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RESEARCH ARTICLE

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Impact of Bread Yeast Extract and Humic Acid on Vegetative Growth, Quantity and Nutrient Content of Two Cultivars of Potato (*Solanum tuberosum* L.).

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ABSTRACT

This experiment was carried out at two different locations, the first location (Duhok) and the second location Zakho (Batifa) during spring growing season (2023). To determine the impact of three concentrations of bread yeast (0, 8 and 16 gL^{-1}) and three concentrations of humic acid (0, 4 and 8 ml L^{-1}) on two cultivars of potato (Laperla cv. and El Mudo cv.). The results appeared that the El Mudo cv. was superior over the Laperla cv. in weight of tuber (g), total yield (kg $plant^{-1}$), phosphorus%, potassium%, and calcium% under both locations, nitrogen% in the first location. Foliar application of 16 g L^{-1} bread yeast significantly increased all the studied vegetative growth, yield and nutrient contents in both locations. Foliar application of 8 ml L^{-1} humic acid gave the highest significant value of plant height (cm), number of branches $plant^{-1}$, leaf area (cm^2), number of tuber, nitrogen%, potassium% and calcium% under both locations, while 4 ml L^{-1} significantly increased weight of tuber (g) and total yield (kg $plant^{-1}$). The combined influences of two factors, namely cultivars and bread yeast, cultivars and humic acid, and bread yeast and humic acid, significantly enhanced most of the studied parameters. The triple interaction among three factors caused positive significant differences in all vegetative growth, yield and nutrient content in both locations..

***Keywords*:** Potato ،organic fertilizer, bio stimulant, cultivars.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most significant vegetable plants grown for human use and belongs to the Solanaceae family. Because potato crop is high in minerals, amino acids, and carbs, they rank fourth in terms of importance, behind wheat, rice, and maize [1]. It is a globally diet that is a great source of carbs and low in fat. The potato production exceeded 376 million tons of potatoes produced worldwide, occupying 19.34 million hectares [2].

Bread yeast has the capacity to produce a variety of enzymes that can change monosaccharides into CO2 and alcohols, which plants utilize for photosynthesis [3]. A rich reservoir of vital nutrients, it also contains amino acid, protein, and plant hormones like cytokines. These include magnesium, calcium, iron, nitrogen, phosphorus, potassium, sulfur, salt, silicon, zing and silicon. [4]. Bread yeast has a significant impact on the growth of fruits and vegetables, speeds up the absorption of carbohydrates, and promotes cell division and elongation, the creation of proteins, nucleic acids, and chlorophyll [5]. According to earlier studies, applying bread yeast topically to various vegetable crops improved their development, yield, and quality [6] [7] [8]. found that the treatment of bread yeast soaking and spraying significantly increased growth and yield of potato plant compared with untreated plants.

Humic acid is one of the humus substance's constituents, is produced when organic matter breaks down. This process produces molecules with various molecular weights, some of which include varying amounts of carbon, hydrogen, and oxygen. These materials play a crucial role in plant nutrition when they are added to the vegetative part of the plant [9]. This can be seen in the way they affect photosynthesis and respiration processes, activating some enzymes and inhibiting others. They also increase the plant's resistance to harsh growing season conditions and increase the permeability of cell membranes, which in turn stimulates a variety of biological reactions in the plant and increases Cytokinin with increasing Auxin. This acid enhances the absorption of nutrients. [10]. Numerous investigations have demonstrated the advantageous function of humic acid in augmenting the permeability of cell membranes, evapotranspiration, hormone, photosynthetic rate, absorption of proteins and elongation of root cells [11]. Humic acid treatment increased the development of potato plants, photosynthetic markers, and yield of tubers under greenhouse conditions at varying degrees of water deficiency [12] . The single plant yield, tuber weight, and plant height were all better with 0.75 gm.m2 of humic acid [13].

The present study aims to examine the effects of applying humic acid, bread yeast, and their combined effects on the vegetative growth, yield and nutrient contents of two cultivars of potato plant in two locations.

MATERIALS AND METHODS

This experiment was conducted at two locations, the first location was at the vegetable farm, College of Agricultural Engineering Sciences, University of Duhok (Duhok location) at latitude 36º.51 N, longitude 42º.52 E. The second location

in the Zakho (Batifa location) at latitude 37°.11 N, longitude 43°.06 E, during spring growing season 2023. Tuber of potato was planting on 23 February 65 cm between separates rows and 25 cm separates plants.

A completely randomized block design (RCBD) was used in this study. There were three replications and ten plants in each experimental unit. The factors investigated in this research were three levels of bread yeast (0, 8 and 16 g L^{-1}), three levels of humic acid (0, 4 and 8 ml L^{-1}) and two cultivars of potato (Laperla cv. and El Mudo cv.). Every plant in this study was given regular horticultural and agricultural treatments, just like the ones used in the vegetable farms in both locations. Starting after the four true leaves stage, three treatments of humic acid and bread yeast were implemented at intervals of fifteen days. The data were analyzed statistically by using SAS statistical analysis. Duncan's multiple range test at 0.05 level was used to verify the differences between the means of the treatments [14].

Experimental measurement:

Vegetative growth parameters:

Five plant were randomly chosen from each experimental unit to measure the plant height (cm), number of branches $plant^{-1}$, and leaf area (cm^2).

Yield parameters:

Five plant were randomly chosen from each experimental unit to measure the number of tuber $plant^{-1}$, weight of tuber (g) and total yield (kg $plant^{-1}$).

nutrients contents in the tubers: nitrogen%, phosphorus%, potassium% and calcium%

RESULTS AND DISCUSSIONS

1-Plant height (cm)

Table (1) shows that the Laperla cv. was superior over the El Mudo cv. in two locations, which gave the highest plant height (54.85 in Duhok and 50.59 cm in Batifa). Application of bread yeast at concentration 16 g L^{-1} significantly enhanced plant height (56.11 Duhok, 52.78 cm in Batifa) as compared with control (46.39 and 43.89 cm) respectively. Foliar application of humic acid at concentration 8 ml L^{-1} produced the highest significant value (54.39 cm in Duhok location and 50.72 cm in Batifa location).

Regarding the combination between cultivars and bread yeast had a significant effect, the best interaction (58.78 cm in Duhok and 55.00 cm in Batifa) was observed between Laperla cv. and 16 g L^{-1} bread yeast. Regarding the interaction between cultivars and humic acid concentrations, the highest value (58.44 cm and 53.56 cm) respectively was observed between Laperla cv. and 8 ml L^{-1} humic acid. The combination between 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid in two locations produced the highest value (58.33 and 54.50 cm) respectively.

Although the interaction among three factors was significant effect, the highest plant height (59.33 cm in Duhok) was observed among (Laperla cv., 16 g l^{-1} bread yeast and 8 ml L^{-1} humic acid). While the highest plant height (56.00 cm in Batifa) was observed among (Laperla cv., 16 g l^{-1} bread yeast and 4 ml L^{-1} humic acid). On the other hand, the lowest (41.33 and 40.00 cm) respectively was observed among (Laperla cv., 0 g L^{-1} bread yeast and 0 ml L^{-1} humic acid).

Table (1) Impact of bread yeast, humic acids and their bombinated application on plant height (cm) of two potato cultivars in (Duhok and Batifa) locations.

		Duhok				
Cultivars	bread yeast g L^{-1}	Humic acid (ml L^{-1}) 0	4	8	Cultivars* Bread yeast	Cultivars
Laperla	0	41.33 h	46.00 e-g	58.33 a	48.56 c	54.85 a
	8	55.67 ab	58.33 a	57.67 ab	57.22 a	
	16	58.33 a	58.67 a	59.33 a	58.78 a	
El Mudo	0	46.00 e-g	44.33 gh	42.33 gh	44.22 d	48.89 b
	8	45.67 fg	50.00 de	51.33 cd	49.00 c	
	16	49.00 d-f	54.00 bc	57.33 ab	53.44 b	
Humic acid		49.33 c	51.89 b	54.39 a	Bread yeast	
Cultivars* Humic acid	Laperla	51.78 c	54.33 b	58.44 a		
	El Mudo	46.89 e	49.44 d	50.33 cd		
Humic acid* Bread yeast	0	43.67 d	45.17 d	50.33 c	46.39 c	
	8	50.67 c	54.17 b	54.50 b	53.11 b	
	16	53.67 b	56.33 ab	58.33 a	56.11 a	
		Batifa				
Laperla	0	40.00 e	42.67 c-e	51.33 ab	44.67 cd	50.59 a
	8	51.33 ab	50.67 ab	54.33 a	52.11 ab	

	16	54.00 a	56.00 a	55.00 a	55.00 a	
	0	43.00 c-e	44.33 c-e	42.00 de	43.11 d	
El Mudo	8	44.00 c-e	48.00 bc	47.67 b-d	46.56 c	46.74 b
	16	46.00 b-d	51.67 ab	54.00 a	50.56 b	
Humic acid		46.39 b	48.89 a	50.72 a	Bread yeast	
Cultivars* Humic acid	Laperla	48.44 b	49.78 b	53.56 a		
	El Mudo	44.33 c	48.00 b	47.89 b		
Humic acid* Bread yeast	0	41.50 e	43.50 de	46.67 cd	43.89 c	
	8	47.67 bc	49.33 bc	51.00 ab	49.33 b	
	16	50.00 bc	53.83 a	54.50 a	52.78 a	

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

2-Number of branches plant^{-1}

Data in Table (2) displays that there were not significant effects between two cultivars in Duhok location, while in Batifa location the Laperla cv. gave the highest number of branches plant^{-1} (9.04). Application 16 g L^{-1} bread yeast produced maximum value in two locations (8.22 and 9.83) respectively. Using humic acid at concentrations 4 and 8 ml L^{-1} in Duhok significantly enhanced number of branches (7.67), whereas in Batifa 8 ml L^{-1} humic acid had a maximum value (9.06).

Concerning the double interaction between El Mudo cv. and 16 g L^{-1} bread yeast produced maximum value (8.33) in Duhok. In comparison, the interaction between Laperla cv. and 16 g L^{-1} bread yeast had a maximum value (10.11) in Batifa. The interaction between cultivars and humic acid was significantly impacted on the branches number, in Duhok location the highest number (7.78) was noticed between El Mudo cv. and 8 ml L^{-1} humic acid, while in Batifa location the highest value (9.56) was found between Laperla cv. and 4 ml L^{-1} humic acid. The interaction between 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid in Duhok produced the maximum number (9.17), whereas in Batifa, the interaction between 16 g l^{-1} bread yeast and 4 ml L^{-1} humic acid produced the greatest significant value (10.33).

The interaction among El Mudo cv., 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid produced the greatest number of branches plant^{-1} (9.33) in Duhok location, whereas the interaction among Laperla cv., 16 g L^{-1} bread yeast and 4 ml L^{-1} humic acid produced maximum value (10.67) in Batifa location.

Table (2) Impact of bread yeast, humic acids and their combination on number of branches plant^{-1} of two potato cultivars in (Duhok and Batifa) locations.

		Duhok				
Cultivars	bread yeast g L^{-1}	Humic acid (ml L^{-1}) 0	4	8	Cultivars* Bread yeast	Cultivars
Laperla	0	5.67 f	6.67 d-f	7.00 c-f	6.44 e	7.37 a
	8	7.67 b-e	8.33 a-c	6.67 d-f	7.56 bc	
	16	7.33 c-e	8.00 a-d	9.00 ab	8.11 ab	
El Mudo	0	6.33 ef	7.33 c-e	6.33 ef	6.67 de	7.44 a
	8	7.00 c-f	7.33 c-e	7.67 b-e	7.33 cd	
	16	7.33 c-e	8.33 a-c	9.33 a	8.33 a	
Humic acid		6.89 b	7.67 a	7.67 a	Bread yeast	
Cultivars* Humic acid	Laperla	6.89 b	7.67 ab	7.56 ab		
	El Mudo	6.89 b	7.67 ab	7.78 a		
Humic acid* Bread yeast	0	6.00 e	7.00 cd	6.67 de	6.56 c	
	8	7.33 b-d	7.83 bc	7.17 cd	7.44 b	
	16	7.33 b-d	8.17 b	9.17 a	8.22 a	

			Batifa			
Laperla	0	6.00 e	7.67 c-e	8.67 a-d	7.44 b	9.04 a
	8	9.67 a-c	10.33 ab	8.67 a-d	9.56 a	
	16	9.67 a-c	10.67 a	10.00 ab	10.11 a	
El Mudo	0	8.33 b-d	7.00 de	8.33 b-d	7.89 b	8.41 b
	8	7.67 c-e	7.33 de	8.33 b-d	7.78 b	
	16	8.33 b-d	10.00 ab	10.33 ab	9.56 a	
Humic acid		8.28 b	8.83 ab	9.06 a	Bread yeast	
Cultivars* Humic acid	Laperla	8.44 b	9.56 a	9.11 ab		
	El Mudo	8.11 b	8.11 b	9.00 ab		
Humic acid* Bread yeast	0	7.17 e	7.33 ed	8.50 cd	7.67 c	
	8	8.67 c	8.83 c	8.50 cd	8.67 b	
	16	9.00 bc	10.33 a	10.17 ab	9.83 a	

*an within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

3- Leaf area (cm^2)

Table (3) shows that there were no significant differences between two cultivars on leaf area in the both locations. Foliar application of 16 g L^{-1} bread yeast produced highest significant value (26.13 cm^2 in Duhok and 24.77 cm^2 in Batifa. Using humic acid at concentration 8 ml L^{-1} significantly enhanced leaf area in both locations which produced (26.64 cm^2 and 24.73 cm^2) respectively.

The dual interaction between two factors had a significant effect, the interaction between El Mudo cv. and 16 g L^{-1} bread yeast had a highest leaf area (26.49 cm^2) in Duhok. In contrast, in Batifa the interaction between Laperla cv. and 16 g L^{-1} bread yeast had a largest leaf area (24.98 cm^2). The interaction between Laperla cv. and 8 ml L^{-1} humic acid produced highest value in both locations (27.08 and 25.25 cm^2) respectively. The maximum leaf area (28.83 cm^2 in Duhok and 27.29 cm^2 in Batifa) was observed between 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid.

The interactions of the three factors had a significant difference, the maximum leaf area in both location (30.14 and 27.44 cm^2) was found from the interaction among El Mudo cv., 16 g Ll^{-1} bread yeast and 8 ml L^{-1} humic acid.

Table (3) Impact of bread yeast, humic acids and their bombinated application on leaf area (cm^2) of two potato cultivars in (Duhok and Batifa) locations.

			Duhok			
Cultivars	bread yeast g L^{-1}	Humic acid (ml L^{-1}) 0	4	8	Cultivars* Bread yeast	Cultivars
Laperla	0	23.80 f	24.43 ef	28.85 ab	25.69 ab	25.61 a
	8	26.77 cd	24.49 ef	24.88 ef	25.38 b	
	16	25.30 d-f	24.49 ef	27.53 bc	25.77 ab	
El Mudo	0	23.81 f	23.86 f	24.18 ef	23.95 c	25.14 a
	8	25.85 de	24.80 ef	24.27 ef	24.98 b	
	16	24.16 ef	25.17 d-f	30.14 a	26.49 a	
Humic acid		24.95 b	24.54 b	26.64 a	Bread yeast	
Cultivars* Humic acid	Laperla	25.29 bc	24.47 c	27.08 a		
	El Mudo	24.61 c	24.61 c	26.20 ab		
Humic acid* Bread yeast	0	23.81 c	24.15 c	26.52 b	24.82 b	
	8	26.31 b	24.65 c	24.58 c	25.18 b	
	16	24.73 c	24.83 c	28.83 a	26.13 a	
			Batifa			
Laperla	0	22.72 de	23.35 c-e	24.97 a-d	23.68 a	24.28 a

	8	25.68 a-c	23.25 c-e	23.64 c-e	24.19 a	
	16	23.70 c-e	24.10 c-e	27.14 ab	24.98 a	
	0	21.66 e	22.39 de	22.39 de	22.15 b	
El Mudo	8	24.46 b-e	24.45 b-e	22.77 c-e	23.89 a	23.53 a
	16	22.77 c-e	23.44 c-e	27.44 a	24.55 a	
Humic acid		23.50 b	23.50 b	24.73 a	Bread yeast	
Cultivars* Humic acid	Laperla	24.03 ab	23.57 b	25.25 a		
	El Mudo	22.96 b	23.43 b	24.20 ab		
Humic acid* Bread yeast	0	22.19 c	22.87 c	23.68 bc	22.91 b	
	8	25.07 b	23.85 bc	23.21 bc	24.04 a	
	16	23.23 bc	23.77 bc	27.29 a	24.77 a	

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

4- Number of tuber plant^{-1}

Result in table (4) shows that there were no significant differences between two cultivars on number of tubers plant^{-1} in both locations. Foliar application of bread yeast at concentrations 8 and 16 g L^{-1} significantly increased the number of tuber plant^{-1}, the maximum value was observed at 16 g L^{-1} in both locations (18.39 and 21.39, respectively). Foliar application of 8 ml L^{-1} humic acid gave the highest significant value (17.94 in Duhok and 21.17 in Batifa).

The interaction between Laperla cv. and 16 g L^{-1} bread yeast had the highest significant number of tubers plant^{-1} (18.78) in Duhok location, whereas in Batifa location the highest value (22.11) was found between Laperla cv. and 8 g L^{-1} bread yeast. The interaction between Laperla cv. and 8 ml L^{-1} humic acid produced the maximum number of tubers plant^{-1} in both locations (18.00 and 21.78) respectivel

Table (4) Impact of bread yeast, humic acids and their bombinated application on number of tuber plant^{-1} of two potato cultivars in (Duhok and Batifa) locations.

		Duhok				
Cultivars	Bread yeast (g L^{-1})	Humic acid (ml.L^{-1}) 0	4	8	Cultivars* Bread yeast	Cultivars
Laperla	0	13.00 f	14.33 ef	16.67 b-d	14.67 c	16.96 a
	8	15.67 c-e	18.67 ab	18.00 a-c	17.44 b	
	16	18.00 a-c	19.00 ab	19.33 a	18.78 a	
El Mudo	0	13.67 ef	15.00 d-f	17.00 a-d	15.22 c	17.00 a
	8	17.67 a-c	17.67 a-c	18.00 a-c	17.78 ab	
	16	17.67 a-c	17.67 a-c	18.67 ab	18.00 ab	
Humic acid		15.94 c	17.06 b	17.94 a		
Cultivars* Humic acid	Laperla	15.56 c	17.33 ab	18.00 a	Bread yeast	
	El Mudo	16.33 bc	16.78 a-c	17.89 ab		
Humic acid* Bread yeast	0	13.33 d	14.67 d	16.83 bc	14.94 b	
	8	16.67 c	18.17 a-c	18.00 a-c	17.61 a	
	16	17.83 a-c	18.33 ab	19.00 a	18.39 a	
		Batifa				
Laperla	0	16.67 e	18.33 c-e	20.00 a-d	18.33 c	20.81 a
	8	21.67 a-c	22.67 ab	22.00 ab	22.11 a	
	16	20.67 a-d	22.00 ab	23.33 a	22.00 a	
El Mudo	0	17.67 de	19.33 b-e	20.00 a-d	19.00 bc	20.15 a
	8	20.67 a-d	20.33 a-d	21.00 a-d	20.67 ab	
	16	20.33 a-d	21.33 a-c	20.67 a-d	20.78 ab	

Humic acid		19.61 b	20.67 ab	21.17 a	
Cultivars* Humic acid	Laperla	19.67 b	21.00 ab	21.78 a	Bread yeast
	El Mudo	19.56 b	20.33 ab	20.56 ab	
Humic acid* Bread yeast	0	17.17 c	18.83 bc	20.00 ab	18.67 b
	8	21.17 a	21.50 a	21.50 a	21.38 a
	16	20.50 ab	21.67 a	22.00 a	21.39 a

*Mean within a column, row and their interaction followi wit the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

The combination between bread yeast and humic acid also had a significant influence, the highest number of tubers planr^{-1} (19.00 in Duhok and 22.00 in Batifa) was found between 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid. Furthermore, the triple interaction among Laperla cv., 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid produced the highest value (19.33 in Duhok and 23.33 in Batifa). Whereas the lowest value (13.00 in Duhok and 16.67 in Batifa) was found among Laperla cv., 0 g L^{-1} bread yeast and 0 ml L^{-1} humic acid.

5-Weight of tuber (g)

Data notices (5) that the El Mudo cv. gave the highest weight of tuber at both locations (195.89 g in Duhok and 193.37 g in Batifa location. Foliar application of bread yeast at 16 g L^{-1} concentration gave the highest significant value in both locations (200.67 g and 210.39 g) respectively. Using 4 g L^{-1} humic acid in Duhok and Batifa locations produced highest value (208.06 g 199.83 g) respectively.

The interaction between cultivars and bread yeast showed significantly impacted in both locations, the maximum weight (227 .00 in first location and 212.89 g in second location) was noticed between El Mudo cv. combined with 8 g L^{-1} and 16 g L^{-1} bread yeast, respectively. The interaction between Laperla cv. and 4 ml L^{-1} humic acid in Duhok had highest value (208.89 g). In contrast, in Batifa location the interaction between El Mudo cv. and 4 ml L-1 humic acid had the highest value (206.89 g). in addition, the highest weight of tuber (221.17 g) was noted between 8 g L-1 bread yeast and 4 ml L-1 humic acid in Duhok. In comparison, the highest weight of tuber (224.00 g) in Batifa was noted between 16 g L^{-1} of bread yeast and 4 ml L^{-1}of humic acid.

The combination among El Mudo cv., 8 g L^{-1} bread yeast and 4 ml L^{-1} humic acid produced the highest weight of tuber (245.33 g) in Duhok location, whereas the interaction among El Mudo cv., 16 g L^{-1} bread yeast and 4 ml L^{-1} humic acid produced the maximum weight of tuber (236.00 g) in Batifa location. The lowest value (98.67 g in Duhok and 97.00 g in Batifa) was noticed from the interaction among Laperla cv., 0 g L^{-1} bread yeast and 0 ml L^{-1} humic acid.

6-Total yield (kg plant^{-1})

The results in Table (6) shows that the El Mudo cv. in the both location significantly increased the total yield (3.37 and 3.92 kg plant^{-1}) respectively compared with the Laperla cv. (2.89 and 3.55 kg plant^{-1}). Foliar application of 16 g L^{-1} bread yeast produced the highest total yield (3.70 in Duhok and 4.51 kg plant^{-1} in Batifa). The highest total yield (3.56 in Duhok and 4.14 kg plant^{-1} in Batifa) was found at 4 ml L^{-1} humic acid.

The interaction between El Mudo cv. and 8 g L^{-1} bread yeast produced maximum total yield (4.03 kg plant^{-1}) in Duhok location. In contrast, in Batifa location the maximum total yield (4.60 kg plant^{-1}) was illustrated between Laperla cv. and 16 g L^{-1} bread yeast. The interaction between cultivars and humic acid had a significant effect, the greatest value (3.61 kg plant^{-1}) in Duhok was found between El Mudo cv. and 8 ml L^{-1} humic acid, while the interaction between El Mudo cv. and 4 ml L^{-1} humic acid give the greatest value (4.23 kg plant^{-1}) in Batifa. The most significant value (4.06 in the first location and 4.90 kg plant^{-1} in the second location) was obtained when 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid interacted.

The highest total yield in Duhok (4.33 kg plant^{-1}) was noticed among El Mudo cv., 8 g L^{-1} bread yeast and 4 ml L^{-1} humic acid, whereas in Batifa the highest value (5.28 kg plant^{-1}) was noticed from the interaction among Laperla cv., 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid.

Table (5) Impact of bread yeast, humic acids and their bombinated application on weight of tuber (g) of two potato cultivars in (Duhok and Batifa) locations.

Cultivars	Bread yeast (g L^{-1})	Duhok Humic acid (ml L^{-1}) 0	4	8	Cultivars* Bread yeast	Cultivars
Laperla	0	98.67 f	215.67 ab	99.33 f	137.89 d	166.78 b
	8	144.00 e	197.00 bc	175.33 c-e	172.11 c	
	16	156.67 de	214.00 ab	200.33 bc	190.33 b	
El Mudo	0	146.00 de	150.00 de	153.00 de	149.67 d	195.89 a
	8	215.33 ab	245.33 a	220.33 ab	227.00 a	

	16	179.33 cd	226.33 ab	227.33 ab	211.00 a	
Humic acid		156.67 c	208.06 a	179.28 b	Bread yeast	
Cultivars* Humic acid	Laperla	133.11 d	208.89 a	158.33 c		
	El Mudo	180.22 b	207.22 a	200.22 a		
Humic acid* Bread yeast	0	122.33 d	182.83 bc	126.17 d	143.78 b	
	8	179.67 bc	221.17 a	197.83 ab	199.56 a	
	16	168.00 c	220.17 a	213.83 a	200.67 a	
			Batifa			
Laperla	0	97.00 h	173.67 c-f	104.33 gh	125.00 c	168.07 b
	8	137.67 f-h	192.67 a-d	183.67 b-e	171.33 b	
	16	185.33 b-e	212.00 a-c	226.33 ab	207.89 a	
El Mudo	0	143.67 e-g	158.33 d-f	162.00 d-f	154.67 b	193.37 a
	8	199.67 a-d	226.33 ab	211.67 a-c	212.56 a	
	16	182.67 b-e	236.00 a	220.00 ab	212.89 a	
Humic acid		157.67 b	199.83 a	184.67 a		
Cultivars* Humic acid	Laperla	140.00 d	192.78 a-c	171.44 c	Bread yeast	
	El Mudo	175.33 bc	206.89 a	197.89 ab		
Humic acid* Bread yeast	0	120.33 d	166.00 c	133.17 d	139.83 c	
	8	168.67 c	209.50 ab	197.67 ab	191.94 b	
	16	184.00 bc	224.00 a	223.17 a	210.39 a	

**Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

Table (6) Impact of bread yeast, humic acids and their bombinated application on plant yield (kg plant^{-1}) of two potato cultivars in (Duhok and Batifa) locations.

		Duhok				
Cultivars	Bread yeast (g L^{-1})	Humic acid (ml L^{-1}) 0	4	8	Cultivars* Bread yeast	Cultivars
Laperla	0	1.28 i	3.06 bc	1.66 hi	2.00 d	2.89 b
	8	2.39 e-h	3.67 a-c	3.16 b-d	3.07 c	
	16	2.83 d-f	4.06 a	3.88 ab	3.59 b	
El Mudo	0	2.00 g-i	2.25 f-h	2.61 d-g	2.29 d	3.37 a
	8	3.80 a-c	4.33 a	3.97 a	4.03 a	
	16	3.17 b-d	3.99 a	4.24 a	3.80 ab	
Humic acid		2.60 c	3.56 a	3.25 b	Bread yeast	
Cultivars* Humic acid	Laperla	2.17 c	3.60 a	2.90 b		
	El Mudo	2.99 b	3.53 a	3.60 a		
Humic acid* Bread yeast	0	1.64 e	2.66 c	2.13 d	2.14 b	
	8	3.10 bc	4.00 a	3.57 ab	3.55 a	
	16	3.00 c	4.03 a	406 a	3.70 a	

			Batifa			
Laperla	0	1.61 h	3.10 d-g	2.10 gh	2.27 d	3.55 b
	8	3.04 e-g	4.36 a-c	4.02 b-e	3.81 b	
	16	3.82 c-e	4.68 a-c	5.28 a	4.60 a	
El Mudo	0	2.55 f-h	3.06 d-g	3.24 d-f	2.95 c	3.92 a
	8	4.13 b-d	4.60 a-c	4.46 a-c	4.40 a	
	16	3.71 c-e	5.03 ab	4.53 a-c	4.43 a	
Humic acid		3.15 b	4.14 a	3.94 a	Bread yeast	
Cultivars* Humic acid	Laperla	2.83 c	4.04 a	3.80 ab		
	El Mudo	3.46 b	4.23 a	4.07 a		
Humic acid* Bread yeast	0	2.08 e	3.09 cd	2.66 de	2.61 c	
	8	3.59 bc	4.48 a	4.24 ab	4.10 b	
	16	3.77 bc	4.86 a	4.90 a	4.51 a	

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

7- Nitrogen%

Table (7) revealed that the El Mudo cv. had a highest nitrogen percentage (2.06%) in Duhok location compared with Laperla cv. (1.84%), while in Batifa location there were no significant effects between two cultivars. Foliar application of 16 g L^{-1} bread yeast produced highest significant value (2.32% in Duhok and 2.48% in Batifa). Foliar application of 8 ml L^{-1} humic acid in both locations had a highest significant nitrogen percentage (2.19% and 2.33%) respectively.

The interaction between two cultivars and 16 g L^{-1} bread yeast in Duhok location gave the highest value (2.32%), the interaction between Laperla cv. and 16 g L^{-1} bread yeast in Batifa gave the highest value (2.49%). The highest value (2.37% in Duhok and 2.43% in Batifa) was observed between El Mudo cv. and 8 ml L^{-1} humic acid. The combination between bread yeast and humic acid, the highest nitrogen percentage (2.61% in first location and 2.66% in second location) was observed between 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid.

The combination among three factors was significant differences, in Duhok location the interaction among El Mudo cv., 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid produced the maximum value (2.65%). In contrast, in Batifa Location the interaction among Laperla cv., 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid produced the maximum value (2.70%).

Table (7) Impact of bread yeast, humic acids and their bombinated application on nitrogen% of two potato cultivars in (Duhok and Batifa) locations.

		Duhok				
Cultivars	Bread yeast (g L^{-1})	Humic acid (ml L^{-1}) 0	4	8	Cultivars* Bread yeast	Cultivars
Laperla	0	1.40 e-g	1.33 fg	1.67 d-g	1.47 c	1.84 b
	8	1.76 c-g	1.68 d-g	1.80 c-f	1.74 bc	
	16	1.99 b-e	2.39 a-c	2.57 ab	2.32 a	
El Mudo	0	1.14 g	2.16 a-d	2.17 a-d	1.82 b	2.06 a
	8	1.85 c-f	1.96 b-f	2.29 a-d	2.03 ab	
	16	2.34 a-c	1.96 b-f	2.65 a	2.32 a	
Humic acid		1.75 b	1.91 b	2.19 a	Bread yeast	
Cultivars* Humic acid	Laperla	1.72 b	1.80 b	2.01 b		
	El Mudo	1.78 b	2.03 b	2.37 a		
	0	1.27 c	1.74 b	1.92 b	1.65 c	

Humic acid* Bread yeast	8	1.80 b	1.82 b	2.05 b	1.89 b	
	16	2.16 b	2.18 b	2.61 a	2.32 a	
			Batifa			
Laperla	0	1.64 d-f	1.53 ef	1.85 c-f	1.67 c	2.05 a
	8	1.93 b-f	1.86 c-f	2.13 a-f	1.97 bc	
	16	2.32 a-d	2.45 a-c	2.70 a	2.49 a	
El Mudo	0	1.48 f	2.18 a-f	2.23 a-e	1.96 bc	2.21 a
	8	2.00 a-f	2.12 a-f	2.46 a-c	2.19 ab	
	16	2.59 ab	2.22 a-e	2.61 ab	2.47 a	
Humic acid		1.99 b	2.06 b	2.33 a	Bread yeast	
Cultivars* Humic acid	Laperla	1.96 b	1.95 b	2.22 ab		
	El Mudo	2.02 b	2.17 ab	2.43 a		
Humic acid* Bread yeast	0	1.56 e	1.86 de	2.04 b-d	1.82 c	
	8	1.97 c-e	1.99 c-e	2.30 a-d	2.08 b	
	16	2.45 ab	2.34 a-c	2.66 a	2.48 a	

**Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

8- Phosphorus%

The results in Table (8) showed that the El Mudo cv. was superior over the Laperla cv. which had a highest phosphorus percentage (0.411% in Duhok and 0.469% in Batifa). Foliar application of 16 g L^{-1} bread yeast produced highest value in both locations (0.421% and 0.492%) respectively. In neither of the locations did the application of humic acid have a substantial impact. The interaction between El Mudo cv. and 16 g L^{-1} bread yeast had a highest value (0.466% in Duhok and 0.538% in Batifa). The interaction between cultivars and humic acid had not a significant effect in Duhok location. In contrast, in Batifa location the highest value (0.513%) was found between El Mudo cv. and 16 ml L^{-1} humic acid. The interaction between bread yeast and humic acid had no a significant effect in Duhok location, while in Batifa location the highest value (0.538%) was found between 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid.

The triple interaction among El Mudo cv., 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid produced highest phosphorus percentage (0.517% in Duhok and 0.648% in Batifa), whereas the interaction among Laperla cv., 0 g L^{-1} bread yeast and 0 ml L^{-1} humic acid produced the lowest phosphorus percentage (0.255% and 0.272%) respectively.

Table (8) Impact of bread yeast, humic acids and their bombinated application on phosphorus% of two potato cultivars in (Duhok and Batifa) locations.

			Duhok			
Cultivars	Bread yeast (g L^{-1})	Humic acid (ml L^{-1})			Cultivars* Bread yeast	Cultivars
		0	4	8		
Laperla	0	0.255 c	0.259 bc	0.244 c	0.253 c	0.328 b
	8	0.354 a-c	0.367 a-c	0.346 a-c	0.356 a-c	
	16	0.367 a-c	0.371 a-c	0.388 a-c	0.376 ab	
El Mudo	0	0.430 a-c	0.418 a-c	0.414 a-c	0.421 ab	0.411 a
	8	0.346 a-c	0.320 a-c	0.372 a-c	0.346 bc	
	16	0.405 a-c	0.477 ab	0.517a	0.466 a	
Humic acid		0.360 a	0.369 a	0.380 a	Bread yeast	
Cultivars* Humic acid	Laperla	0.326 a	0.333 a	0.326 a		
	El Mudo	0.394 a	0.405 a	0.434 a		
Humic acid* Bread yeast	0	0.343 a	0.339 a	0.329 a	0.337 b	
	8	0.350 a	0.344 a	0.359 a	0.351 ab	
	16	0.386 a	0.424 a	0.453 a	0.421 a	
			Batifa			

Laperla	0	0.272 d	0.319 cd	0.322 cd	0.305 c	0.409 b
	8	0.484 bc	0.521 ab	0.426 b-d	0.477 ab	
	16	0.477 bc	0.428 b-d	0.429 bc	0.445 b	
El Mudo	0	0.457 bc	0.453 bc	0.476 bc	0.462 ab	0.469 a
	8	0.408 b-d	0.400 b-d	0.416 b-d	0.408 b	
	16	0.426 b-d	0.541 ab	0.648 a	0.538 a	
Humic acid		0.421 a	0.444 a	0.453 a	Bread yeast	
Cultivars* Humic acid	Laperla	0.411 b	0.423 b	0.392 b		
	El Mudo	0.430 b	0.465 ab	0.513 a		
Humic acid* Bread yeast	0	0.365 c	0.386 bc	0.399 bc	0.383 b	
	8	0.446 a-c	0.461 a-c	0.421 bc	0.443 a	
	16	0.452 a-c	0.484 ab	0.538 a	0.492 a	

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

9- Potassium%

Table (9) shows that the El Mudo cv. had a highest potassium percentage (3.97% in Duhok and 3.55% in Batifa) compared with Laperla cv. (2.83% and 2.58%) respectively. The highest value (3.95% in Duhok and 3.44% in Batifa) was noticed at concentration 16 g L^{-1} bread yeast. Foliar application of 8 ml L^{-1} humic acid had a highest significant value (3.54% and 3.34%) respectively.

The highest potassium percentage (4.16% in Duhok and 4.11% in Batifa) was found between El Mudo cv. and 16 g L^{-1} bread yeast. The interaction between El Mudo cv. and 8 ml L^{-1} humic acid generated the maximum value at both sites. (4.29% and 4.11%) respectively. The combination between 16 g L^{-1} bread yeast and 4 ml L^{-1} humic acid gave the maximum value (4.14% in Duhok and 3.59% in Batifa).

The interaction among El Mudo cv., 0 g L^{-1} bread yeast and 4 ml L^{-1} humic acid produced highest potassium percentage (4.69%) in Duhok location. In contrast, the interaction among El Mudo cv., 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid produced highest value (4.48%) in Batifa location.

Table (9) Impact of bread yeast, humic acids and their bombinated application on potassium% of two potato cultivars in (Duhok and Batifa) locations.

		Duhok				
Cultivars	Bread yeast (g L^{-1})	Humic acid (ml L^{-1}) 0	4	8	Cultivars* Bread yeast	Cultivars
Laperla	0	1.98 de	1.89 e	2.18 de	2.02 c	2.83 b
	8	2.83 cd	2.62 c-e	2.74 c-e	2.73 b	
	16	3.86 ab	3.95 ab	3.43 bc	3.75 a	
El Mudo	0	3.39 bc	4.69 a	4.06 ab	4.05 a	3.97 a
	8	3.44 bc	3.45 bc	4.18 ab	3.69 a	
	16	3.54 bc	4.33 ab	4.62 a	4.16 a	
Humic acid		3.17 b	3.49 ab	3.54 a	Bread yeast	
Cultivars* Humic acid	Laperla	2.89 c	2.82 c	2.78 c		
	El Mudo	3.46 b	4.16 a	4.29 a		
Humic acid* Bread yeast	0	2.68 e	3.29 c-e	3.12 c-e	3.03 b	
	8	3.13 c-e	3.04 de	3.46 b-d	3.21 b	
	16	3.70 a-c	4.14 a	4.02 ab	3.95 a	
			Batifa			
Laperla	0	1.97 g	2.04 g	2.54 f	2.18 e	2.58 b
	8	2.88 ef	2.88 ef	2.58 f	2.78 d	
	16	2.88 ef	2.88 ef	2.58 f	2.78 d	
El Mudo	0	2.58 f	2.68 ef	4.08 ab	3.11 c	3.55 a

	8	3.38 cd	3.12 de	3.77 bc	3.42 b
	16	3.55 c	4.30 a	4.48 a	4.11 a
Humic acid		2.87 b	2.98 b	3.34 a	Bread yeast
Cultivars* Humic acid	Laperla	2.58 c	2.60 c	2.57 c	
	El Mudo	3.17 b	3.36 b	4.11 a	
Humic acid* Bread yeast	0	2.28 c	2.36 c	3.31 ab	2.65 c
	8	3.13 b	3.00 b	3.18 b	3.10 b
	16	3.22 b	3.59 a	3.53 a	3.44 a

Means within a column, row, and their interaction, following the same letters, are not significantly different according to the Duncan multiple range test at the 0.05 level.

10- Calcium%

Table (10) demonstrated that the El Mudo cv. produced highest significant calcium% (1.165% in the first location and 1.015% in the second location) compared with Laperla cv.. Foliar application of 16 g L^{-1} bread yeast significantly enhanced calcium% in the both locations (1.087% and 1.026%) respectively. Foliar application of 8 ml L^{-1} humic acid produced highest value (1.081% in Duhok location and 0.939% in the Batifa location).

The interaction between El Mudo cv. and 16 g L^{-1} bread yeast in the both location increased calcium% (1.148% and 1.097%). The highest percentage (1.240% in Duhok location and 1.80% in Batifa location) was showed between El Mudo cv. and 8 ml L^{-1} humic acid. The interplay between 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid enhanced the calcium% in the both locations (1.159% and 1.084%) respectively.

Table (10) Impact of bread yeast, humic acids and their bombinated application on calcium% of two potato cultivars in (Duhok and Batifa) locations.

Cultivars	Bread yeast (g L^{-1})	Duhok Humic acid (ml L^{-1}) 0	4	8	Cultivars* Bread yeast	Cultivars
Laperla	0	0.569 e	0.652 e	0.765 de	0.662 d	0.882 b
	8	0.957 b-d	0.986 a-d	0.927 cd	0.957 c	
	16	0.986 a-d	1.016 a-d	1.075 a-c	1.026 bc	
El Mudo	0	1.091 a-c	1.273 a	1.273 a	1.212 b	1.165 a
	8	0.927 cd	1.274 a	1.204 a-c	1.135 ab	
	16	1.068 a-c	1.134 a-c	1.243 ab	1.148 a	
Humic acid		0.933 b	1.056 a	1.081 a	Bread yeast	
Cultivars* Humic acid	Laperla	0.837 c	0.885 bc	0.922 bc		
	El Mudo	1.029 b	1.227 a	1.240 a		
Humic acid* Bread yeast	0	0.830 c	0.962 a-c	1.019 a-c	0.937 b	
	8	0.942 bc	1.130 ab	1.066 ab	1.046 a	
	16	1.027 a-c	1.075 ab	1.159 a	1.087 a	
			Batifa			
Laperla	0	0.531 f	0.531 f	0.535 f	0.533 c	0.791 b
	8	0.886 de	0.916 de	0.857 de	0.886 b	
	16	0.916 de	0.946 de	1.005 b-d	0.955 b	
El Mudo	0	0.986 cd	1.093 a-c	1.093 a-c	1.058 a	1.015 a
	8	0.857 de	0.835 e	0.983 cd	0.891 b	
	16	0.997 b-d	1.130 ab	1.164 a	1.097 a	
Humic acid		0.862 b	0.909 ab	0.939 a	Bread yeast	
Cultivars*	Laperla	0.778 c	0.798 c	0.799 c		

Humic acid	El Mudo	0.947 b	1.020 ab	1.080 a	
Humic acid* Bread yeast	0	0.759 e	0.812 de	0.814 de	0.795 c
	8	0.872 cd	0.875 cd	0.920 c	0.889 b
	16	0.957 bc	1.038 ab	1.084 a	1.026 a

**Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level

The combination among cultivars, bread yeast and humic acid was significant effect, the highest value (1.274%) in Duhok location was noticed among El Mudo cv., 8 g L^{-1} bread yeast and 4 ml L^{-1} humic acid. Whereas in Batifa the largest value (1.164%) was noticed among El Mudo cv., 16 g L^{-1} bread yeast and 8 ml L^{-1} humic acid.

It's found that from table (1-10), in the both locations, cultivars, bread yeast, humic acid and how they interacted with one another all had a big impact on vegetative, yield and mineral nutrient parameters. Genetic differences in yield between kinds, the caliber of potato seed, or the variety's ability to adapt to the climate of the trial site could all be contributing factors to this outcome [15].

Shown that increasing the amounts of active dry yeast applied topically to potato plants enhanced their vegetative development characteristics, including plant length and leaf area. The beneficial effects of adding yeast suspension to improve the characteristics of the shoots may result from the yeast's direct or indirect ability to alter the root environment, or from the yeast's development following its breakdown into numerous amino acid and vitamin groups [16]. Similarly, [17]. Reported the advantages of spray application treatments of dry yeast in vegetative growth characteristics, plant height and number of leaves. [18]. discovered that applying treatments with yeast solutions greatly enhanced plant height, the number of branches $plant^{-1}$, yield $plant^{-1}$ and tubers $plant^{-1}$. Bread yeast's function in promoting vegetative growth, increasing the weight of tuber number of tubers, total yield $plant^{-1}$ and mineral nutrients due to the yeast's nutrient content, which is important in promoting development and yeast formation that produces auxin and gibberellin [19].

The application of active dry yeast was found to have beneficial effects due to its high protein content, high vitamin B content, and natural plant growth regulators like cytokinins According to [20]. Additionally, the yeast extract's physiological roles for vitamins and amino acids enhanced the function of metabolic processes and endogenous hormone levels, including IAA and GA3. [21]. It might have encouraged the features of vegetative development, which in turn translated into an increase in the yield of tubers. The increase in the concentration of nitrogen, phosphorus, and potassium elements in plants treated with yeast suspension may also be due to the yeast's nutrient content and increased accumulation in the plant, which is favorably reflected in the increase in vegetative development. As a result, the plant experiences increased processed nutrients and carbon metabolism. These nutrients, when delivered to the roots via phloem tissue, cause the plant to expand and absorb and accumulate more nutrients [22]. These findings concur with those made by[23].

Humic acid applied topically caused appositive significant effect on vegetative, yield and nutrient parameters, this enhance may be due to the humic acid contributes significantly to increases in evapotranspiration, photosynthetic rate, cell membrane permeability, hormone and protein absorption, and root cell elongation. [11] . Humic acid gave the maximum value and significantly increased plant height. The shoot-promoting properties of humic substances may have caused this, as well as their effects on root activity and nitrate root-shoot distribution, which in turn alter the distribution of certain cytokinins, polyamines, and ascorbic acid in the root-shoot, thus influencing plant height [24]. The increase in humic acid-induced chlorophyll and leaf N, P, K, and concentration led to an increase in the number of branches per plant [25]

Humic acid's physiological function and impact on plant growth parameters account for the rise in yield and its constituent parts. Consequently, improving nutrient uptake via spraying created two sources of nutrient uptake the soil's increased nutrient content and the plant. As a result, the humic acid-treated plants' vegetative growth has increased, increasing their output [26].

These findings are consistent with several studies that found humic acid enhanced tuber production [27]. It also enhanced the amount of nutrients (N, P, and K) in tubers [13]. The study's findings are in line with those of [28], who found that increasing the amount of humic acid applied from 0 to 2.5 2 m/L1 humic acid/ha and increasing the availability of nutrients to the plant significantly increased the vegetative growth parameters, potato yield and tuber size, weight, and quality as well as nutritive value of potato tuber. Regarding their development and yield component, several cultivars exhibited varying genetic potential [29]. Humic compounds have been found to have stimulatory effects that are directly connected with improving the uptake of micronutrients [30]. Humic compounds stimulate microbiological activity, which improves the intake of minerals [31]. Research shows that humic acid generally improves vegetable crop nutrient uptake as well as shoot and root growth [32] [33]. Following a humic acid treatment, the mineral content of nutrients, including nitrogen, phosphorous, and potassium, increased.

Conclusion

concluded that utilizing each of cultivars, bread yeast and humic acid caused a positive significant increase in most of the vegetative growth, yield and nutrient content. Also, dual and triple interactions among high levels and cultivars significantly enhanced most study parameters.

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REFERENCES

[1]. John, J. Burke, (2017). Growing the Potato Crop. Vita, Equity House, Upper Ormond Quay, Dublin 7, Ireland. https://www.iverkproduce.com/wp-content/uploads/Growing-the-Potato-Crop.pdf

[2]. FAOSTAT. (2018). Food and agriculture Organization of the United Nations, Rome, Italy. Accessed 13 March 2018.

[3]. Kurtzman, C. P., and J. W. Fell (2005). Biodiversity and Ecophysiology of Yeasts (In: The Yeast Handbook, Gabor P, de la Rosa CL, eds) Berlin, Springer, 11-30. https://www.scirp.org/reference/referencespapers?referenceid=1692799

[4]. Medani, R. A., and R. S. Taha (2015). Improving growth and yield of caraway (*Carum carvi* L.) plants by decapitation and/or active dry yeast application. International Journal Current Microbiology Applied Science, 4(9), 47-60. https://www.ijcmas.com/vol-4-9/Ramadan%20A.%20Medani%20and%20Ragab%20S.%20Taha.pdf

[5]. Heikal, A.E. (2005). Effect of Organic and Bio-fertilization on Growth, Production and Compostion of (*Thymus vulgaris* L.) Plants. M.Sc. Thesis, Coll. of Agric. Univ. of Cairo, Egypt. 101.

[6]. Fawzy, Z. F.; El-Bassiony, A. M.;Behairy, A. G., &Helmy, Y. I. (2010).Effect of foliar spraying by some bio and organic compounds on growth, yield and chemical composition of Snap bean plants.*Journal of AppliedSciences Research, 6*(12), 2269-2274. http://www.aensiweb.com/old/jasr/jasr/2010/2269-2274.pdf

[7]. Ghoname, A. A., M. A. El-Nemr, A. M. R. Abdel-Mawgoud, and W. A. El-Tohamy (2010).Enhancement of Sweet pepper crop growth and production by application of biological, organic and nutritional solutions.*Research Journal of Agriculture and Biological Sciences, 6*(3), 349-355. http://www.aensiweb.net/AENSIWEB/rjabs/rjabs/2010/349-355.pdf

[8]. Draie, R. and Al-absi, M. (2019) Effect of bread yeast treatment on the growth and productivity of potato crop. International Journal of Information Research and Review Vol. 06, Issue, 01, pp.6081-6085. https://www.ijirr.com/sites/default/files/issues-pdf/3179_0.pdf

[9]. Burhan, A. K. and D. K. A. AL-Taey (2018). Effect of Potassium humate, humic acid, and compost of rice wastes in the growth and yield of two cultivars of Dill under salt stress conditions. Advances in Natural and Applied Sciences. 12(11): 1-6. DOsI:10.13140/RG.2.2.12700.33929

[10]. Mousavi, M., A. Soleyman, and M. Shams, (2012). Changes in Yield and Yield Components of Three Cultivar, of Barley Under Different Nitrogen levels in Isfahan region. International Journal of Agricultural and Crops Sciences. 4 (19) : 1433-1435

[11]. Cimrin, K. M, O. Türkmen, M. Turan, and B. Tuncer (2010), Phosphorus and humic acid application alleviate salinity stress of pepper seedlings. Afr J Biotechnol 9: 5845–5851. https://www.researchgate.net/publication/273113334

[12]. Man-hong,Y; Z. Lei, X. Sheng-tao, B. Neil, B; McLaughlin and L.Jing-hui (2020), Effect of water soluble humic acid applied to potato foliage on plant growth, photosynthesis characteristics and fresh tuber yield under different water deficits. Sci Rep 10, 7854. https://www.nature.com/articles/s41598-020-63925-5

[13]. Saaseea, K. G. and N. J. K. Al-a'amry (2018) Effect of foliar application with calcium, magnesium and fertilizing with humic acid on growth , yield, and storage ability of potato tubers. Iraqi Journal of Agricultural Sciences –8102:49(5):298-919. https://www.iasj.net/iasj/download/6457df36814e02da

[14]. SAS (2010). Statistical Analysis System, User 's Guide. Statistical. Version 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA

[15]. Thapa, S., P. R. Rokaya , S. Parajuli , B. Pokhrel and Y. Aryal (2022) Evaluation of Performance of Different Varieties of Potato (*Solanum tuberosum* L.) in Bajhang, Nepal. International Journal of Applied Biology p 115-125. file:///C:/Users/Windows-7/Downloads/21224-Article%20Text-79721-1-10-20221229%20(1).pdf

[16]. Ahmed A.A., M. M. H. Abd El-Baky M. F. Zaki F. S. Abd El-Aal (2011). Effect of foliar application of active extract and zinc on growth, yield and quality of potato plant *Solanum tuberosum* L.. Journal of Applied Sciences Research, 7 12: 2479-2488. file:///C:/Users/Windows-7/Downloads/2479-2488.pdf

[17]. Lazim Z. S., Ahmed Z. M. 2013. The effects spray applications of dry yeast suspension and liquorice root extractions on the vegetative and tubers growth characteristics of wild orchid Anacamptis coriophora. Al-Furat Journal of Agricultural Sciences. 5 3: 28-36. https://www.iasj.net/iasj/article/79016

[18]. Hussain W.A., and L. Q.Khalaf (2007). Some parameters of growth and productivity of potato crop after spraying with different concentrations of bread yeast. Journal of Al-Nahrain University – Science. 11 1: 33-37.html/www.tropentage.de/2007/abstracts/links/khalaf. FPRAXY 90.

[19]. Twfiq, A. A. (2010). Estimation levels of Indole acetic acid (IAA) and Gibberellic acid (GA3) in dry bakery yeast Saccharomy cescereviciae. J. of bio-technology research center. 4 (2): 94-100. DOI:10.24126/jobrc.2010.4.2.133

[20]. Fatty, S. L. and S. Farid, (1996). Effect of some chemical treatments, yeast preparation and royal Jelly on some vegetable crops growing in late summer season to induce their ability towards better thermal tolerance. J. Agric. Sci., Mansoura Univ., 25(4): 2215-2249. DOI: 10.21608/JPP.2000.258798

[21]. Sarhan, T. and O.K. Abdullah, (2010). Effect of Azotobacter Inoculation, Dry Bread Yeast Suspension and Varying Levels of Urea on Growth of Potato cv. Desiree. World Food System https://www.tropentag.de/2010/abstracts/links/Sarhan_I1mkdosQ.pdf

[22]. Saleh N. M., A. K. Hassan, L.J. Sabr and A. A. Ayesh. (2009). Evaluation of the efficacy of bread yeast, some elements, and salicylic acid in combating macrophages. Iraqi Journal of Agricultural Sciences.40 (6): 9-16. https://www.iasj.net/iasj/download/4b9f99da9e53dc72
[23]. Tohamy, W. A., H. M. El-Abagy, and N. H. M. El-Greadly. (2008). Studies on the effect of putrescine, yeast and vitamin C on growth, yield and physiological responses of eggplant (*Solanum melongena* L.) under sandy soil conditions. Aust. J. Agric. And Biol. Sci. 2(2): 296-300. https://www.ajbasweb.com/old/ajbas/2008/296-300.pdf
[24]. Meena, S., 2015. Effect of Humic Acid and Micronutrients on Growth, Yield and Quality of Cucumber under Polyhouse Condition. thesis Department of Horticulture Rajasthan College of Agriculture Udaipur-313001.
[25]. Kazemi, M., 2014. Effect of Foliar Application of Humic Acid and Calcium Chloride on tomato growth. Bull. Env. Pharmacol. Life Sci. 3 (3): 41-46. file:///C:/Users/Windows-7/Downloads/4.pdf
[26]. Shafeek, M. R., Helmy, Y. I., Omar N. M., 2016. Effect of spraying or ground drench from humic acid on growth, total output and fruits nutritional values of cucumber (*Cucumis sativus* L.) grown under plastic house conditions. Inter. J. of Pharm. Res. 9(12): 52-57. https://sphinxsai.com/2016/ph_vol9_no12/1/(52-57)V9N12PT.pdf
[27]. Abu-Zinada, I.A., and K.S. Sekh-Eleid, (2015), humic acid to decrease fertilization rate on potato (*Solanum tuberosum* L.), American Journal of Agriculture and Forestry 3(5): 234–238. DOI: 10.11648/j.ajaf.20150305.20
[28]. Mahmoud, A. R. and M. M. Hafez (2010). Increasing productivity of Potato plants (Solanum tuberosum) by using potassium fertilizer and Humic application. Int. J. Acad. Res., 2(2) : 83-88. https://www.scirp.org/reference/referencespapers?referenceid=1853116
[29]. Young, J., K. J. Meyers, J. V. Der Heide and R. H. Liu (2004) Varietal Differences in Phenolic Content and Antioxidant and Antiproliferative Activities of Onions. J. Agric. Food Chem., 52(22): 6787–6793. DOI:10.1021/jf0307144
[30]. Chen, Y. and T. Aviad. (1990). Effects of humic substances on plant growth. In: Humic Substances in Soil and Crop Science: Selected Readings. P. MacCarthy, C.E. Clapp, R.L. Malcolm and P.R. Bloom (eds.), American Society of Agronomy Inc., Soil Science of America, Inc., Madison, W.I. pp: 161-186. https://doi.org/10.2136/1990.humicsubstances.c7
[31]. Nardi, S.; G. Concheri and G. Dell'Agnola. (1996). Biological activity of humus *In*: Piccolo, A. (Ed), humic substances in terrestial ecosystems, Elsevier science, Amsterdam. pp 361-406. https://doi.org/10.1002/9780470494950.ch8
[32]. Dursun, A.; I. Guvenc and M. Turan. (2002). Effects of different levels of humic acid on seedling growth and macro and micronutrient contents of tomato and eggplant. Acta Agriculture. 56: 81-88. DOI:10.5586/aa.2002.046
[33]. Çimrin, K. M. and Ý. Yalmaz. (2005). Humic acid applications to lettuce do not improve yield but do improve phosphorus availability. Acta Agriculturae Scandinavica Section B-Soil and Plant, 55: 58-63. DOI:10.1080/09064710510008559
[34]. eviciae. J. of bio-technology research center. 4 (2): 94-100.
[35]. bakery yeast Saccharomycescereviciae. J. of bio-technology research center. 4 (2): 94-100.
[36]. bakery yeast Saccharomycescereviciae. J. of bio-technology research center. 4 (2): 94-100.
[37]. Twfiq, A. A. (2010). Estimation levels of Indole acetic acid (IAA) and Gibberellic acid (GA3) in dry
[38]. Twfiq, A. A. (2010). Estimation levels of Indole acetic acid (IAA) and Gibberellic acid (GA3) in dry
[39]. Twfiq, A. A. (2010). Estimation levels of Indole acetic acid (IAA) and Gibberellic acid (GA3) in dry

تاثير مستخلص خميرة الخبز وحامض الهيوميك اسيد على النمو الخضري والحاصل الكمّي والعناصر المعدنية لصنفين من البطاطا

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الخلاصة

أجريت هذه التجربة في موقعين مختلفين، الموقع الأول (دهوك) والموقع الثاني زاخو (باتيفا) خلال موسم النمو الربيعي (2023). لتحديد تأثير ثلاثة تراكيز من خميرة الخبز (0 و 8 و 16 مل−1) وثلاثة تراكيز من حامض الهيوميك (0 و 4 و 8 مل لتر−1) في صنفين من البطاطس (***Laperla cv***. و ***El Mudo cv***))،حيث لاحظت النتائج المدروسة ان الصنف ***El Mudo***. كان متفوقًا على الصنف لابيرلا. في وزن الدرنة (غم)، والحاصل الكلي (كغم نبات−1)،

وفوسفور%، وبوتاسيوم%، وكالسيوم% وفي كلا الموقعين، ونسبة النيتروجين% في الموقع الأول. أدى الرش الورقي بـ 16 جرام لتر−1 من خميرة الخبز إلى زيادة معنوية في النمو الخضري والمحصول والمحتويات الغذائية في كلا الموقعين. أعطى الرش الورقي بـ 8 مل لتر−1 حامض الهيوميك أعلى قيمة معنوية لطول النبات (سم)، عدد الأفرع نبات−1، مساحة الورقة (سم2)، عدد الدرنات، نسبة النيتروجين، نسبة البوتاسيوم، نسبة الكالسيوم في كلا الموقعين. بينما أدى 4 مل لتر−1 إلى زيادة معنوية في وزن الدرنة (غم) والحاصل الكلي (كغم. نبات−1). إن التأثير المشترك لعاملين هما الصنف وخميرة الخبز، الصنف وحامض الهيوميك، وخميرة الخبز وحامض الهيوميك، أدى إلى زيادة معنوي لمعظم المعايير المدروسة. أدى التفاعل الثلاثي بين العوامل الثلاثة إلى وجود فروق معنوية موجبة في جميع صفات النمو الخضري والمحصول والمحتوى الغذائي في كلا الموقعين.

الكلمات المفتاحية :البطاطا ، السماد العضوي ، السمادالحيوي، الاصناف.