



ORIGINAL ARTICLE

EFFECT OF ORGANIC FERTILIZER AND ASCORBIC ACID ON GROWTH AND SOME NUTRIENT CONTENT OF SWEET BASIL *OCIMUM BASILICUM* L.

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Abstract: The research was conducted in one of Al-Kufa/Al-Najaf governorate fields during the spring growing season of 2019. The study aimed to evaluate the effect of foliar application of organic fertilizer Drin-humus with three levels 0, 2 and 4 ml.L⁻¹ and three concentrations of Ascorbic acid including 0, 50 and 100 mg.L⁻¹. Some vegetative growth parameters of the sweet basil plants were measured as well as some nutrient content. A randomized complete block design was adopted using a factorial experiment with three replicate. The comparison between the means was carried out using Duncan's multiple range tests at a probability of 0.05. The results of spraying Drin-humus at the levels of 2 and 4 ml.L⁻¹ showed significant superiority in increasing the plant height 59.38 and 59.18 cm, the number of leaves 59.27 and 57.83 leaves.Plant⁻¹ and the shoots dry weight 23.22 and 23.32 gm.Plant⁻¹, respectively. Applying Ascorbic acid at a level of 100 mg.L⁻¹ showed an increase in total chlorophyll 55.39 mg.100 gm⁻¹ FW, potassium 2.08% and calcium to 2.94%. Ascorbic acid at the level of 50 mg.L⁻¹ increased the nitrogen level to 1.81%. Meanwhile, the comparison treatment showed the lowest value of chlorophyll 52.61 mg, 100 gm⁻¹ fresh weight, nitrogen 1.67%, potassium 1.88% and calcium 2.22%.

Key words: Sweet basil, Organic fertilizer, Ascorbic acid, Physiological parameters.

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1. Introduction

The sweet basil plant *Ocimum basilicum* L. belongs to the Lamiaceae family is considered as medicinal herbs since it contains about 150 species that differ in leaf size, flower color, outward characteristics and flavor. Africa and Asia are the original home of basil [Larimi *et al.* (2014)], while it is farmed in the Middle East, America and all countries of the world. Medicinal and aromatic plants have an important economic place nowadays due to the high demand for their products, whether from local or foreign markets. Basil is one of the most important of these plants [Kumar (2019), Al-aubadi, Inas M. Khaleel (2011)]. Basil is used as a medicinal plant to treat many diseases such as headache, cough, worms, gastroenteritis, anti-malaria and overweight. Also, it is used to reduce

infections and colds, In addition, Basil can add a nice flavor to food and its leaves are eaten as an appetizer, or as a salad. For industrial use, Basil can be used to make spices, vinegar and pickles [Abdel-Hamid (2020)].

Adding solid or Drin-humus to plants has become one of the modern agriculture tactics of clean agriculture. The basic aim of clean agriculture is to produce crops free of chemical compounds and reduce polluting materials to the environment. On the other hand, studies revealed that Organic fertilizers may have an effect in reducing compounds that may harm human health, especially those that have toxic effects when accumulated, such as nitrates, nitrites, phosphates and oxalites [Noroozlo *et al.* (2019)]. The Drin-humus is a rich source of nitrogen, phosphorous and amino acids.

Also, it contain humic and fulvic acids, it dissolves in water with a dark color that forms the bulk of the humus components [Naiji and Sourì (2018)].

Organic fertilization is one of the important factors that have a major effect on plant growth, especially leafy vegetables since it can improve and increase the vegetative growth characteristics by providing the plant with nutrients as well as increasing the availability of the nutrients in the soil. This will help build organic compounds or improving the course of vital activities within the plant and its reflection on growth [Abdou *et al.* (2015)].

Vitamin C is one of the important sugar acids that have the chemical structure $C_6H_8O_6$. It has many physiological roles in the plant such as stimulating the formation of nucleic acids, proteins and enzymes as well as the formation of a number of co-enzymes in enzymatic reactions of carbohydrate and protein metabolism. Vitamin C can help build gibberellins, anthocyanins and regulate cell growth through its role in cell elongation and division [Corrado *et al.* (2020)].

It also has antioxidant properties since it plays an important role in protecting against harmful active oxygen species that are formed during photosynthesis and respiration. It affects the flowering process through its effect on the phytochrome pigment, which is intermediate in the transition processes from the vegetative stage to the reproductive stage. Basil is widespread in Iraq as a cooking herb, food decoration and fresh consumption vegetable. Also, it uses as a folk remedy for many of pathological conditions. This research aimed to study the effect of spraying Drin-humus and ascorbic acid and their interaction on some characteristics of vegetative growth and yield of sweet basil plant.

2. Materials and Methods

The field soil was prepared by plowing it twice and in an orthogonal manner and then it was smoothed and

leveled. Soil analysis tests were conducted before planting and fertilization. Ten soil samples were taken randomly from the field in different places with a depth ranging from 0-30 cm. The samples were mixed homogeneously and exposed to UV rays of the sun light for 24 hours, then it was ground and sieved with a sieve that have diameter holes of 2 mm. Then, the samples were analyzed in the laboratory of the Department of Soil and Water Resources at the College of Agriculture, University of Kufa as shown in Table 1.

The field was divided into three sectors and each sector included 9 panels (experimental units). The area of each panel is 2 m² (1×2 m). The seeds were planted directly in the soil on February 23,2019. The seeds were sown in lines. 25 cm was the distance among lines and 10 cm among seeds. The first irrigation was given immediately after planting and then irrigation was repeated whenever needed according to the environmental conditions. The first factor was sprayed to the plant was the organic nitrogen at three concentration levels including 0, 2 and 4 ml.L⁻¹. The second factor was spraying three concentrations of ascorbic acid including 0, 50 and 100 mg.L⁻¹. The treated plants were sprayed twice. The first spraying was after the formation of (6-5) true leaves and the second spray was after ten days from the first spray. The comparison treatment was sprayed with distilled water only.

The transactions were distributed in a 3×3 factorial experiment using Random Complete Block Design (R.C.B.D.) with three replications for each experimental unit, thus the number of experimental units is 27 experimental units. The means were compared according to the Duncans Multiples Range Test at a probability level of 0.05.

Studied traits

The traits were measured 45-55 days after planting. The plants were taken at random to measure the following traits:

Table 1: Physical and chemical properties of the experimental soil.

Physical analysis		Chemical analysis			
Sand	200 gm.kg ⁻¹	pH	7.3	Mg ⁺⁺ (m.equ.L ⁻¹)	2.71
Silt	350 gm.kg ⁻¹	EC mmohs/cm	1.98	Na ⁺ (m.equ.L ⁻¹)	9.24
Clay	450 gm.kg ⁻¹	Total N%	0.72	HCO ₃ ⁻ (m.equ.L ⁻¹)	0.32
Soil texture	Clay loam	Total P%	0.32	Cl ⁻ (m.equ.L ⁻¹)	4.39
Organic matter (O.M)	4.9 gm.kg ⁻¹	Total K%	0.75	SO ₄ ⁻ (m.equ.L ⁻¹)	19.72
field capacity %	28.32 %	Ca ⁺⁺ (m.equ.L ⁻¹)	3.75	Fe (mg.L ⁻¹)	0.40

- 1- Plant height (cm)
- 2- Total number of leaves (leaf.plant⁻¹): The number of total leaves in each of the randomly harvested plants was calculated for each experimental unit.
- 3- Paper area (cm².leaf⁻¹): Leaf area was measured by cutting three fully expanded leaves for each experimental unit, it was measured by the method described by Sadik *et al.* (2011), using a scanner band then the image was processed using a Digimizer program loaded on a computer. Then the leaf area was calculated.
- 4- Dry weight of the shoot (gm.plant⁻¹): Ten plants were randomly harvested as they were cut from the crown area to separate the vegetative group. And then, it was weighed with a sensitive balance and dried at room temperature of 30-35°C for 24 hours. The following step was placing the sample in perforated paper bags to be dried in an electric oven at 60-65°C.
- 5- Vegetative yield per unit area (kg.m⁻²): The plants were harvested at a height of 10 cm from the ground surface. The plants were placed in paper bags and weighed directly in the field to calculate the wet weight of each sample.
- 6- Chlorophyll pigment content of leaves (mg.100gm⁻¹ fresh weight): The total content of chlorophyll pigment in leaves was estimated using a spectrophotometer to measure optical absorption at wavelengths of 645 and 663 nm following the method described by Salman *et al.* (2019) according to the following equations:

$$\text{Total Chlorophyll} = 20.2 \times D_{645} + 8.02 \times D_{663} \quad (V/W \times 1000)$$
- 7- Percentage of nitrogen in leaves (%): The total nitrogen content was estimated using the Micro Kjeldahl device as mentioned by Tuman and Salman (2020).
- 8- Percentage of potassium in leaves (%): The total potassium percentage was estimated by taking 1 gm of the sample and placing it in the digestion tube of the semi-micro Kjeldahl method [A.O.A.C. (1980)]. The potassium concentration was determined directly by a flame photometer type PGI 2000 Automatic flame photometer.
- 9- The percentage of calcium in the leaves (%): Calcium was determined for the digested leaf samples using a Flame-Photometer.

3. Results and Discussion

The results of Table 2 showed that spraying Drin-

Table 2: Effect of Drin-humus and ascorbic acid on vegetative growth traits of sweet basil.

Foliar application		Plant height (cm)	Number of leaves (leaf.Plant ⁻¹)	Leaf area (cm ² .leaf ⁻¹)	Shoot Dry weight (gm.plant ⁻¹)	Yield (Kg.m ⁻²)
Ascorbic acid (mg.L ⁻¹)	Organic fertilizer (mL.L ⁻¹)					
Control	Control	31.60 f	43.12 d	7.82 d	15.43 f	1.76 c
	2	48.63 d	51.22 c	9.71 bc	20.50 d	2.43 b
	4	38.41 e	50.15 c	9.72 bc	19.08 e	1.92 c
50	Control	51.60 d	45.87 cd	8.87 cd	16.42ef	1.87c
	2	59.34 c	63.13 ab	9.67 c	23.36 c	2.08 b
	4	63.11 c	56.38 b	10.23 b	23.78 c	2.63 b
100	Control	62.32 c	50.32 c	8.44 cd	18.49 e	2.22 b
	2	70.18 b	63.46 ab	9.58 c	25.82 b	2.36 b
	4	76.05 a	66.96 a	11.88 a	27.10 a	4.97 a
Mean of Ascorbic acid	Control	39.55 b	48.16 c	9.08 b	18.33 c	2.03 c
	50	58.01 a	55.12 b	9.59 a	21.18 b	2.19 b
	100	69.51 a	60.24 a	9.96 a	23.80 a	3.18 a
Mean of Organic fertilizer	Control	48.51 b	46.43 b	8.37 b	16.78 b	1.95 c
	2	59.38 a	59.27 a	9.65 ab	23.22 a	2.29 b
	4	59.19 a	57.83 a	10.61 a	23.32 a	3.17 a

*Means followed by the same letter do not differ by Duncan's multiple range test at a probability level (P < 0.05).

humus at a level of 2 and 4 mL.L⁻¹ showed the significant superiority in increasing the plant height 59.38 and 59.18 cm, the number of leaves to 59.27 and 57.83 leaves.plant⁻¹ and the dry weight of the vegetative parts 23.22 and 23.32 gm.plant⁻¹, respectively. The level of 4 mL.L⁻¹ was superior in increasing the leaf area 10.61 cm² and the vegetative yield 3.17 kg.m⁻² compared to the control treatment. Control treatment recorded the lowest value in all vegetative growth traits including plant height 48.51 cm, the number of leaves 46.43 leaves.plant⁻¹, leaf area 8.37 cm², the dry weight 16.78 g.plant⁻¹ and vegetative yield 1.95 kg.m⁻².

Spraying ascorbic acid at the level of 100 mg.L⁻¹ significantly increased some vegetative growth characteristics including plant height 69.51 cm, the number of leaves 60.24 leaves.plant⁻¹ and the vegetative yield 3.18 kg.m⁻². Control treatment recorded the lowest vegetative growth characteristics including plant height, number of leaves, leaf area, dry weight and vegetative yield which scored 39.55 cm and 48.16 leave.plant⁻¹, 9.08 cm² and 18.33 gm.plant⁻¹ and 2.03 kg.m⁻² respectively. The dual interaction between spraying Drin-humus at the level of 4 mL.L⁻¹ and ascorbic acid at the level of 100 mg.L⁻¹ was superior in increasing the plant height 76.05 cm, the number of leaves 66.96 leaves.plant⁻¹, leaf area 11.88 cm² and dry weight 27.10 g.plant⁻¹ and vegetative yield 4.97 kg.m⁻², compared

with the control treatment. Control treatment recorded the lowest value of plant height, the number of leaves, leaf area, dry weight and vegetative yield scored 31.60 cm and 43.12 leaves.plant⁻¹ and 7.82 cm² and 15.43 gm.plant⁻¹ and 1.76 kg.m⁻², respectively.

The results in Table 3 indicated that spraying Drin-humus at a level of 2 and 4 mL.L⁻¹ had a significant effect on improving the leaf content of total chlorophyll, nitrogen, potassium and calcium. The application of ascorbic acid at the level of 100 mg.L⁻¹ increased total chlorophyll 55.39 mg.100 g⁻¹ FW, potassium 2.08% and calcium 2.94%. Whereas applying ascorbic acid at the level of 50 mg.L⁻¹ increased nitrogen percentage to 1.81%. The comparison treatment recorded the lowest value of chlorophyll 52.61 mg.100g⁻¹ FW, nitrogen 1.67%, potassium 1.88% and calcium 2.22%.

The interaction between the experimental factors showed a significant effect. The application of Drin-humus at the level of 2 mL.L⁻¹ and ascorbic acid at the level of 100 mg.L⁻¹ increased the total chlorophyll content to 58.40 mg.100 g⁻¹, percentage of nitrogen 1.90% and potassium 2.44%. While the interaction between applying Drin-humus at the level of 2 mL.L⁻¹ with the same level of ascorbic raised the percentage of calcium to 2.94% compared to the control treatment. The control treatment scored the lowest value of chlorophyll content 48.31 mg.100 gm⁻¹ FW, nitrogen

Table 3: Effect of Drin-humus and ascorbic acid on leaf content of total chlorophyll and some nutrients of sweet basil.

Foliar application		Total Chlorophyll (mg.100gm fresh weight ⁻¹)	N %	K %	Ca%
Ascorbic acid (mg.L ⁻¹)	Organic fertilizer (mL.L ⁻¹)				
Control	Control	48.31 d	1.62 bc	1.44 d	2.11 c
	2	54.06 b	1.67 b	2.16 ab	2.23 bc
	4	51.22 c	1.73 b	2.06 b	2.33 b
50	Control	42.25 f	1.81 ab	1.88 c	2.35 b
	2	46.55 de	1.79 ab	2.01 b	2.89 a
	4	44.32 ef	1.83 ab	2.18 ab	2.45 b
100	Control	52.61 c	1.57 c	1.78 c	2.56 b
	2	58.40 a	1.90 a	2.03 b	2.89 a
	4	55.18 b	1.81 ab	2.44 a	2.94 a
Mean of Ascorbic acid	Control	51.19 b	1.67 b	1.88 b	2.22 b
	50	44.37 c	1.81 a	2.02 a	2.56 ab
	100	55.39 a	1.67 b	2.08 a	2.79 a
Mean of Organic fertilizer	Control	47.72 c	1.66 b	1.70 b	2.34 b
	2	53.00 a	1.78 a	2.06 ab	2.67 a
	4	50.24 b	1.79 a	2.22 a	2.57ab

*Means followed by the same letter do not differ by Duncan's multiple range test at a probability level (P < 0.05).

1.62%, potassium 1.44% and calcium 2.11%.

The role of organic fertilizers, which are rich in water-soluble compounds, can be attributed directly or indirectly to encouraging and increasing the plant growth rate by enzymatic or hormonal action [Mutar *et al.* (2020)].

Macronutrients such as nitrogen and carbon, as well as organic acids and various amino acids can increase the biological activity of the plant and activate cells through stimulating the enzymatic systems and increasing the rate of bio-anabolism. The simple primary molecules are converted into vital and important molecules for the living cell such as nucleic acids RNA and DNA and proteins and carbohydrates [Turk *et al.* (2020)]. Also, it can stimulate and produce plant hormones such as Cytokinins that encourage cell division processes and build plant tissues, thus increasing the leaf area [Tuman and Salman (2020)]. Moreover, it can encourage side branching, as well as stimulate the production of Auxins, which works on elongation and expansion of cells.

This can be done by activating mRNA activity and leads to increase protein synthesis, or by increasing cell size that provides more elasticity of the cell wall. In addition, it can build and flow Xyloglucan in the material of the wall, thus increasing the elasticity of the cell wall in an irreversible way. These activities are associated with a decrease in the inflated pressure of the cells, an increase in osmotic pressure and the entry of water into the plant cell [Alakashy and Al-Bedairi (2020)]. As for the role of ascorbic acid, it led to an increase in the content of chlorophyll in the leaves, which leads to an increase in the ability of the plant to make carbohydrates by photosynthesis. This can positively increase various vital processes, including cell division and expansion and the building of root tissues [Salman *et al.* (2019)].

On the other hand, ascorbic acid is one of the antioxidant compounds which promotes vegetative and reproductive growth, encourages growth-stimulating substances, reduces heat stress, stimulates cell division, enters the electron transport system and protects the chloroplast molecule from oxidation [Nasiri *et al.* (2018)]. In addition, ascorbic acid plays an important role in stimulating the growth of plant organs including roots and then increasing their ability to absorb larger quantities of elements nutrients from the soil, including

nitrogen, potassium and calcium (Table 3).

4. Conclusion

The results showed that the spraying of Drin-humus and ascorbic acid and the interaction between them improved most of the studied vegetative growth characteristics and raised the plant's nutrient content. This was positively reflected in raising the production of vegetative yield per unit area.

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