Effect of organic fertilization with poultry waste on the qualitative traits of two cultivars of Brussels sprout (Brassica oleracea L.var. gemmifera zink

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Abstract

The experiment was conducted in Al-Azzawiya region, located 45 km north of the city center of Hilla/Babylon, to study the effect of organic fertilizer and spraying with potassium sulfate on the growth and yield of two cultivars of Brussels sprouts for the winter season 2021-2022.The experiment was conducted according to the Spilt-Plot-Design system within Randomized Complete Block Design (RCBD) and in 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-plot, and the averages of the treatments were compared. Using the Least Significant Difference (L.S.D) test at the probability level of 0.05.The results showed that there were significant differences between the two cultivars Long Island and Arzuman in some of the studied traits. As for the organic manure treatments, the feather manure treatment was significantly excelled in the traits(percentage of potassium and the Brussels sprouts content of vitamin C), and the local poultry manure treatment excelled in traits (percentage of dry matter of edible buds, percentage of phosphorus,The content of carbohydrates in edible buds, the content of vitamin C in edible buds), which amounted to (18.91%, 0.5039%, and 10.60 µg. 100 mg^{-1}).The treatment of imported poultry manure (percentage of nitrogen, percentage of protein) excelled. The results of bi-interactions between the studied factors indicated that there were no significant differences in most of the studied traits.

key words. Brussels sprouts, local and imported poultry waste, and poultry feather waste.

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 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 edible buds per plant, and the edible buds diameter 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 know 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 provainc, 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, symbol A1 and A2, and the second factor included four additions: comparison 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, symbol F0, F1, F2, and F3, respectively. Adding manufactured poultry manure, Orga pellet, as recommended by the 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 sub plots. All agricultural operations were conducted from tillage, smoothing, leveling, weeding, insect control and diseases to avoid differences in growth. traits of the quantitative and quantitative yield were studied at the chlorophyll, the edible buds content of chlorophyll (mg.100gm^{-1} fresh weight), the edible buds content of carotene (mg.100gm^{-1} fresh weight), Percentage of dry matter in edible buds (%), Determination of NPK in edible buds, Percentage of protein in edible buds on fresh weight, nitrate content of Brussels sprouts(mg.gm^{-1}), carbohydrate content of edible buds (mg.gm-1), Vitamin C content of edible buds (mg 100.gm $^{-1}$ fresh weight)Vitamin C was estimated in edible buds by taking 50 g of it with 50 ml of oxalic acid at a concentration of 6% for each sample, then mixed well .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**

Table 2: Physical and chemical traits 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

Percentage of dry matter of edible buds(%)

Table 3 that there are no significant differences between the two cultivars in the percentage of dry matter for edible buds, as for the addition of organic fertilizer, it was noted that there were no significant differences between the treatments in the percentage of dry matter. The results in Table 3 indicate that the bi-interaction between the cultivar and the organic fertilizer did not significantly affect the percentage of dry matter of green plants between treatments.

Total edible buds content of chlorophyll (mg.100g^{-1} fresh weight)

It is noted from Table 3 that there were no significant differences between the two cultivars in the total chlorophyll content of chlorophyll, as well as for the addition of organic fertilizer.We note from the results of Table 3 that the bi-interaction between the cultivar and the organic fertilizer did not significantly affect the total chlorophyll content of the chlorophyll among the treatments.

edible buds content of carotenoids (mg.100g^{-1} fresh weight)

It is noted from Table 3 that there are no significant differences between the two cultivars, while significant differences were observed for the addition of organic fertilizer in the content of carotenoids, As the treatment of adding feather manure was significantly excelled and achieved the highest content compared to the control treatment, which recorded the lowest content, as we can see from the results of Table 3 that the Aruzman cultivar and feather manure recorded the highest content of carotene, while the Long Island cultivar and the control treatment of organic manure recorded the lowest content.

.Percentage of nitrogen in chloroplasts(%)

It is noted from Table 3 that there are no significant differences between the two cultivars in the nitrogen content of chloroplasts.As for the addition of organic manure, it was noted that there were significant differences between the treatments in the percentage of nitrogen, where the imported poultry manure treatment achieved the highest percentage, while the control treatment recorded the lowest percentage.The results of Table 3 indicate that the bi-interaction between the cultivar and the organic manure had a significant effect on the percentage of nitrogen in fruit of edible buds, where each of the two cultivars Long Island with imported poultry manure and Aruzman with the feather manure achieved the highest percentage of both, while the Long Island cultivar and the feather manure recorded the lowest percentage.

Percentage of Phosphorus in edible buds (%)

It is noted from the results in Table 3 that there are no significant differences between the two cultivars in the percentage of phosphorus in edible buds. While the local poultry manure excelled as it achieved the highest percentage, while the control treatment (from organic manure) recorded the lowest percentage. The results in Table 3 show that the bi-interaction between the organic cultivar had a significant effect on the percentage of phosphorus, where the Aruzman cultivar and the addition of feather fertilizer achieved the highest percentage, while the same cultivar with the control treatment of organic fertilizer recorded the lowest percentage .From the foregoing, the results of the qualitative yield traits in Table 3 indicate that they were not significantly affected by the type of cultivar. The results of Table 3 show that the organic fertilization had a significant effect on the traits of the qualitative yield, where it is noted that traits of edible buds content of carotenoids, the percentage of nitrogen, the percentage of phosphorus, the percentage of potassium, carbohydrates and protein, and that the important role of the added organic fertilizer. It may be due to the increase in the availability of the necessary and nutritious elements for the plant, especially nitrogen, phosphorus and potassium, which have the greatest role in increasing the activity and strength of vegetative growth due to the role of organic fertilizer in improving the physical and chemical trait of the soil and increasing the availability of nutrients for a long period of time up to the late stages of plant growth and benefiting from these elements in carbon construction process,It is also used to increase cell division and elongation, which increases leaf area, stem diameter, plant height, and chlorophyll content, which will reflect positively on qualitative yield indicators (15), and these results are consistent with what Meflaul Islam (14) concluded on broccoli and Manea (18).) on Al-Hana and Manea and Abbas (17) on broccoli.

Table 3: Effect of cultivar, organic fertilization and the interactions between them on (% of dry matter of edible buds plants, total chlorophyll content of edible buds, edible buds content of edible buds, % of nitrogen in edible buds, % of phosphorus in edible buds)

%of phosphorous in edible buds	%of nitrogen in edible buds	Edible buds content of carotene)mg.100g-1 fresh weight(	Edible buds content of total chlorophyll (mg.100g-1(	dry matter edible buds%	treatments
0.4559	1.847	4.243	23.38	16.27	Aruzman
0.4788	1.845	3.625	20.65	19.21	long Island
N.S	N.S	N.S	N.S	N.S	L.S.D 0.05
0.3843	1.616	3.781	21.92	16.41	0
0.4946	1.987	4.151	22.73	17.35	Feather manure
0.5039	1.786	3.924	22.49	18.91	Local poultry manure
0.4866	1.994	3.880	21.82	18.29	Imported poultry manure
0.0133	0.218	0.317	N.S	N.S	L.S.D 0.05
%of phosphorous in edible buds	%of nitrogen in edible buds	Edible buds content of carotene)mg.100g-1 fresh weight(	Edible buds content of total chlorophyll (mg.100g-1(	dry matter edible buds%	treatments
0.3448	1.648	4.068	22.81	15.70	A1F0
0.5060	2.013	4.453	24.17	16.18	A1F1
0.5030	1.752	4.239	24.94	16.99	A1F2
0.4697	1.975	4.212	23.39	16.21	A1F3
0.4238	1.583	3.495	21.02	17.12	A2F0
0.4832	1.962	3.849	21.29	18.51	A2F1
0.5048	1.820	3.609	20.04	20.84	A2F2
0.5035	2.013	3.548	20.26	20.38	A2F3
0.0303	0.289	0.887	N.S	N.S	L.S.D 0.05

Percentage of potassium in edible buds (%)

Table 4 that there were no significant differences between the two cultivars in the percentage of potassium for Brussels sprouts plants. As for the addition of organic fertilizer, feather fertilizer achieved the highest percentage, while the control treatment recorded the lowest percentage, and the bi-interaction between the cultivar and organic fertilizer did not significantly affect the percentage of potassium in edible buds.

Brussels sprouts content of edible buds (mg.100g^{-1})

The results of Table 4 show that there are no significant differences between the two cultivars, the addition of organic fertilizer, and the interaction between them in the trait of edible buds of chloroplasts.

edible buds content of carbohydrates (mg.gm^{-1} dry matter)

It is noted from Table 4 that there were no significant differences between the two cultivars in the content of carbohydrates, while the local poultry manure achieved the highest rate, while the control treatment for organic manure recorded the lowest rate.

The interaction between the Long Island cultivar and local poultry manure achieved the highest rate, while the same cultivar and the control treatment of organic manure gave the lowest rate.

Percentage of protein in carbohydrates (%)

From Table 4, it is noted that there are no significant differences between the two varieties in the percentage of protein in edible buds. As for the addition of organic fertilizer, it was noted that there were significant differences between the treatments, where the imported poultry manure achieved the highest percentage, while the control treatment recorded the lowest percentage. It is noted that the bi-interaction between the cultivar and the organic fertilizer It did not significantly affect the percentage of protein in edible buds.

Vitamin C content of Brussels sprouts(mg.100g^{-1} fresh weight)

It is noted from Table 4 that there were no significant differences between the two cultivars in the content of vitamin C edible buds. As for the addition of organic manure, it was observed that there were significant differences between the treatments, as feather manure and local poultry manure gave the highest rate, while the control treatment for organic manure gave the lowest rate. The bi-interaction between the cultivar and the addition of organic manure also affected significantly the vitamin C content of edible buds, where the Aruzman cultivar and the local poultry manure achieved the highest rate of vitamin C compared to the Long Island cultivar, and the control treatment of organic manure recorded the lowest rate. The above results indicate that organic fertilizer has a direct and indirect role in plant growth and development. The direct effect is that it contains some nutrients such as (N, P, K) and some substances that stimulate growth, which leads to the formation of a strong vegetative and root system. While the indirect effect is represented by the role of humic substances in improving the chemical and physical properties of the soil, which helps in increasing plant growth and development (4). The organic fertilizers are characterized by their containing humic acids, which help to chelate the dissolved ions and increase their available for the plant (16), and these results are consistent with what was reached by (5) and (6) on the broccoli plant, in which they showed that the organic fertilization had a significant effect on the qualitative yield indicators.

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Table 4: Effect of cultivar and organic fertilization and the interactions between them on (% of potassium in edible buds, nitrate content of edible buds, carbohydrate content of edible buds, % of protein in edible buds, vitamin C content of edible buds)

Edible buds content of Vitamin C (mg.100g-1(	%protein in edible buds	Edible buds carbohydrate content (mg.gm-1(	Edible buds content of nitrates (mg.100g-1(	potassium in edible buds %	treatments
68.0	1.919	8.46	16.42	1.475	Aruzman
59.5	2.264	5.92	17.58	1.549	long Island
N.S	N.S	N.S	N.S	N.S	L.S.D 0.05
52.9	1.758	3.35	17.00	1.255	0
69.5	2.141	7.07	15.92	1.795	Feather manure
69.5	2.144	10.60	17.58	1.564	Local poultry manure
63.1	2.321	7.74	17.50	1.434	Imported poultry manure
16.6	0.381	5.17	N.S	0.524	L.S.D 0.05
Edible buds content of Vitamin C (mg.100g-1(	protein in edible buds	Edible buds carbohydrate content (mg.gm-1(	Edible buds content of nitrates (mg.100g-1(	potassium in edible buds %	treatments
53.0	1.721	3.90	16.00	1.203	A1F0
71.0	2.041	7.94	16.00	2.005	A1F1
79.0	1.887	10.52	16.67	1.407	A1F2
68.8	2.025	11.47	17.00	1.286	A1F3
52.7	1.796	2.81	18.00	1.307	A2F0
67.9	2.241	6.19	15.83	1.586	A2F1
59.9	2.401	10.68	18.50	1.722	A2F2
57.4	2.617	4.01	18.00	1.582	A2F3
8.95	N.S	6.87	N.S	N.S	L.S.D 0.05

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