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Effect of the planting data, type of compound fertilizer and spraying with bio-extract on the growth and production of broccoli plant

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Abstract---With the aim of determined the optimum data of the broccoli plant and selecting the appropriate fertilizer for it, as well as determining the importance of foliar spraying with biozyme in growth and production, The experiment was carried out according to the split split plot design with three replicated, that included three factors, the first factor is the study of the effect of planting date (D), which included two planting dates, the first of planting was transplanting in the field at 9/10 (D1) and other date was planting at 9/24 (D2), the main plot was assigned to the planting date, and the sub plot was recognized to the fertilizing factor (F) to studying effect the type of the fertilizer are used (F) that included three levels, without fertilization (F0) and fertilization with the chemical fertilizer balanced 20-20-20 (F1) and fertilizing with DAP (Di ammonium phosphate) and then within each sub plot, the treatments of foliar spraying with Biozyme were distributed, that included two levels, without spraying (B0) and spraying with biozyme (0.5 mg.L⁻¹ (B1)). The Results are shown a significantly superiority of the plants when cultured at the second date (D2-9/24) in the chlorophyll index (68.45) and dry weight of the roots (19.29 g), compared with the plants when cultured at the first date (D1-9/10) in order: (57.35) and (14.69 g). as well as superiority of the plants when cultured at the second date (D2) in the flower weight (1180.06g), the experimental unit yield (9.438 kg) and maturity date (101.39 days) compared with the first transplant date (D1) which produced 926.83 g and 118.17 (days) respectively. The results showed the significantly superiority in the fertilization of the soil with chemical fertilizer 20-20-20 (F1) in the percentage of potassium in leaves (2.02%), weight of the plant yield (1125.00 g),

yield of the experimental unit yield (8.997 kg) and the harvest time (105.33 days), compared with fertilizing with DAP fertilizer (F2) and the control treatment (F0). The results showed a significantly superiority of the spraying treatment with biozyme (B1) compared with untreated plants (B0) in chlorophyll index (64.79), the percentage of phosphorous in the leaves (0.37%) and percentage of potassium in leaves (2.02%), weight of the plant yield (1118.61 g) and the yield of the experimental unit (8.95 kg).

Keywords---broccoli, planting data, chemical fertilizers, bio-extract.

Introduction

Broccoli, whose scientific name is *Brassica Oleracea*, one of the most important vegetable crops of the cruciferous because their nutritional, medicinal and therapeutic benefits, being rich in vitamins, minerals, amino acids and antioxidants as well as its preventive benefits against cancer and reduce cholesterol in the blood and reduce allergies and inflammation, which is beneficial for bone and heart health, detoxification of the heart (Domato et al, 1994). In Iraq, the area planted with broccoli crops in 2018 reached 953 hectare and the total production was 11285 tons with a production rate of 11.841 tons. hectare⁻¹, while the cultivated area in the world amounted to 1417806 hectares and a total production of 26504006 tons with an average productivity of 18.6937 tons.hectares⁻¹ (FAO, 2018). Broccoli is one of the new crops for local consumers, and it is still in the beginning of its production in the country and it offered in the markets in small quantities due to its novelty to Iraqi society despite its nutritional and medical benefits and its high prices compared to other crops of the Crusader family (Losak et al.2014). The growth and productivity of the broccoli crop is affected by several factors, the most important of which is choosing the correct and appropriate date for planting in the country according to the prevailing local conditions that which can be the most suitable for its cultivation. The broccoli crop is a relatively new winter crop and it will planted at an inappropriate time, then causes a decrease in productivity or a decrease in its marketing or quality value.

To determining, the appropriate date for its cultivation in the country was one of the important goals directed by many researchers. There is a great discrepancy between the fertility of local soils in different regions of the country, and that the cultivation of this relatively recent crop requires identifying the quality of fertilizers that can be used to feeding this plant. Using of compound chemical fertilizer (NPK) it is an important way to provide a balance of nutrients important in improving the nutritional status of the plant and improving growth, production and crop quality (Ali,2012). Nitrogen nutrition is important process to regulating of plant hormones and increasing the rate of meristematic cell division and positively reflected on the development of both the vegetative system and increasing in size of the root system (Hossian et al., 2007).

Phosphorous has an important in increasing of plant cell division and increasing their number, as well as stimulating development of the root system and

stimulate the growth of the young parts such as the tips of roots and buds, where high metabolism. Phosphorous is responsible for storing the energy resulting from photosynthesis in the form of high-energy compounds within the plant (ATP and NADPH) (Abu Dahi and Al-younis, 1988). The studies have emphasized the importance of using natural organic extracts that stimulate growth, which using with foliar spraying or with the roots, and these materials are Seaweed Extracts (Zodape, 2001). which are added to spraying in low concentrations as they contain natural growth stimulants such as IAA, GA3, and cytokinin as well as the elements These micro-stimulators help in raising the efficiency of the plant in absorbing nutrients, increasing the concentration of chlorophyll and increasing the efficiency of metabolism (Verklj, 1992). Biozyme is a commercial product produced by specialized companies and under different names, but the same content of biological natural extracts (sea algae) containing some nutrients and natural growth stimulants are Gibberellins, Auxins and Cytokinins (Hassan et al., 2009). Therefore, the study aimed to:

- Determining the appropriate date for planting broccoli according to local conditions to obtain a qualitative and competitive product.
- Determining the most appropriate chemical fertilizer for fertilizing broccoli, according to what is available in the local markets.
- A statement of the benefit of spraying with natural extracts in the growth and yield of the broccoli plant.

Materials and Methods

The experiment carried out in the field of the College of Agriculture / University of Diyala during season 2021. This study included studying of data of the planting (D), type of the compound chemical fertilizer (F) and foliar application with Biozyme (B) on growth and productivity of the Broccoli plants. With the aim of determined the optimum data of the broccoli plant and selecting the appropriate fertilizer for it, as well as determining the importance of foliar spraying with biozyme in growth and production, The experiment was carried out according to the split split plot design with three replicated, that included three factors, the first factor is the study of the effect of planting date (D), which included two planting dates, the first of planting was transplanting in the field at 9/10 (D1) and other date was planting at 9/24 (D2), the main plot was assigned to the planting date, and the sub plot was recognized to the fertilizer factor (F) to studying effect the type of the fertilizer are used (F) with three levels ,without fertilization (F0) and fertilization with the chemical fertilizer balanced 20-20-20 (F1) and fertilizing with DAP (Di ammonium phosphate) and then within each sub plot, the treatments of foliar spraying with Biozyme were distributed, that included two levels, without spraying (B0) and spraying with biozyme (0.5 mg.L⁻¹ (B1)). The results analyzed and the averages compared according to least significant difference (LSD) at 5% probability (Al-Sahoki, 1990).

Field operations

- The seedling of the Broccoli seeds were by cork trays and with using the peat moss as a culture medium and transplant to the field after 30 days.

- Foliar application carried out by using the Biozyme (B₁), the first spraying was after 3 weeks from the transplanting for both type of the plants, and the spraying process repeated every two weeks and an average of fore sprays per season (Table 1).

Table 1
Biozyme TF (French company Arista Life Science)

Materials	the value	Materials	the value
Plant hormones	78.87%		S
0.44% IAA	32.2ppm		B
0.30% GA3	32.2ppm		Fe
0.49% Zeatins	83.2ppm		Mn
0.12% Nutrient minerals	1.86%		Zn
0.37% Mg	0.14%		other materials
19.20%			

- The amount of the fertilizer added to the soil was 250 kg.ha⁻¹ for both fertilizers.
- Used drip irrigation to water the plants.

The parameters of the studying were as follows:

- **Characteristics of the vegetative growth**
Chlorophyll index (Spad-502), leave area (cm.plant⁻¹), dray weight of the roots (g), %N in the leave, %P in the leave, %K in the leave.
- **Characteristics of the yield**
Harvest time (days), yield of the plant (g plant⁻¹), the productivity (ton ha⁻¹).

Results and Discussion

Effect of the treatments on the vegetative characteristics of the Broccoli plants

The results in the Table 2 showed a significantly superiority in chlorophyll index in the leaves that reached 68.45 when cultured of plant at the second date (D₂) compared with first data of the planting (D₁) which recorded 57.35. Fertilization treatment with balance fertilizer 20-20-20 (F₁) produced a significant effect in this character (64.23) compared with other fertilization treatments (F₀ and F₂), and significant superiority in chlorophyll index when spraying of plants with Biozyme (B₁) (64.79), compared with untreated plants (B₀). The results shown a significant increase dry weight of the roots when planting at the second culture data (D₂) produced weight 19.29 g, compared with the first data (14.69), and a significant superiority of the fertilization treatment with DAP fertilizer (F₂) which recorded

20.25 g, compared with other treatments (FO and F1). No significant effect because of treated of plants with Biozyme (B).

Table 2
Effect of the treatments on the vegetative characteristics of the Broccoli

Treatments:	chlorophyll	dry weight	leave area	% minerals in Broccoli	
leaf	Index (spad)	of the roots(g)	cm. plant⁻¹	N	P
K					
D ₁ (9/10)	57.35	14.69	4651.4	1.90	0.349
1.94					
D ₂ (9/24)	68.45	19.29	5681.2	1.84	0.330
1.97					
LSD	3.608	2.569	NS	NS	NS
NS					
F ₀ (no-fertilizer)	58.54	14.34	4800.6	1.42	0.23
1.76					
F ₁ (20-20-20)	64.23	16.38	5200.6	1.82	0.35
2.06					
F ₂ (DAP)	56.93	20.25	4970.7	2.37	0.44
2.05					
LSD	3.352	1.816	NS	0.066	0.020
0.041					
B ₀ (untreated)	61.01	16.73	5006.8	1.76	0.31
1.90					
B ₁ (0.5 mL.L ⁻¹)	64.79	17.24	5325.8	1.99	0.37
2.02					
LSD	1.161	NS	NS	NS	0.025
0.038					
D ₁ F ₀	51.67	13.72	4786.9	1.46	0.23
1.74					
D ₁ F ₁	60.35	14.21	4439.2	1.83	0.36
2.04					
D ₁ F ₂	60.30	14.49	4728.3	2.40	0.44
2.05					
D ₂ F ₀	65.41	16.13	4814.5	1.38	0.23
1.77					
D ₂ F ₁	68.10	18.55	5962.0	1.80	0.33
2.08					
D ₂ F ₂	71.83	24.36	6267.0	2.33	0.24
2.06					
LSD	4.741	2.569	1335.7	0.094	0.028
0.057					
D ₁ B ₀	54.84	14.33	4794.9	1.76	0.32
1.27					
D ₁ B ₁	54.86	15.05	4507.5	2.03	0.37
2.00					
D ₂ B ₀	67.17	19.13	5073.0	1.74	0.30
1.92					

D ₂ B ₁	69.72	19.44	6143.7	1.93	0.36
2.02					
LSD	1.641	1.328	532.60	0.059	0.036
0.053					
F ₀ B ₀	57.93	14.53	5073.0	1.30	0.20
1.68					
F ₀ B ₁	59.15	14.15	4528.2	1.50	0.27
1.84					
F ₁ B ₀	60.45	16.43	4715.5	1.71	0.33
1.97					
F ₁ B ₁	68.00	16.33	5685.5	1.93	0.37
2.16					
F ₂ B ₀	64.65	19.24	5231.8	2.25	0.41
2.06					
F ₂ B ₁	67.22	21.26	5763.5	2.49	0.46
2.05					
LSD	2.010	1.627	652.3	0.072	0.044
0.065					
D ₁ F ₀ B ₀	51.73	13.63	5008.3	1.287	0.203
1.653					
D ₁ F ₀ B ₁	51.60	13.82	4565.0	1.640	0.273
1.833					
D ₁ F ₁ B ₀	55.37	13.40	4827.0	1.717	0.330
1.940					
D ₁ F ₁ B ₁	65.33	15.03	4051.3	1.957	0.393
2.150					
D ₁ F ₂ B ₀	57.43	15.97	4549.3	2.283	0.433
2.037					
D ₁ F ₂ B ₁	62.63	16.30	4907.3	2.520	0.463
2.060					
D ₂ F ₀ B ₀	64.13	15.42	5137.7	1.320	0.193
1.697					
D ₂ F ₀ B ₁	66.70	14.48	4491.3	1.443	0.267
1.847					
D ₂ F ₁ B ₀	65.53	19.47	4604.0	1.703	0.323
2.000					
D ₂ F ₁ B ₁	70.67	17.63	7320.0	1.897	0.350
2.160					
D ₂ F ₂ B ₀	71.80	22.52	5914.3	2.223	0.383
2.077					
D ₂ F ₂ B ₁	71.87	26.22	6619.7	2.453	0.463
2.060					
LSD	2.843	2.300	922.49	0.102	0.062
0.092					

In the same table (2), the results showed no significant effect on the total leave area of the plants because of a single effect of the studying factors (planting data (D), fertilization (F) and spraying with biozyme (B)). From this table, the results showed no significantly superiority because of data of the planting in the

percentage of N, P and K in leave of the broccoli plant, However, the results showed the significant superiority of the fertilization treatment with DAP (F_2) in percentage of the nitrogen (2.37%) and phosphorous (0.44%) in broccoli leaves compared with other treatments. We observed a significantly superiority of the fertilization treatment by the Balanced Fertilizer 20-20-20 (F_1) in percentage of the potassium compared with other treatments. Treated the plants with biozyme produces significantly superiority in chlorophyll index (64.79), percentage of the phosphorous (0.37%) and potassium (2.02%) compared with untreated plants.

Di treatment combination (D_2F_2) in Table 2 produces a significant increase in chlorophyll index (71.83), dry weight of the roots (24.36g) and total leave area (6267.0 cm^2) compared with other combinations, as well as di treatment combination (D_2B_1) was produces a significant increase in the same characters in order: (69.72 spad), (19.44g) and (6173.7 cm^2) compared with other combinations. Triple treatments combination (Table 2) appeared a significantly superiority of the treatment $D_2F_2B_1$ in chlorophyll index (71.87), dry weight of the roots (26.22g) and total leave area (6619.7 cm^2), while a significantly superiority of the treatment $D_1F_2B_1$ in N% (2.52) association with treatment $D_2F_2B_1$ in percentage of P element (0.463) and K element (2.060).

Effect of the treatments on the yield characteristics of the Broccoli plant.

The results in the Table 3 showed a significantly superiority of the second planting data (D_2) Harvest time (101.39 days), plant yield (1180.06 g) and the productivity (33.99 ton.ha^{-1}) compared with the first planting data (D_1) in order: 118.17 days, 926.83g and 26.99 ton.ha^{-1} . The results in Table 3 showed the significant superiority of the fertilization treatment with balanced compound fertilizer (F_1) in harvest time (9105.33 days), plant yield (1125.0 g) and productivity (32.40 ton.ha^{-1}), compared with other treatments of fertilization (F_0 and F_2). No significant effect on the harvest time because of treated of plant with biozyme, while there was a significant effect (B_1) on yield of plant (1118.61g) compared with untreated plants (B_0). Di treatment combination D_2F_2 had a significantly superiority in harvest time (94.66 days), while treatment combination D_2F_1 produced the highest yield (1254.1 g). Di treatment combination F_1B_1 had a significantly superiority in harvest time (99.83 days) and produced the highest yield (1177.5 g), compared with other treatments.

Table 3
Effect of the treatments on the yield characteristics of the Broccoli plant

Treatments: Combinations	Harvest time (days)	plant yield (g. plant ⁻¹)	the productivity (ton.ha ⁻¹)
D_1 (9/10)	118.17	926.83	26.99
D_2 (9/24)	101.39	1180.06	33.99
LSD	3.347	244.33	7.039
F_0 (no-fertilizer)	111.80	953.17	27.45
F_1 (20-20-20)	105.33	1125.00	32.40
F_2 (DAP)	112.92	1082.17	31.17
LSD	2.569	88.985	2.563
B_0 (untreated)	110.80	988.28	28.46

B ₁ (0.5 mL.L ⁻¹)	108.7	1118.61	32.22
LSD	NS	71.551	2.061
D ₁ F ₀	115.8	785.72	22.26
D ₁ F ₁	107.5	995.83	28.68
D ₁ F ₂	131.1	999.17	28.77
D ₂ F ₀	106.3	1120.8	32.28
D ₂ F ₁	103.1	1254.1	32.12
D ₂ F ₂	94.66	1165.1	33.55
LSD	3.633	125.84	3.62
D ₁ B ₀	118.8	881.3	25.38
D ₁ B ₁	118.3	984.4	28.35
D ₂ B ₀	103.6	1072.5	31.89
D ₂ B ₁	99.11	1252.7	36.08
LSD	4.22	101.19	2.914
F ₀ B ₀	111.17	881.33	25.38
F ₀ B ₁	111.0	1025.0	29.52
F ₁ B ₀	110.83	1072.5	30.89
F ₁ B ₁	99.83	1177.5	33.91
F ₂ B ₀	110.50	1011.0	29.12
F ₂ B ₁	115.33	1153.33	33.22
LSD	5.170	123.93	3.569
D ₁ F ₀ B ₀	113.33	754.33	21.73
D ₁ F ₀ B ₁	118.33	816.67	23.52
D ₁ F ₁ B ₀	105.00	903.33	26.02
D ₁ F ₁ B ₁	110.00	1088.33	31.35
D ₁ F ₂ B ₀	135.67	950.00	27.63
D ₁ F ₂ B ₁	126.67	1048.33	30.19
D ₂ F ₀ B ₀	109.00	1008.33	29.04
D ₂ F ₀ B ₁	103.67	1233.33	35.52
D ₂ F ₁ B ₀	116.67	1241.67	35.76
D ₂ F ₁ B ₁	89.67	1266.67	36.48
D ₂ F ₂ B ₀	85.33	1072.00	30.87
D ₂ F ₂ B ₁	126.67	1258.33	36.24
LSD	7.311	175.26	5.047

Triple treatments combination (Table 3) appeared a significantly superiority of the treatment D₂F₂B₀ when produced harvest time of broccoli was 85.33 days, while the highest yield was 1266.67g.plant⁻¹ for the treatment combination D₂F₁B₁.

Discussion

The results showed a significantly superiority of the second planting data (D₂) in chlorophyll index (68.45), harvest time (101.39 days), plant yield (1180.06 g) and the productivity (33.99 ton.ha⁻¹), compared with the first planting data (D₁) when culturing of plant at the second date (D₂) compared with first data of the planting (D₁). Superiority of second planting data in this parameters because of the plants were planted in the first date (D₁) exposed to heat stress and high solar radiation, as a result increasing rate of the plant respiration and reducing of the food stored in the plant and slowing the rate growth of the plant (Obaid et

al.2021). The results showed a significantly superiority of the balance chemical fertilizer treatment 20-20-20 (F_1) in the percentage of potassium in the leaves (2.02%) (Table 2), plant yield (1125.00 g) and harvest time (105.33 days) (Table 3), compared with Di ammonium phosphate treatment (F_2) and control treatment (F_0). This may be due to the potassium content in this fertilizer (F_1), Potassium has an importance in improving the biological processes in the plant and stimulating the bio-building process, which reflected on the development of the plant towards early flowering and improving the qualitative characteristics of the crop (Abu Dahi,1988). The results showed that treating broccoli plants with Biozyme growth stimulator (B_1) produces a significant superiority in many pointers compared with untreated plants (B_0), where the treated plants superiority in order: chlorophyll index in leaves (64.79), percentage of phosphorous in Leaves (0.37%), percentage of potassium in leaves (2.02%) and plant yield (1118.61 g) (Table 3). This superiority is due to because of the bio-extract that which includes natural plant hormones as well as mineral elements, especially magnesium and sulfur (Table 1), this led to an improvement in the bio-building process of the plant, building proteins and producing more chlorophyll and stimulate the plant to the growth, flowering and increasing of the yield (Al-Maliki,2013).

Conclusion

Delaying farming of broccoli until end of September (D2) Produces better growth and yield compared with planting in beginning of September (D_1) within the local environmental conditions in central of Iraq. Using of balanced chemical fertilizers was best in the broccoli plant production, as well as treated of broccoli with bio-extract.

Recommendation

We recommend studying of broccoli cultivation at other dates and using different fertilizer equations as well as organic fertilizer to shows their effects on the production of the broccoli in Iraq.

References

- Al-Maliki, Abdul-Hussein Qassem.2013. Effect of Biozyme marine algae extract on growth and yield of two Brassica oleracea var.capitata L. cultivars grown in desert areas. Basra University Journal (Operations) No. 39, Part 4.
- Al-Sahoki, Medhat and Karima Mohamed Waheeb. 1990. Applications in the design and analysis of experiments. Ministry of Higher Education and Scientific Research. Baghdad University. Iraq.
- Abu Dahi, Youssef Muhammad and Muayyad Ahmad Al-Younis.1988. Plant Nutrition Guide. Ministry of Higher Education and scientific research. Baghdad University. Iraq.
- Ali, Nur al-Din Shawqi. 2012. Fertilizer technologies and their uses. University of Baghdad, Ministry of Higher Education and Scientific Research. Republic of Iraq.

- Damato .G.L.Trotta and A.Elia.1994 .cell size ,transplant age and cultivars effects on timing field production broccoli for processing. *Acta Horturae*,371;53-60.
- FAOSTAT.2018.Available a [http://www. Fao.org /fastat /ar/# data/QC](http://www.Fao.org/fastat/ar/#data/QC) (accessed on March 20,2020).
- Hossian ,M.M.M.Moniruzzaman,S.M.I.Rahman,M.G.kibria and M.ARahman.(2007).Effect of boron and nitrogen on yield and hollow stem of broccoli.*J Soil.Nature*.(3).24-29.
- Losak T.,A.Uher, M.slosar and J Hiusek .2014 .the effect of differentiated nutrition on the content of an tioxidants broccoli ,*Acta Universitates Agriculturae et Silvicultuae Mendelianae Brunensis* 62(3);561-564.
- Obaid, A.A., Al-Alawy, H.H., Hassan, K.D and Hamdi, G.J.2021.Effect of shading net, planting methods and bio-extract on production of muskmelon. *Agraarteadusthis link is disabled*,32(2), pp. 284–288.
- Zodape, S.T.2001. Seaweeds as abiofertilizer.*J.Sci.Ind.Res.*60:378-382.
- Verklij,F.N.1992.Seaweed extracts in agriculture and horticulture .*Reveiw Bio .Agric.Hort*.8:309-324.