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Response of onion plant (Allium cepa) to the addition of Bio-humic fertilizer and planting date on the productivity characteristics of bulb yield

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Abstract

The experiment was carried out in Dhi Qar Governorate - Nasiriyah City - Al-Mustafawiyah area, for the agricultural season 2023/2024 in one of the open plastic houses affiliated with the Agricultural Research Station for the fields of the Department of Horticulture and Landscape Engineering - College of Agriculture and Marshes, University of Dhi Qar. In a sandy loam soil to studying Response of onion plant (Allium cepa) to the addition of Bio-humic fertilizer and planting date on the productivity characteristics of bulb yield. The experiment was carried out using a Randomized Complete Block Design (R.C.B.D). The experiment included four treatments for adding biohumic fertilizer - control treatment (spraying with distilled water only), concentration (3) kg. ha-1, concentration (6) kg. ha-1, concentration (9) kg. ha-1 and three treatments for planting dates - the first date 10.20.2023, 01.11.2023 and the third date 10.11.2023. The addition of biofertilizer at a concentration of 6 kg.ha-1 was superior Giving the highest onion diameter, onion weight, onion neck diameter and onion length, the total yield of the plant from the bulbs, significantly at a concentration of 6 kg.ha-1, in giving the largest onion diameter, which reached (7.967 cm) and (94.06 g) and 35.37 mm) reached 11.126 cm 18.807 tons ha, respectively, and the first date (10/20) was superior to giving the highest onion diameter, onion weight, onion neck diameter and onion length, the total yield of the plant from the bulbs reached (8.158 cm) 90.15 g) 30.76 mm 18.027 tons ha-1

Keywords; Onion plant; Bio-humic fertilizer; planting date; Onion weight, onion diameter, total yield

I. Introduction

Onions (*Allium cepa* L.) are considered one of the most important plants of the Alliaceae family and are one of the most important winter vegetable crops in the world. They play an important role in human nutrition, as an individual needs to consume 7-10 kg of onions annually. The nutritional value of every 100 grams of onions is 92.5 g of water, 1.3 g of protein, 0.1 g of fat, 4.3 g of carbohydrates, 0.9 mg of fiber, 60 mg of vitamin C, 6 mg of vitamin A, 0.004 vitamin B1, 0.006 vitamin B2 (Tutova et al., 2022). Medically, onions are used to treat cough, asthma, bronchitis, and prevent neurological, cardiovascular and vascular diseases due to their content of anthocyanins and flavonoids, which act as antioxidants, in addition to their content of the active substance Allicin, which is responsible for most of the medicinal properties of the plant (Ani et al., 2021).

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The productivity of bulbs per hectare in Iraq in 2017 was about 8262 kg. ha-1. This productivity is relatively low when compared to the productivity of other Arab countries such as Jordan 22660 kg. ha-1, Saudi Arabia 25304 kg. ha-1, and Egypt 31991 kg. ha-1 (Arab Organization for Agriculture and Development, 2008). Bio-organic fertilizers are defined as all bacterial, fungal and algal inoculants that are added to soil or seeds for the purpose of increasing soil fertility by increasing the availability of the necessary elements for plant growth and thus increasing productivity (Tilak and Reddy, 2006). Biofertilizers have economic importance in the agricultural field, as they increase the availability of some nutrients and increase the speed of decomposition of organic waste. They play a role in the secretion of some enzymes, growth regulators, and plant hormones, and they are important in biological control, in addition to reducing costs (Al-Ghazi, 2006).

Vegetable crops grow in areas suitable for their cultivation, and this depends mainly on the appropriate environmental conditions that determine the success of growing the crop in that area rather than others. Among the conditions for the success of vegetable crops in a place are the availability of appropriate climatic conditions represented by temperature, humidity, lighting, ventilation, and appropriateness for the crop, (Fadala, 2022), as vegetables are affected by temperatures and whether they are ideal for crop growth (Borras et al., 2012). Devendra et al., (2018)) indicated when studying Azotobacter bacteria and their effect on onion plants for six doses (T0: NPK, T1: 33 g/m2, T2: 66 2 g/m2, T3: 99 2, g/m2, T4: 132, g/m2, T5: 166, g/m2, T6: 199 2 g/m2). The results showed a significant increase in plant height T6 (57.3 cm), number of leaves, (T6 (11.4 chlorophyll a T6 (0.86 mg / g chlorophyll b 0.47) mg / g. The study conducted by Saleh, et al., 2021 at the College of Agriculture, University of Anbar, showed the effect of humic acids and phosphorus on the growth and yield of onions irrigated with water of different salinity. Using irrigation water of different electrical conductivity (1.1, 3.00, 5.00 and 7.00) dS m-1, three levels of humic acids were used, namely 0, 20 and 40 kg. ha-1, respectively, and three levels of single superphosphate fertilizer were used, namely 0, 100 and 150 kg. ha-1. The results showed an increase in onion plant height, leaf area, stem diameter and total yield, and an increase when adding acid levels Al-Dabalia. Between Khalil (2013) in a study conducted at the Technical Agricultural College / Mosul on the effect of organic fertilization on the growth and yield of green onions Allium cepa L. local white variety. The experiment included six treatments, which are chemical fertilization (65 kg / donum urea + 65 kg / donum superphosphate + 50 kg / donum potassium sulfate), poultry manure at a rate of 15 m3 / donum, sheep manure at a rate of 20 m3 / donum, and three treatments of manufactured poultry manure (Italpollina) at a rate of 20, 30 and 40 kg / 100 m2. The results showed the superiority of manufactured poultry manure added at a rate of 40 kg / 100 m2 in some vegetative growth characteristics (number of leaves per plant 27.62, fresh weight of leaves 93.23 g, and dry weight of leaves 11.53 g).

The study aims to know the Response of onion plant (Allium cepa) to the addition of Bio-humic fertilizer and planting date on the productivity characteristics of bulb yield

II. Materials and Methods

3-1 Experimental site

The experiment was carried out in Dhi Qar Governorate, Nasiriyah City, Mustafawiyya area, for the agricultural season 2023/2024 in one of the open plastic houses affiliated with the Agricultural Research Station for the fields of the Department of Horticulture and Landscape Engineering, College of Agriculture and Marshes, University of Dhi Qar. In a loamy sand soil to study the effect of adding Bio-humic fertilizer and planting date on the vegetative growth characteristics and chemical characteristics of onion *Allium cepa* L.

3-1-2 Soil and irrigation water analysis

An analysis of the plastic house soil was conducted by taking random samples from different locations of the field soil at a depth of (30) cm. The samples were mixed and air-dried for (72 hours) and ground

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and sieved with a sieve with (2 mm) holes, then chemical analysis processes were carried out at the Shatra Institute. While part of the soil remained unground and unsifted to conduct some physical analyses of the soil. Table (1) shows some chemical and physical properties of field soil.

Table (1) some chemical and physical properties of field soil

No.	Analysis Type	Value	Unit
1	EC	1.3	ds/m
2	PH	7.35	/
3	CEC	19.5	mg/L
4	Organic matter) OM(	7.4	mg/L
5	Calcium carbonate) $CaCo_3$(	203.2	m mole/kg-1
6	Ca^+	4.3	m mole/kg-1
7	Mg^+	2.7	m mole/kg-1
8	Na^+	7.3	m mole/kg-1
9	K^+	0.8	m mole/kg-1
10	Cl^-	2.6	m mole/kg-1
11	SO_4	6.3	m mole/kg-1
12	CO_3	/	m mole/kg-1
13	HCO_3	0.98	m mole/kg-1
14	N	12.7	mg/kg m
15	P	6.3	mg/kg m
16	K	38.8	mg/kg m
17	Sand	226	mg/L
18	Loam	450	mg/L
19	Clay	324	mg/L

Table (2) Chemical and physical analysis of irrigation water in the field

No.	Analysis Type	Value	Unit
1	PH	7.25	/
2	EC	1.3	ds/m
3	TDS	910	mg/g
4	T.H	201	mg/g
5	HCO_3	12.3	mg/g
6	CO_3	0	mg/g
7	Ca^{+2}	37.4	mg/g
8	Mg^{+2}	12.4	mg/g
9	Na^+	103	mg/g
10	K^+	5.2	mg/g
11	NO_3	0.11	mg/g
12	P	0.12	mg/g
13	CL^-	200	mg/g
14	SO_4	310	mg/g
15	TSS	740	mg/g

3. Field soil preparation and cultivation:

The field soil preparation process was carried out by ploughing it twice in a perpendicular manner, smoothing it, leveling it and planning it. The land was divided into three sectors, each sector consisting of three lines, the length of the line was 20 m and its width was 50 cm, and the distance between the two lines was 40 cm. The line was dug to a depth of 30 cm and was first filled with compost for a distance of 20 cm, then a layer of decomposed animal manure was added on it at a rate of 10 kg dun-1, and DAP

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fertilizer was added on it at a rate of 50 kg/dunum-1 (Matloub et al., 1989), then peat moss was added at a rate of 5 kg dun-1, then the holes were leveled with the soil surface and the drippers were extended and covered with black nylon (Mulching). Each line was divided into 4 experimental units, the length of the unit was 4 m, then plant holes were dug at a distance of 20 cm between holes alternately and on both sides of the line so that the number of plants in the experimental unit was 40 plants. The land was irrigated two days before planting the bulbs (small bulbs) to moisten the soil. The damaged and infected bulbs were sorted and disposed of, and the weights of the good bulbs were standardized to approximately 1.5 g (Matloub et al., 1989). The bulbs (Red granex variety) were planted on 10.20.2022 and were irrigated immediately after planting and then at a rate of one irrigation per week. After the temperature dropped, irrigation was carried out every 15 days. The patching process was carried out by replacing the failed bulbs with new bulbs 10 days after planting. All service operations were carried out, including weeding and weed removal, and the chemical fertilizer NPK high phosphorus 10-52-10 was added at a rate of 1 kg/ton of water-1 two weeks after planting. Urea was fertilized on 10.11.2023 by adding it with irrigation water at a rate of 100 gm urea 46% nitrogen. 100 liters of water-1, and the high potassium fertilizer 20-10-10 was added in two batches on 05.12 and 20.12.2023. The experiment was completed on 05.04.2024. The experiment was implemented using a Randomized Complete Block Design (R.C.B.D). The experiment included three treatments for planting dates and four treatments for adding biohumic fertilizer, with three replicates and 36 experimental units, as a factorial experiment with two factors. The treatments were randomly distributed to the experimental units for each of the three replicates. The data were analyzed using the Genstat 2011 program, and the averages were compared using the least significant difference (L.S.D) test to compare the averages at a probability level of (0.05) (Al-Sahouki and Wahib 1990).

Experimental treatments: The experiment included two factors: four concentrations of bio-organic fertilizer: - Control treatment (spraying with distilled water only) - concentration (3) kg. ha-1 - concentration (6) kg. ha-1 - concentration (9) kg. ha-1 and three planting dates - the first date 20.10.2023. - the second date 01.11.2023. - the third date 10.11.2023.

The studied characteristics:

1_ Bulb diameter (cm)

Measured as an average of the diameter of ten bulbs from each experimental unit using a vernier from the widest area.

2. Bulb length (cm)

Measured the length of ten bulbs from each experimental unit using a vernier.

3. Bulb weight (g):

Ten randomly selected bulbs were weighed and the average was taken to calculate the weight of one bulb for each experimental unit.

4- Bulb neck diameter

The diameter of the bulb neck was calculated using a Vernier caliper at a height of one centimeter from the soil surface.

III. Results and Discussion

1. Onion diameter (cm)

The results of Table (3) showed the effect of adding biofertilizer and planting date on onion diameter, the biofertilizer treatment was significantly superior at a concentration of 6 kg.ha-1, in giving the largest onion diameter of (7.967 cm) compared to the smallest onion diameter of (6.966 cm) for the comparison treatment.

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The same table also shows that the planting date had a significant effect, as the first planting date 10/20/2023 was significantly superior, as it gave the largest onion diameter of (8.158 cm) compared to the planting date 11/10/2023, which recorded the smallest onion diameter of (6.567 cm).

While the interaction between the study factors had a significant effect, the combination of biofertilizer and planting date had a significant effect, as the biofertilizer treatment at a concentration of 6 kg.ha-1 and the first date 10/20/2023 gave the highest average bulb diameter of (8.817 cm). While the comparison treatment of biofertilizer and the last planting date 11/10/2023 gave the lowest average bulb diameter of 6.567 cm.

Table (3). The effect of adding biofertilizer, planting date and their interaction on the diameter of the bulb in cm.

planting dates	biohumic fertilizer				planting dates average
	Without adding	Concentration (3)kg.h^{-1}	Concentration (6)kg.h^{-1}	Concentration (9)kg.h^{-1}	
20.10.2023	7.283	8.267	8.817	8.263	8.158
01.11.2023	7.047	8.043	8.317	8.080	7.872
10.11.2023	6.567	6.433	6.767	6.500	6.567
biohumic fertilizer average	6.966	7.581	7.967	7.614	Interaction
L.S.D (0.05)	planting dates		biohumic fertilizer		**0.1888**
	0.0944		**0.1090**		

2.Bulb weight (g)

The results of Table (4) showed the effect of adding biofertilizer and planting date on the diameter of the bulb, the biofertilizer treatment was significantly superior at a concentration of 6 kg.ha-1, in giving the largest weight of the bulb, which amounted to (94.06 g), compared to the smallest weight of the bulb, which amounted to (61.81 g) for the comparison treatment.

The same table also shows that the planting date had a significant effect, as the first planting date 10/20/2023 was significantly superior, as it gave the largest weight of the bulb, which amounted to (90.15 g), compared to the planting date 11/10/2023, which recorded the smallest weight of the bulb, which amounted to (72.11 g).

While the interaction between the study factors had a significant effect, the combination of biofertilizer and planting date had a significant effect, as the biofertilizer treatment at a concentration of 6 kg.ha-1 and the first date 10/20/2023 gave the highest average onion weight of (105.00 g).

, While the comparison treatment of biofertilizer and the last planting date 11/10/2023 gave the lowest average onion weight of 56.83 g.

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Table 4. The effect of adding biofertilizer, planting date and the interaction between them on onion weight (g

planting dates	biohumic fertilizer				planting dates average
	Without adding	Concentration (3)kg.h^{-1}	Concentration (6)kg.h^{-1}	Concentration (9)kg.h^{-1}	
20.10.2023	66.93	92.50	105.00	96.17	90.15
01.11.2023	61.67	89.67	96.83	90.67	84.71
10.11.2023	56.83	74.77	80.33	76.50	72.11
biohumic fertilizer average	61.81	85.64	94.06	87.78	Interaction
L.S.D (0.05)	planting dates		biohumic fertilizer		
2.303	**1.329**		**1.151**		

3- Onion neck diameter mm

The results of Table (5) showed the effect of adding biofertilizer and planting date on the diameter of the onion neck, the biofertilizer treatment was significantly superior at a concentration of 6 kg.ha-1, as it recorded the largest diameter of the onion neck (35.37 mm) compared to the smallest diameter of the onion neck (19.63 mm) for the comparison treatment.

The same table also shows that the planting date had a significant effect, as the first planting date 10/20/2023 was significantly superior, as it recorded the largest diameter of the onion neck (30.76 mm) compared to the planting date 11/10/2023, which recorded the smallest diameter of the onion neck (21.68 mm).

While the interaction between the study factors had a significant effect, the combination of biofertilizer and planting date had a significant effect, as the biofertilizer treatment at a concentration of 6 kg.ha-1 and the first date 10/20/2023 gave the highest average onion neck diameter of (31.16 mm), while the comparison treatment of biofertilizer and the last planting date 11/10/2023 gave the lowest average onion neck diameter of (22.51 mm).

Table (4) The effect of adding biofertilizer, planting date and their interaction on the diameter of the onion neck in mm.

planting dates	biohumic fertilizer				planting dates average
	Without adding	Concentration (3)kg.h^{-1}	Concentration (6)kg.h^{-1}	Concentration (9)kg.h^{-1}	
20.10.2023	25.27	30.83	35.37	31.57	30.76
01.11.2023	22.63	27.67	33.67	28.30	28.07
10.11.2023	19.63	21.53	24.43	21.10	21.68
biohumic fertilizer average	**22.51**	**26.68**	**31.16**	**26.99**	Interaction
L.S.D (0.05)	planting dates		biohumic fertilizer		**1.122**
	0.561		0.648		

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4.Bulb length (cm)

The results of Table (6) showed the effect of adding biofertilizer and planting date on the length of the bulb. The biofertilizer treatment was significantly superior at a concentration of 6 kg.ha-1, in giving the highest bulb length of 11.126 cm compared to the lowest bulb length of 8.114 cm for the comparison treatment.

The same table also shows that the planting date had a significant effect, as the first planting date 10/20/2023 was significantly superior, as it gave the highest bulb length of 10.864 cm compared to the planting date 11/10/2023, which gave the lowest bulb length of 8.048 cm.

While the interaction between the study factors had a significant effect, the combination of biofertilizer and planting date had a significant effect, as the biofertilizer treatment at a concentration of 6 kg.ha-1 and the first date 10/20/2023 gave the highest percentage of bulb length, reaching 12.500 cm, while the comparison treatment of biofertilizer and the last planting date 11/10/2023 gave the lowest percentage of bulb length, reaching 7.097 cm.

Table (11) Effect of adding biofertilizer, planting date and their interaction on bulb length (cm)

planting dates	biohumic fertilizer				planting dates average
	Without adding	Concentration (3)kg.h^{-1}	Concentration (6)kg.h^{-1}	Concentration (9)kg.h^{-1}	
20.10.2023	9.167	10.223	12.500	11.567	10.864
01.11.2023	8.080	9.340	11.417	10.380	9.804
10.11.2023	7.097	7.317	9.460	8.463	8.084
biohumic fertilizer average	8.114	8.960	11.126	10.137	Interaction
L.S.D (0.05)	planting dates		biohumic fertilizer		0.2454
	0.1417		0.1227		

5: Total yield of bulbs (tons ha-1)

The results of Table (7) showed the effect of adding biofertilizer and planting date on the total yield of bulbs (tons ha-1). The biofertilizer treatment was significantly superior at a concentration of 6 kg. ha-1, in giving the highest total yield of bulbs, which amounted to 18.807 tons ha-1, compared to the lowest total yield of bulbs, which amounted to 12.357 tons ha-1 for the comparison treatment.

The same table also shows that the planting date had a significant effect, as the first planting date 10/20/2023 was significantly superior, as it gave the highest total yield of bulbs, which amounted to 18.027 tons ha-1, compared to the planting date 11/10/2023, which gave the lowest total yield of bulbs, which amounted to 14.407 tons ha-.

While the interaction between the study factors had a significant effect, the combination of biofertilizer and planting date had a significant effect, as the biofertilizer treatment at a concentration of 6 kg.ha-1 and the first date 10/20/2023 gave the highest percentage of the total yield, reaching 21,000 tons ha-1, while the comparison treatment of biofertilizer and the last planting date 11/10/2023 gave the lowest percentage of the total yield, reaching 11,360 tons ha-1

able (7). The effect of adding biofertilizer, planting date and their interaction on the. : Total yield of bulbs (tons ha-1

planting dates	biohumic fertilizer				planting dates average
	Without adding	Concentration (3)kg.h^{-1}	Concentration (6)kg.h^{-1}	Concentration (9)kg.h^{-1}	
20.10.2023	13.380	18.500	21.000	19.230	18.027
01.11.2023	12.330	17.930	19.360	18.130	16.937
10.11.2023	11.360	14.950	16.060	15.300	14.407

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biohumic fertilizer average	12.357	17.121	18.807	17.553	Interaction
L.S.D (0.05)	planting dates		biohumic fertilizer		0.2787
	0.1393		0.1609		

Tables 3, 4, 6, and 75 show that there are significant differences between planting dates, as the first date (10/20) was superior in tubularity, onion neck diameter, onion weight, onion length, onion neck diameter, and total yield. The reason for the increase in planting on the first date may be due to the long period of vegetative growth and the suitability of environmental conditions, as the increase in the vegetative growth period means exposure to a longer period of lighting and increased photosynthesis and the materials resulting from it, and thus this is reflected in the increase in plant height and the number of leaves (Ahmed, 2001), while the short period of vegetative growth and light period leads to a decrease in plant height and the number of leaves (Al-Hasani, 2001). These results are consistent with Prasad et al. (2017). The reason for the increase in onion neck diameter on the first date (10/20) may be due to the increase in chlorophyll (Table 9), which was positively reflected in the increase in onion neck diameter. The reason for the increase in the dry weight of the vegetative group on the first date (10/20) and its decrease when the planting date is delayed may be attributed to the long period of growth. ncreased activity of microbial enzymes such as Nitrogenase, Urease and Dehydragenase (Mohamed et al., 1999). Al-Sahaf and Aati (2007) also indicated that the decomposition of organic fertilizers produces some amino and organic acids, all of which play an important role in the vital processes in the plant and led to an increase in some vegetative growth characteristics (number of leaves per plant - Table 2 - and fresh and dry weight of leaves - Table 3), which was reflected in the characteristics of the yield, as the average weight and diameter of the bulb and the yield of one plant increased, and thus the total yield of the bulbs increased. These results are consistent with what was found by Salman (2000); Abdelrazzag (2002); Akoun (2004); Magdi (2009); Al-Khafaji (2010); Hamoud (2011). The response to biofertilization (saving) was due to the fact that this fertilizer contains different types of nitrogen-fixing and phosphate-dissolving microorganisms (Table (2)), which have other roles that increase the availability of nutrients in the soil through the secretion of growth regulators and siderophores and increase the absorption of different elements (6, 10 and 15). The response to biofertilization was more evident when added with organic fertilizer because of what organic fertilizer provides in terms of nutrients, energy sources and a suitable environment for the activity of microorganisms contained in the biofertilizer. The role of biofertilization confirms what Mahmoud and Mahanad indicated about its role in secreting growth-promoting substances and in increasing the physiological tolerance to salinity for some crops (). This led to an increase in production and an improvement in water use efficiency (WUE) when adding biofertilizer alone and in combination with organic fertilizer. The reason for the direct increase in all components of the eggplant yield is due to biofertilizer, which works to provide the plant with the necessary nutrients. For growth, in addition to containing odors that encourage plant cells to divide, which leads to increased production () Also, the organisms present in the biofertilizers that work to provide nutrients in their ready form and secrete some growth regulators that have an effective impact on increasing growth). The components of these fertilizers may remain for a longer period and in a ready form without causing any harm to the plant, in addition to improving some soil properties that increase growth. As for containing live microorganisms, which in turn continue their activity and prepare them for the necessary elements. It is possible that biofertilizers containing bacteria (Ozono-Bakter) work to increase the availability of nitrogen and maintain it in the soil. We conclude from this that it is possible to apply cheap technologies such as magnetic technology to increase the level of production. Many studies must be conducted to determine the ideal magnetic intensity for each crop, and it is possible to increase the economic return by using biofertilizers that can be obtained from local markets and are characterized by ease of use. Conclusions

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1_ We conclude that the biofertilizer at a concentration of 6 kg.ha gave a significant superiority in most of the obtained characteristics and quality characteristics of the bulbs

2_ We conclude that the first date on 10/20/2023 was superior in most of the obtained characteristics and quality characteristics of the bulbs

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