

The Response of Cauliflower Growth and Yield to Organic and Chemical Fertilizers Application and Spraying With Salicylic Acid

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ABSTRACT

A field experiment was carried out during fall season of 2020 in the station (A) - College of Agricultural Engineering Sciences, University of Baghdad. In order to study the effect of organic and chemical fertilizers and spraying of salicylic acid on growth and yield of Cauliflower (hybrid Steady) .The experiment included two factors, the first factor was used the chemical fertilizers half according to the recommendation (Z1) and the chemical fertilizers according to the recommendation N: 125 kg ha⁻¹, P2O5 135 kg ha⁻¹ and K2O135 kg ha⁻¹ (Z2), The Organic Fertilizer Manufacturer (Fertisoil) added in three levels, the first level is 1 ton.ha⁻¹(Z3) and the second level is 2 ton.ha⁻¹(Z4) and the third level is 3 ton.ha⁻¹ (Z5) They were added before planting. The second factor is spraying with salicylic acid in three concentrations, which is spraying with distilled water (S0) as the control treatment. (S1) salicylic acid at a concentration of 100 mg.l⁻¹ and (S2) at a concentration of 200 mg.l⁻¹ and by three sprays after the first transplantation after 20 days of transfer The experiment was carried out as a Factorial experiment according to a randomized complete block design (R.C.B.D). The results showed. The treatment of organic fertilizer Z5 was significantly superior in all indicators of vegetative growth and yield. It gave the highest values of plant height, number of leaves, leaf area, dry weight of the vegetative growth. Its also significantly exceeded the head diameter, the head weight, and the total yield of the heads. The S2 treatment excelled in all the vegetative growth and yield characteristics as it gave the highest values compared to the control treatment. The interaction treatment (Z5*S2) was significantly superior in all the vegetative growth and yield characteristics as it was given. Plant height (70.65 cm), total number of leaves (25.57 leaf. Plant⁻¹), leaf area (11537.0 dm².Plant⁻¹), and dry weight of the vegetative growth (249.20 g). It also excelled in the yield indicators: the head diameter (25.87 cm), the head weight (1795.0 g. head⁻¹) and the total yield of the heads (59,830 ton. ha⁻¹). Also, the treatment of (Z4*S2) did not differ significantly with it in the yield characteristics the head diameter (25.68 cm) and the head weight (1763.0 g head⁻¹) and the total yield of the heads (58.767 ton. ha⁻¹). Therefore, we can suggest to increase the curds yield and total cauliflower yield to add (2 ton ha⁻¹)level Fertisoil organic fertilizer with salicylic spray at 200mg / L⁻¹ to reduce costs.

Keywords: Cauliflower Growth. Yield, Fertilizers Application, Salicylic Acid

Introduction

Cauliflower (*Brassica oleracea* var.botrytis) A plant of the (Cruciferae) family . Of winter crops were suitable to moderate heat and Tilted to coldness regions. As it grows wild in Around the Mediterranean Sea and the part of which is eaten the head (curd) It contains a nutritional value of 91.7% water, 25 calories, 4.9g carbohydrates, 2.4g protein and 72 mg phosphorous¹. Fertilization is one of the important processes to Get high productivity and to compensate the soil for the lack of nutrients due to the frequent cultivation operations. Adding chemical fertilizers is one of the important ways to compensate for the lack of soil nutrients that contains one or more Nutritious,

but added them at a high rate have a negative impact on the environment and health as a result of the effect of residual nitrates, phosphates, chlorides, sulfates and oxalates. . The use of organic fertilizers manufactured in recent years and extracted from organic wastes has increased as it does not cause environmental pollution and has a positive role in human, animal and plant health, as well as in increasing agricultural production and its quality, preparing soils with different elements and improving their physical, chemical and biological properties, as well as reducing the impact of heavy elements². Salicylic acid is an organic phenolic compound produced from the amino acid Phenylalanine When spraying plants with low levels, it contributes to an increase in plant growth and photosynthesis process. and accelerates the process of formation of chlorophyll. It also helps in organizing the opening and closing of stomata, as well as increasing the activity of some enzymes and maintaining permeability. which helps to increase nutrients (N.P.K) It also helps to regulate the role of ethylene metabolism as well as counteract the effect of the growth regulator abscisic acid (ABA), which is responsible for plant senescence^{3,4,5}

Materials and Methods

A field experiment was carried out during fall season of 2020 in the station (A) - College of Agricultural Engineering Sciences, University of Baghdad. In order to study the effect of organic and chemical fertilizers and spraying of salicylic acid on growth and yield of Cauliflower (hybrid Steady)

The experiment included two factors, the first of which is chemical and organic fertilizers.

- 1- Chemical fertilizer half the recommended recommendation (Z1)
 - 2- Chemical fertilizers according to the recommendation N: 125 kg ha⁻¹, P₂O₅ 135 kg ha⁻¹ and K₂O 135 kg ha⁻¹ (Z2)⁶ Add phosphate fertilizer at once when planting, and nitrogen and potassium fertilizers in two batches, the first after two weeks of planting and the second a month after the first batch
 - 3- Organic fertilizer (Fertisoil) at a level of 1 ton ha⁻¹ (Z3)
 - 4- Organic fertilizer (Fertisoil) at a level of 2 ton ha⁻¹ (Z4)
 - 5- Organic fertilizer (Fertisoil) at a level of 3 ton ha⁻¹ (Z5)
- Adding organic fertilizer (Fertisoil) in one batch before planting.

Table (1) The Components of the Organic Fertilizer Manufacturer (Fertisoil)

Component	The percentage
Organic matter	% 60
Dry matter	% 88
Total nitrogen (N)	% 3.7
Phosphorus (P ₂ O ₅)	% 3.0
Potassium (K ₂ O)	% 5.0

Magnesium (MgO)	% 1.0
Calcium (CaO)	% 8.6
Ratio C/N	>10

The second factor is sprayed with salicylic acid in three concentrations.

- 1- Spray with distilled water (S0) control treatment
- 2- Spray with salicylic acid at a concentration of 100 mg. l⁻¹ (S1)
- 3- Spray with salicylic acid at a concentration of 200 mg. l⁻¹ (S2)

The plants were sprayed three times after 20 days of transporting the plants to the field, with a 20 day interval between one spraying and another.

The experiment was carried out as a Factorial experiment according to a Randomized Complete Block Design (R.C.B.D) with three replicates, each replicates include 15 treatments, to be 45 experimental units. Their averages were compared using a test Least Significant Difference Test L.S.D. At a probability level of 0.05⁷. The seeds for the hybrid variety Steady were planted in a plastic house and in cork dishes containing 209 eyes on 8/15/2020. The field was prepared, plowed by cross plowing and exposed to the sun, as well as graded and a drip irrigation system was installed. The indicators of the study were taken for each of the plant height, number of leaves, leaf area, dry weight of the vegetative growth, the head diameter, the head weight, and the total yield of the heads.

Results and discussion

The results in Table (2) showed The treatment of organic fertilizer Z5 was significantly superior in all indicators of vegetative growth and yield Which giving the highest values in Plant height (68.98 cm), number of leaves (25.11 leaf. Plant⁻¹) and leaf area (11219.0 dm². Plant⁻¹) The dry weight of the vegetative growth (240.33 g) compared with the half-recommended treatment of chemical fertilizer Z1 Which gave the lowest values in all the characteristics of vegetative growth. The table also showed the superiority of the treatment of spraying with salicylic acid S2 in all studied parameters of vegetative growth which giving the highest values, plant height (65.52 cm), total number of leaves (23.58 leaf. Plant⁻¹), leaf area (10583.40 dm². Plant⁻¹) and The dry weight of the vegetative growth (226.12 g). Compared with the S0 control treatment, which gave the lowest values in the vegetative growth indicators. The interaction treatment (Z5*S2) was superior to give a higher values in the all the characteristics of vegetative growth, Plant height (70.65 cm), the total number of leaves (25.57 leaf. Plant⁻¹), the leaf area (11537.0 dm². Plant⁻¹), and The dry weight of the vegetative growth (249.20 g).

Table (2) Effect of organic and chemical fertilizers and spraying of salicylic acid on vegetative growth characteristics.

Treatment	Plant height (cm plant⁻¹)	Number of leaves (leaf plant⁻¹)	Leaf area (dcm² plant⁻¹)	dry weight of vegetative growth (g plant⁻¹)
Z1	54.41	19.41	8840.6	187.73
Z2	65.55	24.37	10515.3	221.66
Z3	63.41	21.06	9852.3	209.93
Z4	66.44	23.95	10671.3	226.76
Z5	68.98	25.11	11219	240.33
LSD %5	0.58	0.53	126.3	7.87
S0	62.13	21.67	9839.4	208.86
S1	63.63	23.09	10236.4	216.88
S2	65.52	23.58	10583.4	226.12
LSD %5	0.45	0.41	97.8	6.09
Z1 S0	52.92	18.47	8438	179.2
Z1 S1	53.78	19.65	8934	189.7
Z1 S2	56.54	20.12	9150	194.3
Z2 S0	63.81	23.2	10139	215.3
Z2 S1	65.35	24.76	10495	220.5
Z2 S2	67.49	25.15	10912	229.2
Z3 S0	62.86	19.9	9460	198.4
Z3 S1	63.23	21.43	10013	212.6
Z3 S2	64.16	21.86	10084	218.8
Z4 S0	63.74	22.3	10263	217.9
Z4 S1	66.83	24.37	10517	223.3
Z4 S2	68.77	25.2	11234	239.1

Z5 S0	67.34	24.48	10897	233.5
Z5 S1	68.96	25.28	11223	238.3
Z5 S2	70.65	25.57	11537	249.2
LSD %5	1.013	0.93	218.8	13.63

Fertilizers (Z1 half/ chemical),(Z2 chemical), (Z3 Fertisoil 1 ton.ha⁻¹),(Z4 Fertisoil 2 ton.ha⁻¹),(Z5 Fertisoil 3 ton.ha⁻¹) salicylic acid (S0 control) (S1 100mg.l⁻¹) (S2 200mg.l⁻¹)

Table (3) also showed the results of the yield, as it was significantly superior to the Z5 treatment, which giving the highest values in the head diameter (25.45cm) and the head weight (1737.0 g. Plant⁻¹) and the total yield of the heads (57,898 ton. ha⁻¹) compared with the Z1 treatment. The S2 treatment significantly superior the yield characteristics of the head diameter (24.66 cm), the head weight (1647.0 g. Plant⁻¹), and the total yield of the heads (54,899 ton. ha⁻¹) compared with control treatment S0. The treatment of (Z5*S2)was significantly superior in all indicators of yield, which give the highest values. the head diameter (25.87 cm), the head weight (1795.0 g. Plant⁻¹) and the total yield of the heads (59,830 ton. ha⁻¹). Also, the treatment of (Z4*S2) did not differ significantly with it in the head diameter (25.68 cm) and the head weight (1763.0 g. Plant⁻¹), and the total yield of the heads (58.767 ton. ha⁻¹).

Table (3) Effect of organic and chemical fertilizers and spraying of salicylic acid on yield characteristics

Treatment	curd diameter (cm)	weight of curd (g plant ⁻¹)	total yield of the curds (ton.ha ⁻¹)
Z1	21.42	1312.3	43.744
Z2	24.50	1645.6	54.856
Z3	23.41	1502.3	50.077
Z4	24.85	1674.0	55.800
Z5	25.45	1737.0	57.898
LSD %5	0.123	46.7	1.558
S0	23.11	1494.8	49.827
S1	24.01	1581.0	52.700
S2	24.66	1647.0	54.899
LSD %5	0.096	36.2	1.207
Z1 S0	19.62	1202.0	40.067

Z1 S1	21.70	1330.0	44.333
Z1 S2	22.94	1405.0	46.833
Z2 S0	23.80	1578.0	52.600
Z2 S1	24.65	1657.0	55.233
Z2 S2	25.07	1702.0	56.737
Z3 S0	23.11	1426.0	47.537
Z3 S1	23.38	1511.0	50.367
Z3 S2	23.74	1570.0	52.330
Z4 S0	24.06	1589.0	52.967
Z4 S1	24.83	1670.0	55.667
Z4 S2	25.68	1763.0	58.767
Z5 S0	24.96	1679.0	55.967
Z5 S1	25.52	1737.0	57.900
Z5 S2	25.87	1795.0	59.830
LSD %5	0.214	80.9	2.699

Fertilizers (Z1 half/ chemical),(Z2 chemical), (Z3 Fertisoil 1 ton.ha⁻¹),(Z4 Fertisoil 2 ton.ha⁻¹) ,(Z5 Fertisoil 3 ton.ha⁻¹) salicylic acid (S0 control) (S1 100mg.l⁻¹) (S2 200mg.l⁻¹)

The results of Tables (2, 3) showed the superiority of organic fertilization in the vegetative growth and yield characteristics of cauliflower plant. It is attributed to the role of organic fertilizers in improving the physical, chemical and biological properties of the soil, which increases its porosity and aeration, as well as raising the ambient temperature for the growth of the root system. and maintaining soil moisture, which helps the roots to increase the absorption of water and nutrients, which positively affect vegetative growth⁸. It is also attributed to the role of organic matter in the soil that encourages an increase in the number of organisms that accelerate the decomposition of organic compounds and reduce soil pH Which helps to increase the supply of nutrients as they are involved in the biological and physiological reactions in the processes of photosynthesis and as well as in the elongation and division of cells that affect plant height and increase the number of leaves and leaf area^{9,10}. The role of nitrogen in cell division and elongation is also attributed to the stimulation of plants to make proteins and to produce auxins, as well as the increase in the synthesis of chlorophyll. Phosphorous also increases photosynthesis as a result of stimulating enzymatic reactions to build energy and vital compounds, thus increasing the performance of photosynthesis. The role of potassium is also important in increasing vegetative growth as a result of its transfer of the products of carbon metabolism^{11,12}. This is also due to the high level of organic matter in the soil, which supplies the plant with nutrients and works to increase the growth of the vegetative and root system, which helps to increase carbon metabolism and manufacture nutrients that positively affect the yield¹³. The role of organic matter in the soil is attributed to preparing the plant with elements such as nitrogen and phosphorous, which affect the formation of amino acids, DNA and RNA, which are

important in the process of make protoplasm and cell division of cells as it increases the vegetative system and positively affects the yield as potassium has a role in the transfer of processed materials from leaves to fruits^{14,15}. The tables also showed the effect of salicylic acid on the vegetative growth and yield characteristics of the cauliflower plant due to the role of salicylic in stimulating endogenous hormones gibberellins, cytokinins and oxins and not destroying them. It is known that the role of these hormones in cell division and elongation, and thus positively affect the characteristics of vegetative growth^{16,17,18}. The role of salicylic in preserving the activity and vitality of the vegetative system by inhibiting ethylene and reducing it. It also reduces plant senescence and leaf fall by its anti-growth inhibitor Absciscic acid (ABA) effect, which positively affects vegetative growth⁴. The role of salicylic acid is also attributed to its effect on increasing the level of the IAA hormone responsible for cell division, as well as on supplying cells and nucleic acids with protein substances, which makes it supportive of the cell division process, which positively affects the number of leaves¹⁹. It is attributed to the role of salicylic in increasing the yield characteristics as a result of its effect on increasing the vegetative growth of the number of leaves and leaf area as well as the content of the leaves of chlorophyll, which led to an increase in photosynthesis from the manufacture of carbohydrates in the leaves that positively affect the yield characteristics when moving from leaves to curds²⁰.

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