Response of vegetative growth and biochemical content in cauliflower to organic fertilization (DOFERM) and spraying with glutamine

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ABSTRACT

The experiment was carried out at the research station of the College of Agriculture / University of Kufa during the winter season of 2023 with the aim of studying the response of some vegetative growth traits, yield and disc content of active compounds in cauliflower to organic fertilization (DOFERM) and spraying with glutamine. The experiment was factorial according to the Randomized Complete Block Design (R.C.B.D.) The first factor is the use of three levels of organic fertilizer (3000, 1500, 0) g experiment unit-1 (3 m2) and the second factor is glutamine at three concentrations (0, 50, 100) mg L-1. The results showed that organic fertilization and glutamine acid had a significant effect on all studied traits. The interaction treatment with organic fertilization at a concentration of (3000) g/experiment unit-1 (3 m2) and glutamic acid at a concentration of (100) mg L-1 was characterized by recording the highest rates in plant height 36.37 cm, leaf area 80.76 cm2.plant, number of leaves 29.93 leaves. plant, fresh weight of the vegetative group 775 gm. plant, dry weight of the vegetative group 139.5 gm. plant, compared to other single and combined treatments.

Keywords: Brassica, amino acids, biochemicals, Botanicals .

Introduction

Cauliflower (Brassica oleracea L.) belongs to the Brassicaceae family. It is an annual herbaceous plant in some varieties and biennial in others. It requires two seasons, the first is vegetative growth and continues until the flower buds are formed, then the flowers bloom in the second growing season to form seeds. Cauliflower grows wild in the Mediterranean region and it is believed that the island of Cyprus is the original home. Cauliflower is cultivated to obtain the flower discs (curds), which is the edible part of the plant, as the thick fleshy inflorescence stalks are eaten, which carry at their ends groups of pre -
flowering meristematic tissues (Boras et al., 2006.(

Cauliflower is widely cultivated worldwide and is considered a good source of antioxidants due to its phenolic and flavonoid content (Zeb et al., 2022). It contains a wide range of biologically active components such as vitamins, polyphenols, glucosinolates, and antioxidants (Koss-Mikołajczyk et al., 2019). The cauliflower has good nutritional value and is considered a low-sodium, low-fat, and low-calorie food. It also contains many vitamins A and C, carotenoids, folic acid, riboflavin, and niacin. It also contains some nutrients such as calcium, iron, potassium, and phosphorus. Cauliflower proteins are easily digestible and the cauliflower floret contains vitamin C (50–100 mg) more than orange juice (Mustafa, 2010.(

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Due to the importance of the plant and the increasing demand for it, it is necessary to increase productivity, which can be achieved in several ways, including the cultivation of new genetic compositions of good quality suitable for the conditions of agricultural areas, as there are many studies that have shown the best productivity and quality (Al-Shammari, 2016). Organic fertilization is an important means of increasing the productive value of agricultural lands and reducing environmental pollution resulting from the excessive use of mineral fertilizers. Organic fertilizers provide nutrients slowly compared to mineral fertilizers. Humic is considered the most important part of humic compounds because it contains a high exchange capacity for positive ions, and it also plays an important role in building the physical and chemical properties of the soil (Al-Araji and Al-Hamdani, 2012.(

On the other hand, glutamine is one of the essential amino acids in nitrogen absorption and is often the most abundant amino acid in plant roots. Glutamine is a vital and important element of amino acids that plays an effective role in plant functions, including metabolic processes, including the representation of nitrogen pathways (Marschner, 2011 and Amin et al., 2011). Glutamine, arginine and asparagine are also key amino acids that contribute to many metabolic and biochemical reactions in plants including detoxification of toxins, neutralization of H+ produced in ammonium-fed plants and giving the plant the highest tolerance to stress conditions (Cao et al., 2010; Amin et al., 2011; Marschner, 2011.(

Due to the importance of this crop, the need to increase its productivity was among the main motivations for the study, which aimed to determine the effect of soil fertilization with organic fertilizer (DOFERM) or foliar spraying with glutamine in improving growth and increasing the yield and content of the crop of active compounds in cauliflower.

Materials and methods

Materials and methods:

The field soil preparation was carried out by plowing and smoothing the soil well and it was divided into three rows with a distance of 1 meter between each row, a width of 1 meter, a length of 3 meters and an area of the experimental unit of 3 m2. The plants were planted with 50 cm planting distances and each experimental unit contained 12 plants and each row was divided into 9 experimental units.

The treatments were carried out using organic fertilizer and glutamic acid and the treatments were distributed according to the Randomized Complete Block Design (R.C.B.D.), with two factors, the first is three levels of organic fertilizer (3000, 1500, 0) g. Experimental unit -1 3 m2 and the second factor is three concentrations of glutamic acid (0, 50, 100) mg. L-1. In two batches, the first after 21 days of transplanting, i.e. after 4-5 true leaves are formed on the plant, and the second after four weeks from the second batch. As for spraying the amino acid glutamine after 25 days of transplanting in the permanent field, the second spray after 15 days from the first spray, while the third spray was after 30 days from the second spray, respectively. Service, irrigation, weeding and control .

Samples of the studied traits were taken on six plants from each experimental unit randomly, where data analysis was conducted according to the variance analysis table and the averages were compared according to the least significant difference test L.S.D.

Analysis is carried out at a probability level of 0.05 (Al-Rawi and Khalaf Allah, 2000) using the statistical program, and at the end of the experiment the averages of the traits were recorded. The vegetative growth indicators were measured including: plant height (cm), total number of leaves (leaf. plant), leaf area (cm2. plant) using ImageJ program and according to the method used by (Al-Zaidi, 2016), fresh and dry weight of the plant vegetative group (g. plant) for six selected plants at the end of the season (Al-Sahaf, 1989). The chemical and qualitative characteristics data were also recorded including: Estimation of the leaf content of total chlorophyll (mg. g-1) Goodwin (1976) and estimation of nutrients in the leaves (Al-Sahaf, 1989) for the leaf content of major elements Nitrogen % (Haynes, 1980.(

Phosphorus (%) Spectrophotometer at a wavelength of (700 nm). The potassium content was determined by flame photometer (Al-Sahaf, 1989). The magnesium content of the leaves was also estimated by titration with calcium (Al-Sahaf, 1989) and boron ppm according to the Garmins method mentioned in Black (1965) using a Spectrophotometer using optical density and calibrating the device at a wavelength of 585 nm. The concentration of sulfur in the leaves (mg kg-1) was measured as absorbance at 420 nm using a Spectrophotometer (Salem and Ali, 2017.(

Results and discussion

The results (Table 1) showed that the vegetative growth indicators under study were positively affected by the presence of organic fertilization treatments or spraying with amino acids. The plant height, number of leaves, leaf area, fresh and dry weight of the vegetative mass increased with increasing the level of fertilization used, and they also increased significantly with increasing amino acid concentration. The highest rate for all studied traits was recorded in the treatment of interaction with organic fertilization at 3000 g/3 m2 and amino acid at 100 mg/L, with a significant difference from all treatments in all traits except for the fresh and dry weight of the vegetative mass, which will not differ from the treatment of interaction with organic fertilization at the same level with the presence of amino acid at a concentration of 50 mg/L.

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Table1. Effect of using different levels of organic fertilizer (DOFERM) and spraying with glutamine on the vegetative growth indicators of cauliflower grown in ambient conditions

OR fertilizer g. 3m^2	Glutamic acid mg. $^{L-1}$	Plant height	Total leaves	Leaf area	Shoot fresh weight	Shoot dry weight
0	0	19.45	19.83	4371	407.1	73.27
	50	21.73	21.85	4727	479.9	86.39
	100	22.36	22.1	5281	493.7	88.87
1500	0	24.25	22.45	5749	548.2	98.67
	50	25.96	23.6	5936	613.6	110.44
	100	28.3	24.68	6396	668.9	120.4
3000	0	28.7	26.18	7101	732.6	131.87
	50	30.94	27.87	7452	782.5	140.86
	100	36.37	29.93	8076	775	139.5
L.S.D. ($P \leq 0.05$)	OR Fertilizers	0.604	0.526	87.7	19.23	3.461
	Glutamic acids	0.604	0.526	87.7	19.23	3.461
	Interaction	1.046	0.912	151.9	33.3	5.994

As for the qualitative indicators, the plant content of chlorophyll and essential nutrients, the results also showed (Table 2) that these indicators recorded higher values under the influence of organic fertilization treatments or spraying with amino acids. The results indicate that the plant content of chlorophyll, nitrogen, phosphorus, potassium, and magnesium recorded a significant increase with the increase in the level of fertilizer used, and in the same context with the increase in amino acid concentration. The interaction treatment with organic fertilization at 3000 g/3 m2 and amino acid at 100 mg/L recorded the highest values significantly for all studied traits with a significant difference from all interaction or individual treatments (Table 2.(

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Table2. Effect of using different levels of organic fertilizer (DOFERM) and spraying with glutamine on plant content of some qualitative indicators in cauliflower grown in ambient conditions.

OR fertilizer g. 3m^2	Glutamic acid mg. $^{L-1}$	Leaf total chlorophyll	N%	P%	K%	Mg%
0	0	0.61	1.833	0.229	1.6933	
	50	0.63	2.017	024	1.84	
	100	0.66	2.14	0.249	1.923	
1500	0	0.67	2.257	0.262	1.973	
	50	0.70	2.377	0.279	2.18	
	100	0.72	2.52	0.278	2.18	
3000	0	0.67	2.7	0.299	2.283	
	50	0.69	2.773	0292	2.366	
	100	0.70	2.8	0.312	2.426	
L.S.D. ($P \leq 0.05$)	OR Fertilizers	0.0048	0.0568	0.005161	0.03267	
	Glutamic acids	0.0048	0.0568	0.005161	0.03267	
	Interaction	0.0084	0.0985	0.00894	0.05659	

The results (Table 3) showed that the specific plant content of nutrients and elements was also affected by the presence of organic fertilization treatments or spraying with amino acids. It was noted that the plant content of boron %, carbohydrates and total dissolved solids in addition to the fruit discs content of protein and magnesium increased with the increase in the level of fertilization used and also increased significantly with the increase in the concentration of amino acid. The highest rate for all studied traits was recorded in the interaction treatment with organic fertilization at 3000 g/3 m2 and amino acid at 100 mg/L with a significant difference from all treatments in all traits except for the fruit protein content which did not differ from that recorded with the presence of amino acid at a concentration of 50 mg/L at the same level of organic fertilization.

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Table3. Effect of using different levels of organic fertilizer (DOFERM) and spraying with glutamine on the head qualitative contents in cauliflower grown in ambient conditions

OR fertilizer g. 3m^2	Glutamic acid mg. $^{L-1}$	Leaf content of B%	CHO	TSS	Protein	Mg%
0	0	57.48	6.1353	4.3043	22.696	3.2887
	50	58.757	6.2353	5.134	23.811	3.4453
	100	59.083	6.277	5.3143	24.639	3.491
1500	0	60.51	6.3443	5.5613	25.215	3.663
	50	61.613	6.4593	5.7613	26.295	3.684
	100	62.207	6.7503	5.962	26.828	3.8667
3000	0	62.967	6.7633	6.137	27.057	4.0327
	50	62.78	6.956	6.254	27.175	4.1927
	100	64.133	7.1697	6.5293	27.34	4.293
L.S.D. (P≤0.05)	OR Fertilizers	0.2722	0.02024	0.04327	0.1362	0.02559
	Glutamic acids	0.2722	0.02024	0.04327	0.1362	0.02559
	Interaction	0.4715	0.03506	0.07494	0.2359	0.04433

The results show that organic fertilizer showed a significant effect on vegetative growth indicators (plant height, number of leaves, leaf area, fresh weight of the vegetative group, dry weight of the vegetative group). This is attributed to the important nutritional compounds contained in organic fertilizer, as it contains some nutritional elements that play an important role in the process of carbon metabolism, respiration and protoplasm construction, as they enter into the composition of nucleic acids (DNA and RNA) necessary in the process of cell division. Which is reflected in the plant height (Hamad et al., 2011), and the result is consistent with AbouEL-Magd et al. (2006); Summar (2008); Khaled (2014). Organic fertilizers also produce chelating compounds with micronutrients, preventing them from fixing and increasing the chance of their absorption by the plant and their effect on increasing plant growth, weight and dry matter, in addition to their role in carbon metabolism and respiration and providing the energy needed to form new cells, which increases plant growth (Meftaul et al. (2014); Junaid (2016); Khalaf (2012). It was also found that the results of the study agree with Al-Zamli (2012); Al-Birmani (2017) when they studied the effect of organic matter on cauliflower and broccoli, respectively. The organic fertilizers contain most of the necessary elements needed to form and increase the products of carbon metabolism processes, which cause an increase in the activity of the root group and

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vegetative growth represented in an increase in cell division Rhahman (2011); Mahmoud and Al-Zaidi (2012); Marza et al. (2013). Adding organic fertilizer contributed to increasing the availability of essential nutrients and thus led to an increase in the absorption of essential nutrients that enter or contribute to the manufacture of materials Food and then increase the dry matter in it (Havli et al., 2005), Al-Shammari et al. (2016); Al-Sahaf et al. (2012) Al-Saeedi (2022.(

The results indicate that vegetative growth indicators are enhanced by the effect of spraying the amino acid (glutamine), especially plants treated with a concentration of 100 mg L-1. This is often attributed to the essential role of amino acids in building proteins, which is reflected in the construction of cell protoplasm and then the formation of plant tissues (Ziaei et al., 2012). Also, amino acids are the initiator of a number of vital pathways for the production of vital molecules that have important physiological functions in the plant. Thus, the reason for encouraging vegetative growth of plants by the effect of the amino acid glutamine is due to its ability to form indole acetic acid (IAA), the natural auxin (Sugawara et al., 2015), which is responsible for the elongation and expansion of cells (Taiz and Zeiger, 2006), thus increasing the height of the plant. This is consistent with Badir (2021) that spraying amino acids on red cabbage plants has a significant effect on vegetative growth characteristics, with the importance of the biological and physiological response in the plant tissue, as it contributes to the process of cell division, stimulates resistance to some stresses, and increases the plant's nutrient content (Kusano et al., 2008). (Bekheta and Mahgoub, 2005). (AbdEl-Aal et al., 2010). (Shekari and Javanmardi, 2017). This is consistent with what Al-Eissawi (2023) reached on broccoli plants, who found that spraying amino acids led to a significant. increase in the plant's vegetative growth indicators, and spraying the amino acid (glutamine) on the vegetative group of broccoli plants had a significant effect on the chemical content indicators of the leaves. This is consistent with what was reported by (Al-Khaikani, 2022, Shabr, 2023, and Toman, 2024) on broccoli.

Organic fertilizer showed a clear effect in increasing the values of chemical properties including the plant content of chlorophyll, nitrogen, phosphorus, potassium, magnesium, boron, carbohydrates, total dissolved solids (T.S.S.), protein, and sulfur. The increase in carbohydrates in the flower discs treated with organic fertilizer is due to the role of amino acids and organic nitrogen contained in the organic nutrient in activating various vital processes and its reflection on plant height and leaf area. Then, the products of photosynthesis increased, carbohydrate accumulation increased, and the percentage of total dissolved solids (T.S.S.) of the flower discs in the organic fertilizer treatment increased. In addition to the role of glutamic acid in activating various vital processes such as protein building and enzyme activity. This led to improving vegetative growth and increasing the products of carbon metabolism and their transfer to the flower discs. Thus, increasing the availability of nutrients, including nitrogen, phosphorus, potassium and some trace elements that activate the vital activities of the plant and then form organic acids (Hamad et al., 2011). Al-Zuhairi (2016); Zak et al. (2015). Organic fertilizer always works

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to increase the availability of nutrients, especially the basic nitrogen in building the chlorophyll molecule, as it is directly linked to the nitrogen content in the plant, which has an important role in increasing the effectiveness of carbon metabolism and also building carbohydrates. Al-Ajeel and Ghali (2014); Abdul Rahman and Ramadan. This is consistent with (2015 Al-Saeedi (2022) in an experiment on cauliflower plants, where it was found that treatment with fulvic organic fertilizer at the level of 150 was significantly superior in chemical and qualitative characteristics. (Yaronskaya et al., 2006). Abbas and Salman, (2019). Spraying with amino acids often leads to an increase in the effectiveness of metabolic processes in plants as well as physiological functions due to the increased ability and efficiency of the roots to absorb nutrients in the soil (Youssef, 2007). It has a significant effect on the nitrogen content of the leaves, and this may be attributed to the fact that the amino acid contains in its chemical structure an amine group NH2 (AL-Ajeel and Zamili, 2017), as this is positively reflected in increasing nutrient absorption (Azza and Yousef, 2015). In addition to the effect of amino acids on the biosynthesis of chlorophyll as well as in influencing the physiological processes within the plant and its growth and development (Hashim and Salman, 2021). (Al-Khafaji, 2014), thus increasing the nitrogen content of the leaves (Abohanah et al., 2021.(

Thus increasing the nitrogen, phosphorus and potassium content of the leaves (11,12,13). The reason is also that amino acids have provided plant cells with a direct source of nitrogen that can be absorbed by cells and bio-represented faster than inorganic nitrogen, or because glutamic acid is linked to many cellular metabolic processes, which begins with the step of ammonia representation and its association with glutamate by the enzyme glutamine (Glutamine synthetase) to form glutamine, from which the rest of the amino acids and nucleic acids are derived, as glutamic acid is one of the initiators of chlorophyll formation (Yaronskaya et al., 2006) (AbdEl-Aal et al., 2010). Then, the absorption of nutrients such as nitrogen, phosphorus and potassium increases (Azza and Yousef, 2015) (Hashim and Salman, 2021) (Shekari and Javanmardi, 2017). This was supported by Abbas and Salman, (2019) by their conclusion that the amino acid spray treatment was superior in most percentages of nutrients in the leaves, with results consistent with the findings of previous studies on cauliflower and broccoli (Al-Azzawi 2020) and Obaid et al., 2020) (Hashim and Salman, 2021) (Al-Khaikani, 2022 and Shaber 2023, and Toman, 2024.(

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