snedecor and Cochran's (1980) statistical analysis of variance was applied to the recorded data, and Duncan's (1958) means separation was performed.

3.RESULTS AND DISCUSSION

3.1.Plant growth

3.1.1. Effect of compost fertilizer rate

The obtained results in Tables 1 to 5 shows that fertilizing sweet potato plants grown in clay soil with compost as organic fertilizer at 5 tons/fed. increased plant length (139.5 and 135.4 cm), branches number /plant (15.80 and 16.20), leaves number /plant (280.40 and 240.60), fresh weight of shoots (528.28 and 506.50 g), and dry weight (115.29 and 130.90 g) agnist unfertilized with compost which recorded (129.95 and 126.62 cm), (13.40 and 13.20), (252.0 and 231.20), (446.78 and 437.0 g), and (80.46 and 87.51 g) for plant length, branches number of plant , leaves number of plant , shoots fresh weight and dry weight, respectively at 100 days after transplanting (DAT) , in each of the seasons. The increases in shoots' dry weight were roughly 34.83 and 43.39 g/plant for compost at 5 tons/fed. over the control in the 1st and 2nd seasons, respectively.

This could be because organic manure contains a variety of living organism species that release photohormonases like GA_3, IAA, and CYT, which promote plant growth, nutrient absorption, and photosynthesis processes (Reyndres and Vlassake, 1982). Additionally, applying organic manures increased organic matter, fixed nitrogen, and increased the availability of major and minor nutrients (Tahoun et al., 2000). Increasing the amount of organic manure may have improved the vegetative development characteristics of sweet potato plants by increasing the amount of nutrients in the rooting zone, which in turn may have increased nutrient absorption.

These results are harmony with those obtained with Al-Esaily, (2017), Still, (2019), Nwanne, and Ikeh (2020) and Zhao *et al*. (2020). They showed that fertilizing sweet potato plants with organic manure gave the best results for increasing plant growth parameters as compared to untreated plants.

3.1.2. Effect of some stimulants

Foliar spray with some stimulants (seaweed extract, fulvic acid, yeast extract, and lithovit) at 2 ml of each increased plant length, branches number per plant, number of leaves/plant, shoots fresh weight, and shoots dry weight as compared to untreated (spraying with water) at 100 days after transplanting in both seasons (Tables 1 to 5). Spraying with fulvic acid or yeast extract at 2 ml/l of each significantly increased plant length, number of branches per plant, number of leaves per plant, fresh weight of shoots, and dry weight of shoots, followed by spraying with lithovit .

In the first and second seasons, the increases in dry weight of shoots for seaweed extract, fulvic acid, yeast extract, and lithovit above the control were around 36.2 and 58.8%, 83.8 and 104.4%, 85.5 and 105.3%, and 67.9 and 91.0 %, respectively.

Table 1. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on plant length (cm) at 100 DAT of sweet potato in both seasons 2023 and 2024

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	115.08 e	125.33 d	138.11 b	138.50 b	132.75 c	129.95 B
5 ton /fed.	122.62 d	139.06 b	146.00 a	146.50 a	141.07 b	139.05 A
Mean (S)	118.85 D	132.20 C	142.06 A	142.50 A	136.91 B	--
LSD at 5 %	A (CR)= 4.02		B (S)= 3.13		AxB (CRxS) = 4.93	
			2024 season			
Without	110.60 d	120.25 c	134.15 b	135.07 b	133.05 b	126.62 B
5 ton /fed.	118.20 c	132.75 b	141.69 a	142.00 a	140.57 a	135.04 A
Mean (S)	114.40 D	126.50 C	137.92 AB	138.54 A	136.81 B	--
LSD at 5 %	A (CR)=2.06		B (S)=1.60		AxB (CRxS) =2.27	

Table 2. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on number of branches / plant at 100 DAT of sweet potato in both seasons 2023 and 2024

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	10.00 e	11.00 de	15.00 c	16.00 bc	15.00 c	13.40 B
5 ton /fed.	12.00 d	15.00 c	17.00 ab	18.00 a	17.00 ab	15.80 A
Mean (S)	11.00 D	13.00 C	16.00 B	17.00 A	16.00 B	--
LSD at 5 %	A (CR)=0.99		B (S)=0.77		AxB (CRxS) =1.09	
			2024 season			
Without	9.00 f	11.00 e	15.00 d	16.00 cd	15.00 d	13.200 B
5 ton /fed.	11.00 e	16.00 cd	19.00 a	18.00 ab	17.00 bc	16.200 A
Mean (S)	10.00 D	13.500 C	17.00 A	17.00 A	16.00 B	--
LSD at 5 %	A (CR)= 0.99		B (S)=0.77		AxB (CRxS) =1.09	

Table 3. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on number of leaves / plant at 100 DAT of sweet potato in both seasons 2023 and 2024

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	195.00 h	230.00 f	280.00 cd	285.00 c	270.00 e	252.00 B
5 ton /fed.	220.00 g	275.00 de	305.00 a	307.00 a	295.00 b	280.40 A
Mean (S)	207.50 D	252.50 C	292.50 A	296.00 A	282.50 B	--
LSD at 5 %	A (CR)=7.45		B (S)=5.80		AxB (CRxS) = 8.21	
			2024 season			
Without	182.00 h	225.00 e	253.00 cd	251.00 cd	245.00 d	231.20 B
5 ton /fed.	195.00 g	210.00 f	270.00 a	268.00 ab	260.00 bc	240.60 A
Mean (S)	188.50 D	217.50 C	261.50 A	259.50 A	252.50 B	--
LSD at 5 %	A (CR)=7.45		B (S)=5.80		AxB (CRxS) =8.21	

Table 4. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on shoots fresh weight (g) at 100 DAT of sweet potato in both seasons 2023 and 2024

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	275.11 f	385.17 d	535.25 b	540.10 b	498.25 c	446.78 B
5 ton /fed.	350.06 e	495.10 c	620.13 a	625.00 a	551.10 b	528.28 A
Mean (S)	312.59 D	440.14 C	577.69 A	582.55 A	524.67 B	--
LSD at 5 %	A (CR)= 17.51		B (S)= 13.64	AxB (CRxS) =19.29		
			2024 season			
Without	265.00 g	375.00 e	525.00 b	527.50 b	492.50 c	437.00 B
5 ton /fed.	352.50 f	475.00 d	580.00 a	585.00 a	540.00 b	506.50 A
Mean (S)	308.75 D	425.00 C	552.50 A	556.25 A	516.25 B	--
LSD at 5 %	A (CR)=12.42		B (S)=9.67	AxB (CRxS) =13.68		

Table 5. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on shoots dry weight (g) at 100 DAT of sweet potato in both seasons 2023 and 2024

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2033 season			
Without	49.52 h	69.33 g	96.35 d	97.22 d	89.87 e	80.46 B
5 ton /fed.	77.01 f	103.04 c	136.23 a	137.55 a	122.60 b	115.29 A
Mean (S)	63.27 D	86.19 C	116.29 A	117.39 A	106.24 B	--
LSD at 5 %	A (CR)= 2.15		B (S)=1.67	AxB (CRxS) =2.37		
			2024 season			
Without	53.33 g	75.07 f	105.03 d	105.53 d	98.57 e	87.51 B
5 ton /fed.	73.73 f	126.67 c	154.67 a	155.33 a	144.10 b	130.90 A
Mean (S)	63.53 D	100.87 C	129.85 A	130.43 A	121.34 B	--
LSD at 5 %	A (CR)= 2.51		B (S)=1.96	AxB (CRxS) =2.77		

The improvements in vegetative growth characteristics observed after yeast spraying could be attributed to the elevation of endogenous hormone such as indole acetic acid “IAA” and gibberellic acid “GA_3”, vitamins and amino acids in the treated plants, which are believed to stimulate cell growth and division (Khedr and Faried, 2002). Additionally, fulvic acid may have a beneficial effect on sweet potato growth because it promotes vegetable growth and development, speeds up cellular division, boosts cellular energy, and controls plant metabolism to avoid nitrate compound buildup in plants (Jackson, 1993). Its function as a long-term reservoir that supplies plants with CO2 (Bilal, 2010) may also be the reason why plants respond to lithovit with greater growth than unsprayed plants. In general, higher CO_2 concentrations increase carbon assimilation, biomass, and leaf area of plants (Maswada and Abd El-Rahman, 2014).

These results are in harmony with these reported by El-Tohamy *et. al.* (2015) and Abo EL-Fadl *et al.* (2017). They mentioned that sweet potato plants spraying with yeast extract had enhanced effect on the parameters of plant growth than untreated plants. Also, El-Metwaly, 2021 came up with similar results on sweet potato for the fulvic acid effect.

3.1.3. Effect of the interaction

The interaction between 5 ton /fed. compost and foliar spray with fulvic acid at 2ml/l and the interaction between the same rate of compost and foliar spray with yeast extract at 2ml/l increased plant length, branches number per plant, leaves number /plant, fresh weight of shoots, and dry weight of shoots, followed by the interaction between compost at 5 ton /fed. and foliar spray with lithovit at 2ml/l in both seasons (Tables 1 to 5).

The increases in shoots dry weight were about 175.1 and 190.0% , 177.8 and 191.3%, 147.6 and 170.2 % for the interaction between 5 ton /fed compost and fulvic acid at 2ml/l as foliar spray and the interaction between 5 ton /fed. compost and yeast extract at 2ml/l as foliar spray with and the interaction between 5 ton /feddan compost and lithovit at 2ml/l as foliar spray over the interaction between 0 compost and spraying with water in the each of the two seasons.

According to Atti and Al-Sahaf (2007), The favorable benefits of each component alone or the combined and additive influence of the two components together may be the cause of the notable effects of interaction treatments between organic fertilizer and spraying yeast extract on the growth parameters of potato plants. In addition to providing a favorable environment for the yeast's development and activity, the organic fertilizer may encourage the yeast's breakdown.

These findings are consistent with those published by Kahlel (2015), who demonstrated that the organic fertilizer and yeast interaction treatments have a significant impact on the majority of the vegetative growth of potatoes, including the number of stems, leaf area, and fresh and dry weight of the plant when compared to the control treatment.

3.2. Leaf pigments

3.2.1. Effect of compost fertilizer

Fertilizing sweet potato with compost at 5 ton /fed. significantly increased all leaf pigments of sweet potato at 100 days after transplanting and produced the maximum concentrations of chlorophyll a (3.350 and 3.368), chlorophyll b (1.282 and 1.276), chlorophyll a+b (4.623 and 4.644) and carotenoides (2.168 and 2.168) mg /gDW agnist control treatment which produced (3.054 and 3.120), (1.128 and 1.200), (4.182 and 4.320) and (2.116 and 2.036) mg /g DW for chlorophyll a, chlorophyll b , chlorophyll a+b and carotenoides (mg /g DW) in the 1st and 2nd seasons, respectively (Tables 6 to 9).

The increases in total chlorophyll in leaf tissues of sweet potato were about 10.76 and 7.5 % for fertilizing with at compost at 5 tons/fed. over the zero compost (control treatment) in the 1st and 2nd seasons, respectively.

These results are in harmony with those reported by Naqib *et al*. (2016) and El-Shahat *et al*. (2023). They indicated that the chlorophyll a, chlorophyll b, total chlorophyll contents in sweet potato leaves were the best value with application of compost fertilizer as compared to untreated plants .

3.2.2. Effect of some stimulants

Spraying with some stimulants significantly increased the concentrations of all leaf pigments as compared to spraying with water (control treatment) in both seasons (Tables 6 to 9). Spraying plants with yeast extract at 2ml /l produced the maximum concentrations of chlorophyll a (3.430 and 3.770), chlorophyll b (1.325 and 1.330), total chlorophyll a+b (4.735 and 4.695), and carotenoids (22.210 and 2.180) mg/g DW in the 1st and 2nd seasons, respectively, followed by spraying with lithovit, while spraying with fulvic acid came in third rank, and finally spraying with seaweed extract.

The increases in total chlorophyll in leaf tissues of sweet potato duo to spraying plants with yeast extract at 2ml /l were about 23.59 and 42.0 % over the spraying with water (control treatment) in the 1st and 2nd seasons, respectively.

It is generally known that yeast is a natural source of cytokinins, which promote the production of proteins, nucleic acids, and chlorophyll as well as cell division and expansion (Fathy & Farid, 1996). Additionally, lithovit contains nano-Mg, a nutrient that is vital to many plant physiological functions, including photosynthesis (because magnesium is the main component of the chlorophyll molecule) (Allison *et al*., 2001).

In this regard, Sarhan and Abdulah, (2010) and Fouda (2021) on potato. They showed that spraying plants with yeast extract significantly increased chlorophyll a, b total chlorophyll a+b in leaves of potato as compared to control treatment. Also, spraying plants with lithovit significantly enhanced all

Table 6. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on chlorophyll a (mg /g DW) at 100 DAT of sweet potato in both seasons 2023 and 2024

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	2.350 d	3.050 c	3.200 b	3.390 a	3.280 b	3.054 B
5 ton /fed.	3.060 c	3.400 a	3.440 a	3.430 a	3.420 a	3.350 A
Mean (S)	2.705 D	3.225 C	3.320 B	3.410 A	3.350 B	--
LSD at 5 %	A (CR)=0.074		B (S)=0.058		AxB (CRxS) = 0.082	
			2024 season			
Without	2.080 g	3.030 e	3.420 cd	3.500 bc	3.570 bc	3.1200 B
5 ton /fed.	2.540 f	3.290 d	3.630 ab	3.770 a	3.610 ab	3.3680 A
Mean (S)	2.310 C	3.160 B	3.525 A	3.635 A	3.590 A	--
LSD at 5 %	A (CR)= 0.104		B (S)= 0.116		AxB (CRxS) =0.164	

Table 7. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on chlorophyll b (mg /g DW) at 100 DAT of sweet potato in both seasons 2023 and 2024

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	1.000 f	1.050 e	1.060 e	1.300 b	1.120 d	1.128 B
5 ton /fed.	1.350 a	1.280 b	1.370 a	1.180 c	1.340 a	1.282 A
Mean (S)	1.025 E	1.180 D	1.235 C	1.325 A	1.260 B	
LSD at 5 %	A (CR)= 0.029		B (S)= 0.023		AxB (CRxS) =0.032	
			2024 season			
Without	1.080 d	1.150 c	1.190 c	1.310 ab	1.270 b	1.200 B
5 ton /fed.	1.180 c	1.200 c	1.330 a	1.350 a	1.320 ab	1.276 A
Mean (S)	1.130 E	1.175 D	1.260 C	1.330 A	1.295 B	
LSD at 5 %	A (CR)=0.039		B (S)=0.031		AxB (CRxS) = 0.052	

Table 8. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on chlorophyll a+b (mg /g DW) at 100 DAT of sweet potato in both seasons 2023 and 2024

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	3.350 f	4.110 e	4.320 d	4.670 b	4.460 c	4.182 B
5 ton /fed.	4.110 e	4.700 b	4.790 a	4.800 a	4.760 ab	4.632 A
Mean (S)	3.730 D	4.405 C	4.555 B	4.735 A	4.610 B	--
LSD at 5 %	A (CR)=0.074		B (S)=0.058		AxB (CRxS) =0.082	
			2024 season			
Without	3.160 i	4.180 g	4.610 e	4.810 d	4.840 cd	4.320 B
5 ton /fed.	3.720 h	4.490 f	4.960 b	5.120 a	4.930 bc	4.644 A
Mean (S)	3.440 E	4.335 D	4.785 C	4.965 A	4.885 B	--
LSD at 5 %	A (CR)=0.089		B (S)= 0.069		AxB (CRxS) =0.098	

Table 9. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on carotenoides (mg /g DW) at 100 DAT of sweet potato in both seasons 2023 and 2024

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	2.010 g	2.090 ef	2.170 bcd	2.180 bc	2.130 de	2.116 B
5 ton /fed.	2.050 fg	2.140 cde	2.220 ab	2.240 a	2.190 b	2.168 A
Mean (S)	2.030 D	2.115 C	2.195 A	2.210 A	2.160 B	--
LSD at 5 %	A (CR)=0.044		B (S)= 0.034		AxB (CRxS) =0.049	
			2024 season			
Without	1.930 d	2.010 cd	2.090 bc	2.100 bc	2.050 cd	2.036 B
5 ton /fed.	2.070 cd	2.160 abc	2.240 ab	2.260 a	2.110 bc	2.168 A
Mean (S)	2.000 C	2.085 BC	2.165 AB	2.180 A	2.080 BC	--
LSD at 5 %	A (CR)=0.199		B (S)=0.092		AxB (CRxS) =0.131	

leaf pigments parameters than unsprayed plants in garlic and potato , respectively (Merwad *et al.* ,2018 and Salama and Haggag 2024) .

3.2.3. Effect of the interaction

In general, the interaction between compost at 5 ton /fed. and spraying with fulvic acid at 2m/l and the interaction between compost at 5 ton /fed. and spraying with yeast extract at 2m/l increased the concentrations of chlorophyll a , b total (a+b) and carotenoides in sweet potato tissues at 100 days after transplanting in both seasons .

The total chlorophyll (a+b) levels in sweet potato leaf tissues increased by about 43.0 and 57.0 % for the interaction between compost at 5 ton /fed. and foliar spray with fulvic acid at 2ml/l, 43.3 and 62.0% for the interaction between compost at 5 ton /fed. and foliar spray with yeast extract at 2ml/l over the interaction between 0 compost and spraying with water in the each of the two seasons.

These results are agreement with Manea *et al*. (2019) on potato. They indicated that maximum concentration of total chlorophyll in leaf tissues were scored with application of 1.5 Mt/ ha organic fertilizer combination with 4 g/l dry yeast extract .

3.3.Yield and its components

3.3.1. Effect of compost fertilizer

Data in Tables 10 to 13 show that, there were significant differences between compost rates on yield and its components in sweet potato cv. Beauregard grown in clay soil during summer plantations. Fertilizing of sweet potato with compost at 5 ton/fed. produced the highest values of tuber root diameter (5.86 and 6.28 cm) tuber root weight (198.09 and 212.33 g) , marketable yield 11.288 and 10.941 ton/fed.) and total yield (14.110 and 13.650 ton/fed.) agnist (5.40 and 5.62 cm) , 182.85 and 201.75 g), 8.823 and 8.488 ton/fed.) and 12.600 and 12.080 ton/fed.) for the two seasons' relative tuber root diameter, weight, marketable yield, and total yield.

The increases in total yield of sweet potato were about 11.84 and 8.33% for compost at 5 tons/fed. over the control in the 1^{st} and 2^{nd} seasons, respectively.

It is well known that adding organic compost enhances the physical and chemical properties of soil. Furthermore, the application of these organic-based materials has been linked to increases in yield because they have been shown to improve the soil's beneficial microbial communities, improve the conditions for plants to absorb minerals, and stimulate defense compounds, growth regulators, or phytohormones in plants (Pujiastuti *et al.* 2020).

These results are in agreement with those by Naqib *et al*. (2016), Still (2019), Zhao *et al*. (2020), Fernandes *et al*. (2021), Mohamed and El-Gepaly (2021) and Dong *et al*. (2023). All showed that fertilizing sweet potato plants

Table 10. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on root diameter (cm) at harvesting time of sweet potato during 2023 and 2024 seasons

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	4.50 e	5.05 d	5.80 bc	5.90 bc	5.75 bc	5.40 B
5 ton /fed.	5.00 d	5.70 c	6.30 a	6.30 a	6.00 b	5.86 A
Mean (S)	4.75 D	5.37 C	6.05 AB	6.10 A	5.87 B	--
LSD at 5 %	A (CR)=0.28		B (S)=0.19	AxB (CRxS) =0.27		
			2024 season			
Without	4.55 f	5.25 e	6.10 cd	6.25 bcd	5.95 d	5.62 B
5 ton /fed.	5.50 e	6.15 cd	6.45 bc	6.80 a	6.50 ab	6.28 A
Mean (S)	5.02 D	5.70 C	6.27 B	6.52 A	6.22 B	--
LSD at 5 %	A (CR)= 0.27		B (S)=0.21	AxB (CRxS) =0.30		

Table 11. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on root weight (g) at harvesting time of sweet potato during 2023 and 2024 seasons

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	153.50 h	183.45 f	193.50 d	194.00 d	189.80 e	182.85 B
5 ton /fed.	165.33 g	198.40 c	210.22 a	211.10 a	205.40 b	198.09 A
Mean (S)	159.42 D	190.93 C	201.86 A	202.55 A	197.60 B	--
LSD at 5 %	A (CR)=2.64		B (S)= 2.06	AxB (CRxS) =2.91		
			2024 season			
Without	173.30 g	200.00 e	211.86 bcd	216.60 bc	207.00 de	201.75 B
5 ton /fed.	185.50 f	209.50 cd	220.00 b	231.00 a	215.65 bcd	212.33 A
Mean (S)	179.40 D	204.75 C	215.93 B	223.80 A	211.33 B	--
LSD at 5 %	A (CR)= 6.60		B (S)=5.14	AxB (CRxS) =7.27		

Table 12. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on marketable yield (ton/fed.) at harvesting time of sweet potato during 2023 and 2024 seasons

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	7.154 g	8.050 f	9.660 de	9.800 de	9.450 e	8.823 B
5 ton /fed.	9.920 d	10.960 c	11.960 ab	12.000 a	11.600 b	11.288 A
Mean (S)	8.537 D	9.505 C	10.810 A	10.900 A	10.525 B	--
LSD at 5 %	A (CR)=0.327		B (S)=0.255	AxB (CRxS) =0.361		
			2024 season			
Without	6.800 f	7.710 e	9.200 d	9.530 d	9.200 d	8.488 B
5 ton /fed.	9.530 d	10.500 c	11.450 ab	11.975 a	11.250 b	10.941 A
Mean (S)	8.165 D	9.105 C	10.325AB	10.753 A	10.225 B	--
LSD at 5 %	A (CR)=0.596		B (S)=0.464	AxB (CRxS) =0.656		

Table 13. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on total yield (ton/fed.) at harvesting time of sweet potato during 2023 and 2024 seasons

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	10.200 g	11.500 f	13.800 cd	14.000 bc	13.500 d	12.600 B
5 ton /fed.	12.400 e	13.700cd	14.950 a	15.000 a	14.500 b	14.110 A
Mean (S)	11.300 D	12.600 C	14.375 A	14.500 A	14.000 B	--
LSD at 5 %	A (CR)=0.397		B (S)=0.309	AxB (CRxS) = 0.437		
			2024 season			
Without	9.700 f	11.000 e	13.100 c	13.600 bc	13.000 cd	12.080 B
5 ton /fed.	11.900 de	13.100 c	14.300 ab	14.950 a	14.000 bc	13.650 A
Mean (S)	10.800 D	12.050 C	13.700 B	14.275 A	13.500 B	--
LSD at 5 %	A (CR)= 0.844		B (S)=0.658	AxB (CRxS) =0.930		

with compost significantly increased yield and its components as compared to zero compost .

3.3.2. Effect of some stimulants

Foliar spray with some stimulants such as seaweed extract , Fulvic acid, yeast extract and lithovit at 2ml of each significantly increased yield and its components as compared to spraying with water (control treatment) in both seasons (Tables 10-13).

Spraying plants with yeast extract at 2ml/l significantly increased and produced the maximum values of tuber root diameter (6.10 and 6.52 cm) tuber root weight (202.55 and 223.80g) , marketable yield (10.900 and 10.753 ton/fed.) and total yield (14.500 and 14.275ton/fed.) in both seasons, respectively, with no significant differences with spraying with fulvic acid at 2ml/l in most traits of yield and its components in both seasons . Spraying with lithovit at 2ml /l came in the third rank, and finally spraying with seaweed extract at 2ml/l.

The increases in total yield of sweet potato were around 11.50 and 11.57%, 27.21 and 26.85 %, 28.32 and 32.18%, and 23.89 and 25.00 % for seaweed extract, fulvic acid, yeast extract, and lithovit above the control treatment in the each of the two seasons, respectively.

The superiority of dry yeast extract for the production of higher tuber root weight, yield per plant and total and marketable tuber yields might be due to presence of amino acids, vitamins, etc. in yeast extract (Table 2) which stimulate division and extension of cells, growth of plant leaves, and their role in the balance of biological processes within plant tissues, which in turn activates plant growth (Tables 1-5) and then increased total yield (Eata *et al*., 2001).

Additionally, raising net photosynthetic rates and chlorophyll content, which in turn increases the translocation and accumulation of certain metabolites in plant organs, may be the cause of fulvic acid's yield-promoting impact. Additionally, lithovit contains nano-iron, which is crucial for plant growth and is involved in photosynthetic reactions, which in turn affect overall yield (Chen *et al*., 2004).

These results are in agreement with those reported by El-Tohamy *et. al.* , 2015 and Abo EL-Fadl *et al.*, 2017 on sweet potato and Al-Zaidi and Al-Jumaili, 2022 on potato as for yeast extract, and El- Metwaly, 2021 and Duan *et al., 2024* on sweet potato as for fulvic acid effect, also, Abdelghafar *et al.*, 2016 on onion and Salama and Haggag 2024 on potato concerning the response to lithovit. All found that spraying plants with yeast extract , fulvic acid or lithovit recorded the highest values of all yield parameters as compared to unsprayed plants .

3.3.3. Effect of the interaction

In general, the interaction between compost at 5 ton /feddan and spraying with fulvic acid at 2ml/l and the interaction between compost at 5 ton /fed. and spraying with yeast extract at 2ml/l greatly raised the diameter tuber root, weight of tuber root, marketable yield and total yield , followed by the interaction between 5 ton /feddan compost at and spraying with lithovit at 2ml/l (Tables 10 to 13). For all interaction treatments, average tuber root weight, marketable yield and total yield as average of the to seasons were a rounded from 163.4 and 221.05 g for average tuber root weight, 6.79 and 11.98 ton for marketable yield and 9.95 to 14.97 ton for total yield/feddan.

The favorable benefits of each component alone or the combined and additive influence of the two components may account for the significant impact of interaction treatments between organic fertilizer and spraying yeast extract on the vegetative development and yield metrics of plants. The organic fertilizer provides an environment that is conducive to the growth and activity of the yeast, while the yeast may also promote the decomposition of organic fertilizer (Atti and Al-Sahaf, 2007).

These results are agreement with those indicated with Kahlel (2015) how found that the interaction treatments between the organic fertilizer and yeast extract significantly increased number of tubers , average weight of tuber , yield /plant , total yield/ha. and marketable yield of potato compared with the control treatment. Also, , Manea *et al*. (2019) showed that the maximum yield and its components of potato were produced from the interaction of 1.5 Mt/ha organic manure in combination with 8 g/l dry yeast.

3.4.Quality of tuber root

3.4.1. Effect of compost fertilizer

There were significant differences between two compost rates for quality of tuber root sweet potato (Tables 14 to 18). Fertilizing with compost as organic fertilizer at 5 tons/fed. recorded the highest values of N (2.866 and 2.590%) , P(0.288 and 0.287%), K (1.920 and 1.822%), total sugars(11.26 and 10.89%) and starch (64.45 and 61.50 %) agnist control treatment which produced (2.298 and 2.276%), (0.237 and 0.237%), (1.636 and 1.536%), (10.72 and 10.57 %) and (59.09 and 57.57 %) in tuber roots for N, P, K, total sugars, and starch, respectively, in both sweet potato seasons.

The increases in tuber root starch of sweet potato were about 9.07 and 6.82% for compost at 5 tons/fed. over the control in the 1st and 2nd seasons, respectively.

The obtained results are in good line with those reported by Al-Esaily (2017), Fernandes *et al*. (2021) and Mohamed and El-Gepaly (2021).They showed that fertilizing sweet potato with compost produced the best tuber roots quality than unfertilized plants.

3.4.2. Effect of some stimulants

Foliar spray with various stimulants (seaweed extract, fulvic acid, yeast extract, and lithovit) at 2 ml of each had substantial influence on N, P and K , total sugars and starch in tuber roots of sweet potato in both seasons, (tables 14 to 18).

In both seasons, fulvic acid or yeast extract spraying generally enhanced N, P, and K, total sugars, and starch in sweet potato tuber roots. This was followed by lithovit spraying.

The increases in starch in sweet potato tuber root were about 5.86 and 8.11%, 9.86 and 13.24%, 11.17 and 15.09%, and 5.60 and 10.75% for spraying with seaweed extract, fulvic acid, yeast extract, and lithovit at 2ml/l of each above the control treatment in the each of the two seasons, respectively.

By extending the root surface in soil and accumulating plant metabolients, yeast extract's high content of macro and micronutrients may be the cause of the rise in tuber roots' chemical content in reaction to it (Nagodawithana, 1991).

Results are agreement with El-Tohamy *et. al.* , 2015 and Abo EL-Fadl *et al.*, 2017 on sweet potato with respect to yeast extract, Abd- All *et al*., 2017, El- Metwaly, 2021 and Duan *et al., 2024* on sweet potato regarding fulvic acid effect and Farouk, 2015 on potato, and Salama and Haggag 2024 on potato as for lithovit effect. They mentioned that potato plants spraying with different stimulants , i.e., fulvic acid, yeast extract, and lithovit significantly improved nitrogen, total soluble solids and protein contents in tuber roots as compared to control treatment.

3.4.3. Effect of the interaction

The interaction between compost at 5 ton /fed. and foliar spray with fulvic acid at 2ml/l and the interaction between compost at 5 ton /fed. and foliar spray with yeast extract at 2ml/l significantly increased N, P and K ,

Table 14. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on nitrogen content (%) of sweet potato tuber roots during the 2023 and 2024 harvest seasons

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	2.200 d	2.300 cd	2.350 c	2.340 c	2.300 cd	2.298 B
5 ton /fed.	2.780 b	2.880 ab	2.900 a	2.910 a	2.860 ab	2.866 A
Mean (S)	2.490 B	2.590 A	2.625 A	2.625 A	2.580 A	--
LSD at 5 %	A (CR)=0.099		B (S)=0.077	AxB (CRxS) =0.109		
			2024 season			
Without	2.050 f	2.150 e	2.400 d	2.410 d	2.370 d	2.276 B
5 ton /fed.	2.330 d	2.530 c	2.860 a	2.680 b	2.550 c	2.590 A
Mean (S)	2.190 E	2.340 D	2.630 A	2.545 B	2.460 C	--
LSD at 5 %	A (CR)= 0.074		B (S)= 0.058	AxB (CRxS) =0.082		

Table 15. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on phosphorus content (%)of sweet potato tuber roots during the 2023 and 2024 harvest seasons

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	0.216 f	0.235 e	0.245 cd	0.250 c	0.241 de	0.237 B
5 ton /fed.	0.265 b	0.292 a	0.298 a	0.295 a	0.290 a	0.288 A
Mean (S)	0.240 D	0.263 C	0.271 AB	0.272 A	0.265 BC	--
LSD at 5 %	A (CR)= 0.007		B (S)=0.006	AxB (CRxS) =0.008		
			2024 season			
Without	0.219 d	0.223 d	0.248 c	0.253 c	0.246 c	0.237 B
5 ton /fed.	0.268 b	0.275 b	0.299 a	0.300 a	0.294 a	0.287 A
Mean (S)	0.243 B	0.249 B	0.273 A	0.276 A	0.270 A	--
LSD at 5 %	***A (CR)=0.009***		***B (S)=0.007***	***AxB (CRxS) =0.010***		

Table 16. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on potassium content (%)of sweet potato tuber roots during the 2023 and 2024 harvest seasons

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	1.240 e	1.550 d	1.750 c	1.900 b	1.740 c	1.636 B
5 ton /fed.	1.700 c	1.850 b	2.000 a	2.050 a	2.000 a	1.920 A
Mean (S)	1.470 D	1.700 C	1.875 B	1.975 A	1.870 B	--
LSD at 5 %	A (CR)= 0.069		B (S)=0.054	AxB (CRxS) =0.076		
			2024 season			
Without	1.160 g	1.480 f	1.650 cd	1.820 b	1.570 de	1.536 B
5 ton /fed.	1.530 ef	1.680 c	2.050a	2.070a	1.780 b	1.822 A
Mean (S)	1.345 E	1.580 D	1.850 B	1.945 A	1.675 C	--
LSD at 5 %	A (CR)=0.079		B (S)=0.061	AxB (CRxS) = 0.087		

Table 17. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on total sugars content (%)of sweet potato tuber roots during the 2023 and 2024 harvest seasons

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	9.48 d	10.80 c	11.15 ab	11.20 ab	11.00 bc	10.72 B
5 ton /fed.	10.80 c	11.33 a	11.40 a	11.45 a	11.35 a	11.26 A
Mean (S)	10.14 C	11.06 B	11.27 A	11.32 A	11.17 AB	--
LSD at 5 %	A (CR)=0.23		B (S)= 0.18	AxB (CRxS) =0.26		
			2024 season			
Without	9.43 g	10.45 e	11.10 bc	11.15 abc	10.75 d	10.57 B
5 ton /fed.	10.05 f	10.75 d	11.35 ab	11.40 a	10.90 cd	10.89 A
Mean (S)	9.74 D	10.60 C	11.22 A	11.27 A	10.82 B	--
LSD at 5 %	A (CR)=0.21		B (S)=0.16	AxB (CRxS) =0.23		

Table 18. Impact of the compost rate, certain stimulants as foliar spraying and their interaction on starch content (%) of sweet potato tuber roots during the 2023 and 2024 harvest seasons

Compost rate (CR)	Stimulants (S)					Mean (CR)
	Unsprayed	Seaweed extract	Fulvic acid	Yeast extract	Lithovit	
			2023 season			
Without	55.20 i	59.50 g	61.00 ef	61.46 e	58.30 h	59.09 B
5 ton /fed.	60.80 f	63.30 d	66.45 b	67.50 a	64.20 c	64.45 A
Mean (S)	58.00 D	61.40 C	63.72 B	64.48 A	61.25 C	--
LSD at 5 %	A (CR)=0.33		B (S)=0.36	AxB (CRxS) =0.51		
			2024 season			
Without	53.30 f	57.33 de	59.00 cd	60.22 c	58.00 d	57.57 B
5 ton /fed.	55.50 e	60.30 c	64.20 ab	65.00 a	62.50 b	61.50 A
Mean (S)	54.40 D	58.81 C	61.60 A	62.61 A	60.25 B	--
LSD at 5 %	A (CR)=1.63		B (S)= 1.27	AxB (CRxS) =1.80		

total sugars and starch in tuber roots of sweet potato, followed by the interaction between compost at 5 ton /fed. and foliar spray with lithovit at 2ml/l in both seasons (tables 14-18).

For all interaction treatments. Total sugars and starch contents (as average of the two seasons) in cv. Beauregard were around from 9.54 to 11.42 % for total sugars and from 54.25 to 66.25 % for starch.

Concerning positive effect of fulvic acid, it increases the uptake of N, P, K, Ca, Mg and is one of the most efficient transporters of vitamins into the cell (Fahramand *et al*., 2014).

The addition of organic fertilizer and yeast may have increased the percentage of starch in the tubers because of the nutrients and plant growth regulators they contain, which promote growth and increase the efficiency of photosynthesis. This may have resulted in an increase in the production of carbohydrates at the tubers' storage locations.

These results are in agreement with what has been found by Kahlel (2015) how found that the best TSS and dry matter content in tuber of potato were recorded with interaction treatments between the organic fertilizer and yeast extract as compared with the control treatment. In this concern, Manea *et al*. (2019) showed that the interaction of 1.5 Mt/ha organic manure in combination with 8 g/l dry yeast produced maximum percentage of dry matter and starch content in potato tubers .

According to Duncan's multiple range test, values that shared the same alphabetical letter or letters did not differ substantially at the 0.05 level of significance.

4. CONCLUSION

Based on the aforementioned findings, it can be said that the best interaction treatments for increasing plant growth (length of plant, number of branches and leaves per plant, shoot fresh and dry weight/plant), leaf pigments, average tuber root weight, marketable and total yield, and N, P, K, total sugars, and starch contents in tuber roots were the combination of 5 tons of compost (organic fertilizer) and foliar spraying with fulvic acid at a rate of 2 milliliters per liter.

5. REFERENCES

AOAC (2018). Association of official analytical chemists. "Official Methods of Analysis", 21st Edition AOAC International, Washington, D.C; USA.

Abdelghafar MS, Al-Abd MT, Helaly AA and Rashwan AM (2016). Foliar application of lithovit and rose water as factor for increasing onion seed Production. Nat. and Sci., 14 (3): 53-61.

Abd- All AE, El-Namas AE and EL-Naggar EM (2017). Effect of humic acid and foliar application of different potassium sources on yield, quality and water use efficiency of sweet potato grown under drip irrigation in sandy soil. Alex. Sci. Exch. J., 38(3): 543-552.

Abo EL-Fadl NI, Dina SE and Hebatulla MR (2017). Effect of foliar spraying with yeast extract and hydrogen peroxide on yield and quality of sweet potato. Alex. J. Agric. Sci. 62 (3): 303-310**.**

Al- Bayati HJ and Al-Quraishi GM (2019). Response of three potato varieties to seaweed extracts . Kufa Journal For Agricultural Sciences -:11(1):36-48.

Al-Esaily AS (2017). Response of sweet potato plant to the same sources of organic manure and application methods of potassium humate under sandy soil conditions. J. Product. & Dev., 22(2): 219-240.

Allison MF, Fower JH and Allen EJ (2001). Factors affecting the magnesium nutrition of potatoes (*Solanum tuberosum* L.). J. Agric. Sci. Cambridge, 137 : 397- 409.

Al-Zaidi MAH and Al-Jumaili MAH (2022). Impact safe nutrients in raising production and chmical contents of potato. Iraqi Journal of Agricultural Sciences –2022:53(6):1397-1406

Antonious GF (2023). Impact of biochar and organic fertilizers on sweet potato yield, quality, ascorbic acid, β-carotene, sugars, and phenols contents. Inter. J. Environ. Health Res., https://doi.org/10.1080/09603123.2024.2318368

Atti AS and Al-Sahaf FH (2007). Potato production by organic farming 2 - The role of organic fertilizers and whey on NPK availability and percentage of mycrorrhiza infection. Iraqi J. of Agric. Sci., 48 (4): 52-64.

Bilal AB (2010). Recommended application of lithovit on different plants. Presented at the 3rd Conf. Agric. Bio. Sci., (LeCAB 2010).

Carmen B, Sumalan R, Gadea S and Vatca S (2014): Physiological indicators study involved in Productivity increasing in tomato. Pro-Environment, 7: 218-224.

Chen Y, Clapp CE and Magen H (2004). Mechanisms of plant growth stimulation by humic substances: the role of organo-iron complexes. Soil Sci. Plant Nutr., 50: 1089–1095.

Dong HT, Li Y, Brown P and Xu CY (2023). Sweet potato storage root formation as affected by soil organic amendment applications. Acta Physiol Plant, 45(7):88. doi: 10.1007/s11738-023-03570-3 .

Doss MM, El-Araby SM, Abd El-Fattah MA and Helaly AA (2015). The impact of spraying with different concentrations of seaweed extract under different levels of mineral NPK fertilizers on sweet potato (*Ipomoea batatas* (L.)) plants. Alex. J. Agric. Res. , 60 (3): 163-172.

Duan PW, Li G, Zhang H and Zhang L (2024). The impact of humic acid compound fertilizer on sweet potato variety Jishu 25: A comprehensive study on dry matter, root yield, and starch properties. Scientia Horticulturae, 327, (3), 112822.

Duncan DB (1958). Multiple Range and Multiple F-Test. Biometrics, 11: 1-5.

Eata AMHAE, Elsayed HM, Abd El-Naby, Gamilly SI and Salem EMM (2001). Response of some tomato cultivars to natural soil salinity and use of some treatments to reduce salt injury. Ph. D. diss., Faculty of Agriculture, Mansoura University, Mansoura, Egyp

El- Metwaly HMB (2021). Response of yield and quality of sweet potato plants to irrigation intervals and some soil and foliar application treatments. J. Product. and Dev., 26(1):61-95.

El-Shahat MM, El-Sheshtawy AA and Ghanem KhM (2023). How do biostimulants support sweet potato production in an organic and sustainable farming system? J. of Agricultural Chemistry and Biotechnology, Mansoura Univ., 14 (5):51-56.

ELTohamy WA, EL-Abagy HM, Badr MA, Abou-Hussein SD, Helmy YI and Shafeek MR (2015). Effect of yeast extract and GA_3 on water status, growth, productivity and quality of sweet potato grown in sandy soils. Int. J. Envir. Vol:40/Issue:04/Oct-Dec./pages:256-261

Fahramand M, Moradi H, Noori M, Sobhkhizi A, Adibian M, Abdollahi S and Rigi K (2014). Influence of humic acid on increase yield of plants and soil properties. Intl. J. Farm. & Alli. Sci., 3(3): 339-341.

Farouk S (2015). Improving growth and productivity of potato (*Solanum tuberosum* L.) by some biostimulants and lithovit with / or without boron. J. Plant Prod., Mansoura Univ., 6 (12): 2187 – 2206.

Fathy SL and Farid S (1996). The possibility of using vitamin B and yeast to delay senescence and improve growth and yield of common beans (*Phaseolus Vulgaris* L) J. Agric. Sci. Mansoura Univ., 21(4):1415-1423.

Fernandes AM, Ribeiro NP, Assunção NS, da Silva Nunes JG, Sorroche CP and Leonel M (2021). Impact of nitrogen and green manure on yield and quality of sweet potato in sandy soil: A Brazilian case study. J. Agric. Food Res., 4, 100131

Forsee WTJr (1938). Determination of sugar in plant materials A photometeric method. Indus. Eng. Chem. Anal. Ed. 10:411-418.

Fouda KF (2021). Response of different cultivars of potato to foliar spray with boron and bio-stimulants. Plant Cell Biotechnology and Molecular Biology, 22 (43 and 44):1-8.

Garai S, Brahmachari K, Sarkar S, Mondal M, Banerjee H, Nanda MK and Chakravarty K (2021). Impact of seaweed sap foliar application on growth, yield, and tuber quality of potato (*Solanum tuberosum* L.). Journal of Applied Phycology 33(3): 1893-1904

Hu Y, Deng L, Chen J, Zhou S, Liu S, Fu Y, Yang C, Liao Z and Chen M (2016). An analytical pipeline to compare and characterize the anthocyanin antioxidant activities of purple sweet potato cultivars. Food Chem. 194:46–54.

Jackson WR (1993) Humic, fulvic, and microbial balance: Organic soil conditioning: Jacks. Res. Cent., 958 p.

Kahlel AMS (2015). Effect of organic fertilizer and dry bread yeast on growth and yield of potato (*Solanum tuberosum* L.). J Agric Food Tech, 5 (1):1-11.

Khedr ZMA and Farid S (2002). Response of naturally virus infected tomato plants to yeast extract and phosphoric acid application. Annals of Agric. Sci. Moshtohor. Egypt, 38 (2): 927-939.

Li X, Li D, Lu Q, Wang D, Ren X, Lv L, Ahmed T, Yan J and Li B (2022). Effects of Different Organic Fertilizers on Sweet Potato Growth and Rhizosphere Soil Properties in Newly Reclaimed Land. Agronomy , 12, 1649.

https://doi.org/10.3390/agronomy12071649

Mahmoud R, El-Desuki S, Abdel-Mouty M and Ali A (2013). Effect of compost levels and yeast extract application on the pea plant growth, pod yield and quality. Journal of Applied Sciences Research, 9 (1): 149-155.

Malan C (2015). Humic and fulvic acids. A Practical Approach. In humic and fulvic acids. A Practical Approach. In sustainable soil management symposium. Stellenbosch, South Africa: Agrilibrium Publisher, 21 p.

Manea AI, AL-Bayati HJ and AL-Taey DKA (2019). Impact of yeast extract, zinc sulphate and organic fertilizers spraying on potato growth and yield. Res. on Crops, 20 (1) : 95-100.

Maswada HF and Abd El-Rahman LA (2014). Inducing salinity tolerance in wheat plants by hydrogen peroxide and lithovit "A nano-$CaCO_3$ fertilizer". J. Agric. Res. Kafr El-Sheikh Univ., 40 (4): 696-719.

Mbuyisa S, Bertling I and Ngcobo BL (2023). Impact of foliar-applied plant extracts on growth, physiological and yield attributes of the potato (*Solanum tuberosum* L.). Agronomy, 14 (38):1-12.

Merwad AM, El-Sawah MH and Mohsen AAM (2018). Effect of foliar spray with lithovit on dry weight productivity and storability of two garlic cultivars. Zagazig J. Agric. Res., 45 (6A) :1871-1884.

Mohamed HE and El-Gepaly HMKH (2021). Effect of organic and bio-fertilizers on yield quality and insect infestations of sweet potato plants in upper Egypt. J. of Plant Protection and Pathology, Mansoura Univ., 12 (2):99 – 105.

Morsi MK, El-Magoli B, Saleh NT, El-Hadidy EM and Barakat HA (2008). Study of antioxidants and anticancer activity licorice *Glycyrrhiza glabra* extracts. Egyptian J. Nutr. And Feeds, 2(33): 177-203.

Nagodawithana WT (1991). Yeast technology. Universal foods corporation milwaukee, wisconsin. Vau Nostrand Reinhold, New York. 273 P.

Naqib SA, Khairunisha WN and Nozulaidi M (2016). Copper and compost induced sweet potatoes production in sandy soil. IOSR Journal of Agriculture and Veterinary Science , 9 (9): 75-80

Nwanne AJ and Ikeh AO (2020). Response of sweet potato (*Ipomoea batatas* (L.) lam) to organic soil amendment in an ultisol of southeastern Nigeria. J Agron Agri Sci. 3:019.

Priya BNV, Mahavishnan K, Gurumurthy DS, Bindumadhava H, Upadhyay AP and Sharama NK (2014). Fulvic acid for enhanced nutrient uptake and growth: insights from biochemical and genomic studies. Journal of Crop Improvement, 28(6): 740-757.

Pujiastuti ES, Tarigan JR, Sianturi E and Ginting B (2020). The effect of chicken manure and beneficial microorganisms of EM-4 on growth and yield of kale (*Brassica oleraceae acephala*) grown on Andisol. IOP Conf. Series*: Earth and Environmental Science,* 205(1): 12-20.

Reynders L and Vlassak K (1982). Use of *Azospirillum brasilense* as biofertilizer in intensive wheat cropping, Plant and Soil, 66: 217-223.

Rizk FA, Rageb ME, Shaheen AM and Mahmoud SH (2018). Enhancing the productivity of potato crop by using sea weeds extract. Middle East Journal of Agriculture Research ,7 (2): 269-277.

Saif El-Deen UM, Ezzat AS and El-Morsy AHA (2011). Effect of phosphorus fertilizer rates and application methods of humic acid on productivity and quality of sweet potato. J. Plant Production, Mansoura Univ., 2 (1):53.66.

Salama ANA and Haggag IAA (2024). Impact of lithovit and planting depth on growth, productivity and quality of potato crop. Al-Azhar Journal of Agricultural Research , 49 (1): 12-25.

Saleh MA, Atala SA and Bardisi EA (2024). Effect of foliar application with potassium silicate and seaweed extract on plant growth, productivity, quality attributes and storability of Potato. Scientific Journal of Agricultural Sciences, 6 (2): 78-96.

Sarhan T and Abdullah OK (2010). Effect of Azotobacter Inoculation, Dry Bread Yeast Suspension and Varying Levels of Urea on Growth of Potato Cv. Desiree. html/www.tropentage.de/2010/abstracts /full/62 8.

Snedecor GW and Cochran WG (1980). Statistical Methods.7th ed. Iowa State Univ., Press, Ames., Iowa, U.S.A.

Still SM (2019). Yield Comparison of Sweet Potatoes Grown in Four Commercial Organic Soils. Hortscience, 54, S236

Suliman NS, Othman J and Hamad D (2021). Effect of foliar spraying with yeast extract and boron on growth and yield of potato *Solanum tuberosum* cv.spunta. Tishreen University Journal for Research and Scientific Studies - Biological Sciences Series, 34. (6): 291-304.

Tahoun SA, Abdel-Bary EA and Atia NA (2000). A greenhouse trial in view of organic farming in Egypt. Egypt. J. Soil Sci., 40 (4): 469-479.

Wang DF, Chen XG, Tang ZH, Liu M, Jin R, Zhang AJ and Zhao P (2022). Application of humic acid compound fertilizer for increasing sweet potato yield and improving the soil fertility. J. Plant Nutr., 45, 1933–1941.

Wettestein D (1957). Chlorophyll. Lethale under submikroskopische formwechsel der plastiden. Exptl. Cell Reso. 12:427-506.

Zhang X and Ervin EH (2008). Impact of seaweed extract based cytokins and zeatin riboside on creeping bent grass heat tolerance. Crop Sci 48 : 364—370.

Zhao WR, Li JY, Jiang J, Lu HL, Hong ZN, Qian W, Xu RK, Deng KY and Guan P (2020). The mechanisms underlying the reduction in aluminum toxicity and improvements in the yield of sweet potato (Ipomoea batatas L.) After organic and inorganic amendment of an acidic ultisol. Agric. Ecosys. Environ., 288, 106716.

المخلص العربي

إنتاجية وجوده جذور البطاطا المتأثره بالتسميد العضوى وبعض المغذيات صديقة البيئه

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أجريت تجربة حقلية خلال موسمى صيف لعامي ٢٠٢٣ و٢٠٢٤ فى مزرعة محطة الجميزة للبحوث الزراعيه ، مركز البحوث الزراعيه بمحافظة الغربية (وسط الدلتا، مصر) لدراسة تأثير معدلات الكمبوست كسماد عضوي (صفر ، 5 طن/فدان) والرش الورقى ببعض المنشطات (مستخلص الطحالب البحرية، وحامض الفولفيك، ومستخلص الخميرة، والليثوفيت بمعدل ٢ مل لكل منهم) والتفاعل بينهم على نمو النبات ، وصبغات الأوراق والمحصول وجودة جذور الدرنات في البطاطا صنف بيوروجارد تحت ظروف الارض الطينيه.

سجل تسميد نباتات البطاطا المنزرعه في الأرض الطينية بالكمبوست كسماد عضوي بمعدل 5 طن/فدان والرش بحامض الفولفيك أو مستخلص الخميرة بمعدل ٢ مليلتر لكل لتر زيادة فى طول النبات وعدد الأفرع والأوراق /النبات، الوزن الطازج والوزن الجاف للنبات؛ كما أنه قد ادى لزياده تركيزات الكلوروفيل أ، ب، والكلورفيل الكلى أ + ب في أنسجة أوراق البطاطا الحلوة؛ متوسط وزن الجذر المتدرن والمحصول القابل للتسويق والمحصول الكلى ؛ محتوى السكريات والنشا في الجذور المتدرنه. وفى هذا الصدد فقد سجلت معامله التفاعل بين اضافه الكومبست بمعدل ٥ طن/فدان والرش بمسخلص الخميره بمعدل ٢ مل /لتر زياده نسبيه فى المحصول الكلى بنسبه ٥٠.٥٨ % يليه اضافه الكمبوست والرش بحمض الفولفيك بتركيز ٢ مل/ لتر والذى سجل زياده نسبيه مقدارها ٤٧.٠ % كمتوسط للموسمين مقارنه عن معامله الكنترول (صفر كمبوست + الرش بالماء).