



Effect of organic, mineral and bio-fertilizer and their interaction on growth, and some quality characters of potato *Solanum tuberosum* L. cv. (Burren)

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Abstract

The experiment was conducted in the greenhouse of the Department of Horticulture and Garden Engineering - College of Agricultural Engineering Sciences - University of Baghdad in the spring season 2020-2021 within randomized complete block (RCBD) to study the effect of the foliar application with (Humic), biofertilizer (Biohealth) and balanced mineral fertilizer (NPK) 20:20:20 and the interaction among them on growth and yield of potatoes (Burren) cultivar, After completing the laboratory and field study indicators, the averages were compared to calculate the least significant difference (L.S.D) at 5% significance level. The results were as follows:

The interaction between humistar and NPK was significantly superior in leaf chlorophyll content (0.916 mg.gm^{-1}), while the number of stems per plant was not significantly different between NPK treatment and biofertilizer and triple interaction ($3.33 \text{ stem. plant}^{-1}$), While there were significant differences among the rest of the experimental treatments, while the treatment of biofertilizers was significantly superior in the stem diameter which gave (0.833 mm).

The root length characters was superior in treatment of interaction between the biofertilizer and the NPK with significant difference compared to other treatments (37.00 cm), while the biofertilizer treatment significantly increased the weight of the roots by giving (91.00 gm). The percentage of soluble solids in tubers was highest in the treatment of triple interaction (organic, mineral and biological) with significant difference compared to the rest of the treatments (17.10%).

The treatment of NPK and the interaction with the organic acid were significantly superior in leaf nitrogen and nitrate content by giving (1.85% and 125.67 ppm), whereas The leaf content of potassium showed that the interaction between organic acid and NPK and the triple interaction treatment significant differences compared to the rest of the experimental treatments which gave (1.78%).

.Keywords: Humic acids, NPK, bio-fertilizers, organic fertilizers, potato.

Introduction

Concerns are usually focused on meeting the needs of the growing population of food and combating undernourishment without paying attention to the environmental risks that threaten the ecosystem first and human health. Recent efforts have therefore been directed at providing equal attention to the ecosystem because it is the main reason for the existence of life on our planet. One of the most important concerns of the consumer is the use of vegetables for nutritional reasons (1), Therefore, the tendency to grow potato crops and work to increase the quantitative and qualitative production to face the food crisis associated with the growing population in developing countries because it is a source of energy because it contains carbohydrates, vitamins, proteins, amino acids, salts and minerals (2).

Challenges have also crystallized to reduce the dangers of pollution from the use of chemical fertilizers, so the importance of organic fertilizers emerged humic acid because of its rapid effect harmless to humans, animals and plants, and because it contains nutrients that increase plant growth Plant (3). Observed a significant increase in the percentage of dry matter, starch, NPK concentration and the yield of Aladin cultivar when sprayed with liquid humic acid (4). Also (5) in the study of potato plant found significant superiority in the characters of the number of

marketable tubers and the total yield per plant using 3 ml.L⁻¹ of humic acid

The use of bio-fertilizers has recently emerged to regulate production, protect the environment and produce pollutant-free crops for their role in supplying plants with elements and transforming them into ready-to-absorb form, In addition to the protection provided by some pathogens, which leads to lower production costs and reduce environmental pollution (6 and 7),(8) also found that inoculation of potatoes with bio-fertilizers improved vegetative growth, dry matter and carbohydrate content, which positively reflected on potato yield, and increased NPK using bio-fertilizers.

Therefore, the experiment aims to study the effect of mineral, organic and bio-fertilizers separately and then study their combined effect on the growth and yield of potato crop.

Materials and working methods

The experiment was conducted in the greenhouse of the Department of Horticulture and Garden Engineering - College of Agricultural Engineering Sciences - University of Baghdad at spring season 2020-2021. The tubers were planted on 4/2/20 on the terraces of 4 m long and 1 m wide. within randomized complete block (RCBD) .the distance between the tuber and another 25 cm and a depth of 10 cm and in accordance with the cultivated cultivar to study the effect of the foliar application with (Humic), biofertilizer

(Biohealth) and balanced mineral fertilizer (NPK) 20:20:20 and their interaction on growth and yield of potatoes (Burren) cultivar. After completing the laboratory and field study indicators, the averages

were compared to calculate the least significant difference (L.C.D) at 5% significance level. Using SAS program in statistical analysis..

Table (1) Experiment treatments, symbols and details of each treatment.

treatment	symbols	Details
T1	H	organic nutrient treatment (Humic) 5-10 l.ha ⁻¹
T2	B	biofertilizertreatment (Biohealth) 40 gm.l ⁻¹
T3	C	balanced mineral fertilizer treat. (NPK) 20:20:20
T4	HB	Interaction treatment between organic nutrient treatment and biofertilizertreatment
T5	HC	Interaction treatment between organic nutrient treatment and balanced mineral fertilizer treatment.
T6	BC	Interaction treatment between biofertilizerand balanced mineral fertilizer treatment treatment and
T7	HBC	Triple interaction among between organic nutrient treatment,biofertilizertreatment and balanced mineral fertilizer treatment..

Study parameters:

1. Number of main stems. (Stem Plant⁻¹)
2. stem diameter (mm): was measured using an electronic (vernier) from the central stem area.
3. Concentration of Chlorophyll in leaves mg/100gm: With using Spectrophotometer and according to the method (9).
4. Root length: using tape measure
5. Root Weight (gm).
6. NPK content in leaves Using a device (Microkjeldahi) by distillation process (10).

7. NPK content in tubers

8. Nitrate leaves content: The method described by (11) was applied.

9. Nitrate content in tubers.

10. T.S.S: Using the Hand Refractometer according to the method mentioned in (12).

Results and discussion

Table (2): Effect of organic, mineral and bio-fertilizer and their interaction on some vegetative growth indicators and leaf chlorophyll content of potato plant Burren cultivar.

Qualities Transactions	Number of main stems (Stem Plant ¹)	stem diameter (mm)	Chlorophyll content mg.100g ⁻¹
C	3.33	0.567	0.813
H	3.00	0.600	0.860
B	3.33	0.833	0.856
HC	2.33	0.800	0.916
BC	2.33	0.767	0.866
HB	2.00	0.767	0.830
HBC	3.33	0.733	0.916
L.S.D	NS	0.2202	0.03256

It is noted from Table (2) that the interaction between humistar and NPK was significantly superior compared to other treatments and without significant difference with triple interaction (biomedical, organic and mineral) in total leaf chlorophyll content which gave (0.916 mg. g⁻¹) for both treatments. As for the number of stems, it was noticed that there were no significant in character of number of main stems, while the treatment of biocatalysts was significantly superior in the diameter of the stem that gave (0.833 mm). This is due to the increase in chlorophyll ratio to the treatment of organic and mineral interaction because

these fertilizers contain the three necessary elements NPK, which encourages the increase of the manufacture of Porphyrins rings which are the basis in the construction of chlorophyll and cytochrome which is important for carbon metabolism and respiration (13). The effect may be due to the small number of stems of these treatments. The diameter of the stem the biocatalyst treatment gave the highest value due to its role in processing the elements, increasing the secretions of growth regulators and improving the absorption of water and nutrients, thus increasing photosynthesis and thus increasing the manufacture of carbohydrates (14).

Table (3): Effect of organic, mineral and bio-fertilizer and their interaction on some root growth indicators of potato plant Burren cultivar.

Qualities Transactions	Root length (cm)	Root Weight (gm)	T.S.S (%)
C	31.67	81.33	15.83
H	32.33	35.33	16.10
B	30.33	91.00	16.63
HC	28.33	32.33	17.06
BC	37.00	32.76	16.40
HB	20.33	44.33	15.80
HBC	25.33	74.33	17.10
L.S.D	3.810	4.508	0.3162

The results of Table (3) showed that BC treatment was significantly superior than the other treatments in root length which reached (37.00 cm), While B treatment was significantly superior on root weight as it gave (91.00 gm). The percentage of solid material in tubers the highest value obtained from triple interaction (biomedical, organic and mineral) and a significant difference compared to the rest of the treatments by giving (17.10%). This may be due to the increased root length of the treatment of bilateral interaction between chemical fertilizer and biocatalyst because of its effect on changing the soil

pH surrounding the roots and increase the movement of elements and plant enrichment (14), it can also be explained that the amino acids and sugars secreted by the roots increase the response of bacteria chemically (15), As for the percentage of solid material percentage in tubers , it is a reflection of the effect of the three fertilizers (organic, mineral and bio) and their favorable conditions for the absorption of water and nutrients and the improvement of soil properties. The effect of this on the indicators of vegetative growth Table (2), which reflected positively on (T.S.S) (16).

Table (4): Effect of Organic, Mineral and Bio Fertilizers and their Interaction on NPK and Nitrate Content in leaves of Potato Plant Burren cultivar.

Qualities Transactions	Nitrogen leaves content	Phosphorus leaves content	potassium leaves content	Nitrate leaves content
C	1.85	0.53	1.75	123.33
H	1.84	0.54	1.77	122.33

B	1.84	0.52	1.73	122.33
HC	1.85	0.53	1.78	125.67
BC	1.84	0.54	1.75	120.00
HB	1.81	0.53	1.73	120.67
HBC	1.82	0.53	1.78	121.67
L.S.D	0.02079	NS	0.04130	3.294

It is noticed from Table (4) that the treatment of NPK and the interaction with organic acid were significantly superior in the nitrogen and nitrate content of leaves which gave (1.85% and 125.67 ppm), whereas the treatment of organic acid and the interaction between the biofertilizer

and NPK were significantly superior in the leaves content of phosphorus which gave (0.54%). The leaves content of potassium showed a significant difference among the treatments of organic acid and NPK and the triple interaction treatment by giving (1.78%).

Table (5): Effect of organic, mineral and bio-fertilizer and their interaction on content of NPK and nitrate in tubers of potato plant Burren cultivar.

Qualities Transactions	Nitrogen tubers content	phosphorus tubers content	potassium tubers content	Nitrate tubers content ppm
C	0.210	0.052	0.410	32.33
H	0.243	0.054	0.413	35.33
B	0.210	0.051	0.383	32.67
HC	0.243	0.055	0.413	33.00
BC	0.253	0.053	0.413	34.00
HB	0.236	0.051	0.400	31.33
HBC	0.273	0.055	0.420	36.00
L.S.D	0.01793	0.001779	0.01647	2.440

The results of table (5) showed no significant differences among treatments of organic acid interfered with NPK and treatment of triple interaction (biomedical,

organic and bio) in the tubers content of phosphorus by giving (0.055%) and for both treatments but there were significantly superior compare with other treatments, while the treatment of triple interaction in the tubers content of Nitrogen, potassium and nitrate which gave (0.273%, 0.420% and 36.00ppm) respectively. The reason for the superiority of fertilizer treatment in the characteristic of the marketable yield and percentage of dissolved solids for the role of humic acids in increasing the permeability of cell membranes, which increases the readiness of nutrients and this effect is associated with the function of hydroxyl and carboxyl groups effective in the plant. which is reflected positively on the vegetative total Table (2). This leads to an increase in photosynthesis and the manufacture of carbohydrates, thus increasing the marketing yield. The increase in nutrient ratios in leaves and tubers is due to the source of energy needed by soil organisms in their activities, which leads to mineralization of organic matter and thus release elements and increase their readiness (17, 18).

conclusion

1. The Biohelth treatment was significantly superior in stem diameter and wet root weight
2. The overlap between Biohelth and NPK in the root length characteristic
3. The interaction between Humistar and NPK significantly increased the leaf content of chlorophyll, nitrogen, nitrate and potassium.
4. The triple overlap of Humistar, NPK and Biohelth in T.S.S. And the content of leaves of phosphorus and the content of tubers - of nitrogen and potassium.

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Appendix 1: Specifications Biohealth

%	the ingredients
10	Trichoderma harinam and Bacillus strains
75	Humic acid
5	Seaweed
10	Water