Effect of fertilization with poultry manure on the growth and yield of two cultivars of Brussels sprouts

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Abstract

The experiment was conducted in a farmer's field in Al-Azzawiya, 45 km north of the city center of Hilla/Babylon, to study the effect of organic manure with poultry waste on the growth and yield of two Brussels sprouts for the winter season 2021-2022. The experiment was conducted according to the split-plot-design (RCBD) split-plot system, with three replicates, where the cultivars (Arzuman and Long island) were placed in the main plot and organic manure (without fertilization, feather manure 6.3 ton ha^{-1}, local poultry manure 5.7 ton ha^{-1}, and imported poultry manure 3 ton ha^{-1}) in the sub-sub-plot, and the averages were compared. treatments using the Least Significant Difference (L.S.D) test at the probability level of 0.05.The Long Island cultivar showed a significantly excelled in plant height, the yield per plant increased by 64% and the total yield increased by 64%, and the Arzuman cultivar was significantly excelled in stem diameter. In organic manure treatments, feather manure treatment was significantly excelled in edible buds weight, single plant yield and total yield, with an increase of 23%, 34% and 34%, respectively. The local poultry manure treatment was excelled in edible buds diameter, leaf area and percentage of dry matter, while the imported poultry manure treatment was excelled in plant height and number of plant leaves. The interaction showed the excelled of Long Island cultivar with feather fertilizer in plant height,Edible buds diameter, yield of one plant and total yield. The interaction between the Long Island cultivar with local poultry manure was excelled in the number of Brussels sprouts per plant. The interaction between the Long Island cultivar and imported poultry manure was excelled in the number of plant leaves and weight of edible buds. The bi-interaction between Arzuman cultivar and local poultry manure was excelled in stem diameter.

introduction

Brussels sprouts (Brassica oleracea L. var. gemmifera Zenk) is one of the cruciferous plants of the Brassicaceae family, and it is a type of vegetable that is not widespread in Iraq. The edible part is buds that grow under the armpit of each leaf and leaves and buds spread along the stem. Brussels sprouts are a crop with high nutritional value and contain chemicals that enhance the activity of the body's natural defense system. It is a rich source of sulforaphane, which is a powerful anti-cancer disease and is also characterized by its high content. of vitamins (A, C, B6), minerals (K, Fe, S) and folic acid (7). Brussels sprouts are also characterized by producing a well-known class of cancer-preventing compounds, glucosinolates (GSLs), which are glucosidic compounds that contain sulfur, present in the leaves of Brussels sprout in capable concentrations. It inhibits the development of pathogens and pests and, upon decomposition, gives the flavor and pungent taste trait of cruciferous vegetables. Determination of the amount of GSL is necessary to determine the enhanced benefits to human health (8).The increasing awareness of peoples about the importance of vegetables on the one hand and the increase in the population on the other hand has increased the interest of specialists in the production of these crops and work on improving them using the best breeding methods, as well as interest in agricultural service operations to increase production and improve quality. As the genetic factors determine the degree of growth and

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development of the organism, so the genetic nature of the cultivated cultivar greatly affects the quantity and quality of the crop (9). Omar (10) showed in the results of his experiment on two hybrid Brussels sprouts Topline F1, Attwood F1, that Topline F1 was significantly excelled on Attwood F1 in shoot weight, leaf area, total plant yield, total yield, and bud size.Turbin and others (11) found in his study of two hybrids of Brussels sprouts Franklin and Diablo that the Diablo hybrid was significantly excelled in the average fresh weight of the vegetative total, the weight of the leaves, the number of Brussels sprouts per plant, and the diameter of the cabbage compared to the Franklin hybrid.Studies have recently focused on the use of organic fertilizers after it was almost limited to chemical fertilizers as a result of the negative effects caused by chemical fertilizers such as environmental pollution because of its danger to humans and animals, especially nitrogen, which is needed by large quantities of leafy vegetable crops (12).The interest of peoples in the world has begun to shift to environmentally safe agriculture, and one of the alternatives to overcome this problem is to develop the organic fertilizer industry and make it the main component as a system that can maintain harmony between the components of the ecosystem continuously and permanently.Accordingly, organic matter improves the physical and chemical properties of the soil through the use of organic fertilizer and improves the growth and productivity of plants, which works to increase soil fertility and provide nutrition to plants. It can be called organic fertilizer (6),In addition, the use of organic fertilizer may not leave behind chemical residues such as oxalates and nitrates resulting from the addition of chemical fertilizers because the part of the plant that is consumed is the leaf (1).Omar (10) observed in an experiment to find out the effect of adding three types of organic fertilizers in two quantities for each type of cow manure 10 and 20 tons.ha^{-1} and sheep manure 10 and 20 tons.ha^{-1} and chicken manure 4 and 8 tons.ha^{-1} on the quality and yield of two hybrids of Brussels sprouts Topline F1 and Attwood F1 indicated that the addition of poultry manure 8 tons.ha^{-1} gave the highest significant values of the number of leaves of the plant and the weight of the leaves of the plant. While the addition of cow manure 20 tons.ha^{-1} gave the highest significant values of the total yield compared to the control treatment. Abd al-Rahman et al (3) found that poultry waste significantly affected the growth and productivity of the red cabage plant, where the level of 75 gm .The study aim: To know the effect of poultry manure as an organic fertilizer on the growth and yield of two cultivars of Brussel Sprout.

Materials and Methods

The experiment was conducted in one of the fields of Al-Azzawiya region - Al-Musayyib project district, 40 km north of the center of the city of Hilla in Babylon province, during the winter agricultural season 2021-2022. A drip irrigation system was used. The soil of the field is mixed and suitable for cultivation. Table (1) shows the physical and chemical traits of the soil of the field. before cultivation. The land was divided into terraces, and the split-plot system was used according to the RCBD design, with three replicates, and each replicate was divided into 8 experimental units with dimensions of 1m x 3m. The seeds were planted on 9-3-2021 in the nursery and the transplanting process took place on 10-8-2021 on both sides of the terrace. The experiment included a study of two factors, the first of which was the cultivar , which included the Turkish Arzuman cultivar and the American Long island cultivar, coded A1 and A2, and the second factor included four additions: control and the addition of organic fertilizer, feather waste compost (6.3 tons.ha^{-1}). The local poultry waste fertilizer (5.7 tons.ha^{-1}) and the factory poultry waste fertilizer (3 tons.ha^{-1}) in addition to the comparison treatment, coded F0, F1, F2, and F3, respectively. Adding manufactured poultry manure, Orga pellet, as recommended by the

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company, and the percentage of nitrogen contained in it was adopted as a basis for adding other organic fertilizers. The process of preparing feather manure and poultry manure was conducted by making two separate pits, the dimensions of the pit were 2m x 3m, and the pits were lined with agricultural nylon, and after putting the feather and poultry waste, a small amount of urea and a decomposed manure were added to it.The heap was moistened and wrapped with nylon, and it was stirred and moistened every seven days, starting from April until August. Fertilizer was added to the experimental units according to their treatments by feeding under the plants (Table 2). The cultivars were placed in the main plots and the organic fertilizers in the secondary plots. All agricultural operations were conducted from tillage, smoothing, leveling, weeding, insect control and diseases to avoid differences in growth. The traits of vegetative growth and the quantitative yield at the ripening of carnivores were studied, namely plant height (cm), number of leaves (leaf.plant^{-1}), stem diameter (cm),Leaf area (cm^2.plant^{-1}), % of dry matter of vegetative total, weight of one edible buds (gm. plant^{-1}), diameter of edible buds (cm), number of edible buds per plant (edible buds.plant-1), yield per plant of edible buds. and the total yield (tons.ha^{-1}). The results of the experiment were analyzed statistically according to the analysis of variance method. Significant differences between the treatments were calculated at the level of probability 0.05 using LSD (4), and the Genstat program was used in the statistical analysis.

Table (1): Physical and chemical analysis of field soil before planting.

values	units	Traits
7.9	....	**pH**
3.5	m^3/ds	**electrical conductivity EC**
11.3	g.kg^{-1}	**organic matter**
13.4	mg.kg^{-1}	**available nitrogen**
5.6	mg.kg^{-1}	**available phosphorous**
192.0	mg.kg^{-1}	**available Potassium**
1.13	g.cm^3	**bulk density**
155	g.kg^{-1}	**sand**
600	g.kg^{-1}	**silt**
245	g.kg^{-1}	**clay**
silty clay loam	soil texture	

***The chemical and physical properties of the soil were analyzed in Al- Muradia Laboratory of the Directorate of Agriculture of Babylon**

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Table 2: Physical and chemical properties of organic fertilizers after decomposition

Chicken feather waste	Poultry waste is local	Poultry waste factory	units	traits
6.7	6.40	6.4	-	pH
41.6	23.0	65	%	C Organic
2.1	2.3	4.2	%	N كلي
9.72	9	9	%	C/N
0.61	4.30	3	%	P_2O_5
0.99	1.12	2.8	%	K_2O
0.76	3.76	9	%	Ca
0.81	0.9	1	%	Mg

*** The chemical and physical properties of the organic fertilizers were analyzed in the Muradia Laboratory of the Directorate of Agriculture of Babylon**

Results and discussion

1. Plant height (cm)

The results in Table 3 that the Long Island cultivar was significantly excelled on the Aruzman cultivar in plant height. The results in Table 3 show the excelled of imported poultry manure by giving the highest rate of plant height compared to the control treatment (without addition). The results of the bi- interaction indicated the excelled of the Long Island cultivar interaction treatment with Feather manure by giving it the highest significant value, and the Aruzman cultivar interaction with the control treatment that gave the lowest value for this trait.

2. stem diameter (cm)

The results in Table 3 that there are significant differences between the two cultivars in the traits of the average stem diameter, as the Aruzman cultivar, which gave the highest significant value, was excelled compared to the Long Island cultivar, which gave the lowest value for the stem diameter. Significant for stem diameter While the control treatment achieved the lowest value for stem diameter. The results of the bi-interaction between cultivar and fertilizer quality indicate a significant effect on the average stem diameter.The Aruzman cultivar and the local poultry manure treatment achieved the highest significant value in stem diameter compared to the Long Island cultivar, with the comparison giving the lowest value for this trait.

3. The number of plant leaves (leaf.plant^{-1})

No significant difference was observed between the two cultivars in this traits. As for fertilizer additions, the addition of local poultry manure was significantly excelled on all treatments by giving it the highest significant value for the number of plant leaves, while the control treatment achieved the lowest value.In the bi-interaction between the cultivar and the quality of manure, the treatment of the Long Island cultivar with imported poultry manure was significantly excelled by giving it the highest significant value compared to the treatment of the Aruzman cultivar and the control treatment, which gave the lowest rate.

4. Leaf area (cm^2.plant^{-1})

It is noted from Table 3 that there are no significant differences between the two cultivars in the average leaf area, as for the addition of

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organic fertilizerThe local poultry manure gave the highest significant value for the leaf area and the control treatment that gave the lowest value for this trait, and no significant differences were observed between the interaction treatments in this trait.

5. Percentage of leaf dry matter (%)

It is noted from the results of Table 3 that there is no significant difference between the two cultivars in the percentage of dry matter of leaves. The local poultry manure was excelled by giving it the highest value, and the control treatment gave the lowest value for this trait. In the bi-interaction between cultivar and organic fertilizer, it did not significantly affect the percentage of dry matter of the vegetative group, although there were differences in the percentages between the treatments.The above results are in line with what is also consistent with the findings of Abou El-Magd (13), who showed in his study the effect of four cultivar of Brussels sprouts on the trait of the vegetative yield, that the added organic fertilizer led to an increase in the traits of vegetative growth such as an increase in cell division and elongation, which increases of stem diameter, leaf area, dry weight and plant height, and this is consistent with the results (1), (5), (6) and (10), and this is attributed to the fact that organic fertilizers are one of the most important means to improve the soil content of organic matter (17).

Table 3: Effect of cultivar and fertilization with poultry waste and the interactions between them on vegetative growth traits

dry matter of vegetative growth%	Leaf area (cm2.plant-1)	Number of leaves (leaf.plant-1)	stem diameter (cm)	plant height(cm)(	treatments
11.98	21601	26.50	3.78	34.88	A1
11.33	20771	27.41	2.76	39.37	A2
N.S	N.S	N.S	0.735	0.621	L.S.D 0.05
10.14	17901	23.99	2.72	35.33	(0)
11.99	21730	27.75	3.42	38.17	((F1
12.34	22601	27.50	3.54	36.75	(F2)
12.16	22513	28.58	3.36	38.25	(F3)
1.815	3062.7	2.062	0.312	2.58	L.S.D 0.05
dry matter of vegetative growth%	Leaf area (cm2.plant-1)	Number of leaves (leaf.plant-1)	stem diameter (cm)	plant height(cm)(	treatments
10.08	18351	23.67	3.05	32.83	A1F0
12.36	21067	26.83	4.00	35.83	A1F1
12.68	23732	27.33	4.08	33.17	A1F2
12.81	23256	28.17	3.91	37.67	A1F3
10.20	17451	24.33	2.40	37.83	A2F0
11.63	22393	28.67	2.85	40.50	A2F1
11.99	21469	27.67	3.00	40.33	A2F2
11.50	21770	29.00	2.81	38.83	A2F3
N.S	N.S	4.848	0.575	3.180	L.S.D 0.05

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6-edible buds Diameter (cm)

It is noted from the results of Table 4 that there is no significant difference between the two cultivars in Edible buds diameter, and in the addition of organic fertilizer significantly affected the average Edible buds diameter, where the treatment of adding organic fertilizer was significantly excelled on feathers manuer and achieved the highest significant value, which did not differ significantly from the two treatments of adding local and imported poultry manure.While a significant difference was recorded with the control treatment, which recorded the lowest value. In the binary interaction, the Long Island cultivar excelled with the treatment of adding feather fertilizer and gave the highest significant value, which differed significantly with most of the treatments of the Aruzman cultivar, with the control treatment (without fertilization) recording the lowest values in this trait.

7- The number of diameter (diameter.plant^{-1})

The results in Table 4 show that there is no significant difference between the two cultivars in the number of edible buds. In the fertilizer additions, it is noted that there are no significant differences between the treatments. In the interaction, it is noted that the Long Island cultivar and the treatment of adding feather fertilizer gave the highest significant values, while the Aruzman cultivar, with the control treatment of spraying with potassium sulfate, had the lowest value.

8- Weight of edible buds (g)

It is noted from the results in Table 4 that there is no significant difference between the two cultivars in the average weight of edible buds, and the treatment of adding feather manure achieved a significant difference where it gave the highest significant value in the average weight of edible buds while the comparison gave the lowest value, and the treatment of the Long Island cultivar with imported poultry manure achieved the highest significant value in Average weight of edible buds, Aruzman cultivar treatment with control treatment gave the lowest value in this trait.

9- Yield per plant (g. plant^{-1})

It is noted from the results in Table 4 that the Long Island cultivar was significantly excelled in this trait and gave the highest significant value compared to the Aruzman cultivar, which gave the lowest plant yield rate, and the treatment of adding feather fertilizer gave the highest rate, while the control treatment of organic fertilizer recorded the lowest rate. The results of Table 4 indicate that the Long Island cultivar was significantly excelled with the treatment of adding feather manure and gave the highest rate compared to the Aruzman cultivar, which differed significantly with most of the treatments.

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Table 4: Effect of cultivar and fertilization with poultry by-products and the interactions between them on yield traits

Total yield(ton.ha-1)	Yield per plant (g.plant-1(	edible budsWeight (g(	The number of edible budsper plant (Brussel Sprout.plant-1)	Average diameter of five edible buds (cm(	treatments
1.249	31.2	3.66	8.11	1.748	A1
3.545	88.6	4.61	19.25	2.343	A2
2.075	51.9	N.S	N.S	N.S	L.S.D 0.05
1.864	46.6	3.71	11.31	1.851	(0)
2.827	70.7	4.82	14.09	2.205	((F1
2.502	62.6	3.91	15.25	2.166	(F2)
2.395	59.9	4.09	14.09	1.959	(F3)
0.542	13.55	0.767	N.S	0.353	L.S.D 0.05
Total yield (ton.ha^{-1})	Yield per plant (g.plant-1(	edible buds Weight (g(	The number of edible budsper plant (Brussel Sprout.plant-1)	Average diameter of five edible buds (cm(	treatments
0.817	20.4	3.15	5.78	1.525	A1F0
1.402	35.1	4.05	8.49	1.663	A1F1
1.535	38.4	3.97	9.53	1.998	A1F2
1.241	31.0	3.47	8.65	1.805	A1F3
2.911	72.8	4.27	16.83	2.177	A2F0
4.251	106.3	5.60	19.68	2.747	A2F1
3.469	86.7	3.85	20.97	2.333	A2F2
3.550	88.8	4.72	19.53	2.113	A2F3
1.593	39.8	1.727	11.839	0.560	L.S.D 0.05

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