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Effect of Nitrogen Fertilizer and Amino Acid Spraying on the Growth of Sunflower *Helianthus annuus* L.

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ABSTRACT

A field experiment was conducted in a farm (5) km from the center of Al-Muthanna Governorate) during the 2024 season to study the effect of three levels of nitrogen fertilizer, symbolized as N0, N1, and N2, and two levels of amino acids, symbolized as S1 and S2, to determine the level at which maximum utilization of nitrogen fertilizer and amino acids is achieved3. The experiment was applied according to a factorial arrangement using a Randomized Complete Block Design (R.C.B.D) with three replications4. The results of the study showed the following: Nitrogen fertilizer had a significant superiority in some study traits, as level N2 excelled in plant height (158.3 cm), number of leaves (31.17 leaf /plant), and leaf area (476 cm^2). As for amino acids, they also had a significant effect, as level S2 excelled in plant height (152.6 cm). The interaction was significant in the number of leaves trait, where the interaction treatment (N2×S2) excelled with 32.33 leaves/plant, and in stem diameter, where the interaction treatment (N2×S2) excelled with 28.67 mm.

Keywords :- Helianthus annuus L., Sunflower, Nitrogen fertilization, Amino acids, Foliar spraying, Vegetative growth, Leaf area

1. INTRODUCTION

The sunflower crop (Helianthus annuus L.) is considered one of the crops belonging to the family Asteraceae. It is one of the important oil crops in the world, ranking third after soybean and rapeseed in terms of oil content (Aziz, 2000; Meric et al., 2003). It has many uses; oil is extracted from its oilseed varieties and used in cooking, soap making, butter, and cosmetics, and the cake is used as animal fodder, making it a dual-purpose crop (Al-Badri, 2013; Jadaan et al., 1999). As for its low-oil varieties, their seeds are consumed by humans after roasting as they are palatable and have a distinct flavor, in addition to their high nutritional value, containing carbohydrates (5–7%) and proteins (16–18%), in addition to elements such as calcium, iron, phosphorus, potassium, fiber, vitamins, and others (Al-Rawi et al., 2013).

Given its high financial return and the presence of factories specialized in roasting and packaging seeds, the demand for it has increased recently. This has prompted specialists to focus on these varieties, expanding their cultivation horizontally and vertically, and introducing necessary improvements in their cultivation technology to stimulate their genetic and physiological potential to express themselves better in the cultivation environment. This aims to improve seed growth and development, reduce the percentage of empty seeds, and increase their specific weight to cover the deficit in productivity per unit area, especially since productivity in Iraq is still low compared to global production (Central Statistical Organization, 2020).

The addition of nutrients is considered an important factor in increasing plant productivity through their major role in many vital processes within the plant. However, adding these nutrients directly to the soil exposes them to loss, fixation, and precipitation processes, so the plant benefits from them only in small quantities. This has led researchers to consider finding alternative methods for fertilizer application that ensure obtaining the highest production and best quality (Faraj, 2006).

Nitrogen plays a major role in crop production, especially when used correctly. It is an important and limiting element in plant growth and development and also has an important role in building chlorophyll, protein, nucleic acid, hormones, and vitamin synthesis, and helps in cell division and elongation (Silberbush, 2002). Its increase leads to an increase in dry matter through the speed of photosynthesis, leading to rapid plant growth and increased productivity. Conversely, its decrease leads to a shortage in the number of leaves and their production, and consequently reduced photosynthesis, which reflects negatively on production (Abdel-Motagally et al., 2010; Fayyaz-ul-Hassan et al., 2005).

Amino acids are involved in the formation of the chlorophyll molecule, and their use increases the rate of photosynthesis in the plant. They are effective at various stages of plant growth, increasing the cell's ability to absorb water and dissolved nutrients from the growth medium, thereby increasing vegetative growth. They play a role in increasing protein synthesis and enhancing the rate of carbon absorption, thus increasing dry matter (Dromantiene, 2013; Ghadiyat and Sharma, 2005). Amino acids

work on the biosynthesis of proline, which is one of the amino acids that help plants resist most stress conditions such as salinity, cold, high temperatures, and drought (Farid et al., 2020).

This study aims to:

1. Determine the extent of sunflower crop response to spraying with amino acids and nitrogen fertilizer and their effect on some growth traits.
2. Determine the appropriate level of amino acids and nitrogen fertilizer.
3. Determine the best interaction between amino acids and nitrogen fertilizer and determine the best growth.

2. MATERIALS AND METHODS

2.1 Experiment Site A field experiment was carried out during the spring season on a farm located 5 km from the center of Al-Muthanna Governorate on 22/3/2024.

2.2 Experiment Factors

- One Factor: Three levels of Nitrogen fertilizer (N):
  - Level One (N1): (0) kg N ha^{-1}.
  - Level Two (N2): (120) kg N ha^{-1}.
  - Level Three (N3): (160) kg N ha^{-1}.

    (Translator's Note: While defined here as N1, N2, N3, the abstract and results tables refer to these levels as N0, N1, and N2 respectively, where N0 is the control).
- Two Factor: Two levels of Amino Acids (S):
  - Level One (S1): 1 ml/1 liter water.
  - Level Two (S2): 2 ml/1 liter water.

2.3 Experiment Design The field experiment was implemented using a factorial arrangement according to the Randomized Complete Block Design (R.C.B.D) (Al-Rawi and Khalaf, 2000) with three replications. It included two factors: three levels of nitrogen fertilizer and two levels of amino acids, totaling (18) experimental units.

2.4 Agricultural Operations The experiment land was plowed with two perpendicular plowings before planting using a moldboard plow, then the land was smoothed using disc harrows, followed by leveling. The field land was divided into (18) experimental units, the area of each unit being (3) m^2. The experimental unit contained (3) lines, the length of one line being (2) m, and the distance between one line and another was 50 cm. Planting was done in (6) holes per line with a distance of (25) cm between holes. Sunflower seeds were planted on 22/3/2024, putting three seeds in one hole at a depth of (3-4) cm, and thinned to one plant after two weeks of planting.

Nitrogen fertilizer was added according to the study levels in the form of Urea fertilizer (46% N) after 24/4/2024, while amino acids were added and sprayed at the (5) leaf stage.

2.5 Studied Traits

- 3.5.1 Plant Height (cm): Measured from the soil surface (base of the

stem) to the highest top of the plant for five plants from the middle line.

- 3.5.2 Number of Leaves (leaf plant^{-1}): The leaves of five plants taken randomly from the middle line of each experimental unit were counted in full.
- 3.5.3 Leaf Area (cm²): Estimated according to the equation: Total Leaf Area (cm²) = Max Length × Max Width × 0.64.
- 3.5.4 Stem Diameter (mm): Measured using a measuring tape from the middle region of the stem for five plants taken randomly from each experimental unit.

2.6 Statistical Analysis All studied traits were analyzed according to the Randomized Complete Block Design with factorial arrangement statistically using the statistical program (GenStat 12.1), and means were compared using the Least Significant Difference (L.S.D) test at a significance level of 0.05 (Al-Rawi and Khalaf Allah, 2000).

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm) The statistical analysis results in Table (1) indicate a significant effect of nitrogen fertilizer and amino acids on the plant height trait, while there was no significant effect for the interaction in this trait.

The results of Table (1) showed significant differences for nitrogen fertilizer levels in the plant height trait. Level N2 gave the highest average of 158.3 cm, with no significant difference from level N1 with an average of 152.7 cm, but with a significant difference from level N0 which recorded the lowest average of 131.8 cm. The increase in plant height may be attributed to the increase in dry matter in the plant because nitrogen is a main component of chlorophyll and protein; its sufficient supply encourages photosynthesis, leading to increased cell division and elongation, thus increasing dry matter accumulation and stem elongation.

As for amino acid levels, level S2 recorded the highest average of 152.6 cm, with a significant difference from level S1 which achieved the lowest average of 142.7 cm. This is likely due to the role of amino acids in increasing photosynthesis efficiency, thereby increasing dry matter accumulation in the stem and increasing plant height.

Table (1): Effect of nitrogen fertilizer and amino acid spraying and their interaction on plant height of sunflower (cm)

Nitrogen Fertilizer	Amino Acids (S1)	Amino Acids (S2)	Mean Nitrogen Fertilizer
N0	124.0	139.7	131.8
N1	147.3	158.0	152.7
N2	156.7	160.0	158.3
Mean Amino Acids	142.7	152.6	
L.S.D (0.05)	N: 7.59	S: 6.20	S×N: N.S

3.2 Number of Leaves (leaf plant^{-1}) The statistical analysis results in Table (2) show a significant effect of nitrogen fertilizer and the interaction for the number of leaves trait, while there was no significant effect of amino acids on this trait.

The results of Table (2) indicate significant differences for nitrogen fertilizer levels in the number of leaves trait. Level N2 gave the highest average of 31.17 leaves plant^{-1}, with no significant difference from level N1 with an average of 30.00 leaves plant^{-1}, and with a significant difference from level N0 which recorded the lowest average of 25.50 leaves plant^{-1}. The reason may be attributed to the increase in plant height (Table 1), which led to an increase in the number of leaves for this level.

As for the interaction, the combination (N2×S2) gave the highest average of 32.33 leaves plant^{-1}, and the lowest average was in the combination (N0×S1) reaching 24.33 leaves plant^{-1}.

Table (2): Effect of nitrogen fertilizer and amino acid spraying and their interaction on the number of leaves of sunflower (leaf plant^{-1})

Nitrogen Fertilizer	Amino Acids (S1)	Amino Acids (S2)	Mean Nitrogen Fertilizer
N0	24.33	26.67	25.50
N1	29.33	30.67	30.00
N2	30.00	32.33	31.17
Mean Amino Acids	27.89	29.89	
L.S.D (0.05)	N: 3.235	S: N.S	S×N: 4.574

3.3 Leaf Area (cm²) The statistical analysis results in Table (3) show a significant effect of nitrogen fertilizer on the leaf area trait, while there was no significant effect of amino acids and the interaction on this trait.

The results of Table (3) clearly show significant differences for nitrogen fertilizer levels. Level N2 recorded the highest average of 476 cm², with a non-significant difference from level N1 which averaged 441 cm², and significantly from level N0 which gave the lowest average of 336 cm². The reason for the superiority may be attributed to the increase in the number of leaves (Table 3 sic/Table 2 context) for this level.

Table (3): Effect of nitrogen fertilizer and amino acid spraying and their interaction on leaf area of sunflower (cm²)

Nitrogen Fertilizer	Amino Acids (S1)	Amino Acids (S2)	Mean Nitrogen Fertilizer
N0	328	345	336
N1	425	458	441

Nitrogen Fertilizer	Amino Acids (S1)	Amino Acids (S2)	Mean Nitrogen Fertilizer
N2	467	484	476
Mean Amino Acids	407	429	
L.S.D (0.05)	N: 90.5	S: N.S	S×N: N.S

3.4 Stem Diameter (mm) The statistical analysis results in Table (4) show a significant effect of nitrogen fertilizer and the interaction for the stem diameter trait, while there was no significant effect of amino acids on this trait.

It is noted from the results of Table (4) that there are significant differences for nitrogen fertilizer levels in the stem diameter trait. Level N2 gave the highest average of 27 mm, with no significant difference from level N1 with an average of 26.17 mm, and with a significant difference from level N0 which recorded the lowest average of 22.33 mm.

As for the interaction, the interaction treatment (N2×S2) recorded the highest average of 28.67 mm, and the lowest average was in the interaction treatment (N0×S1) reaching 21.00 mm.

Table (4): Effect of nitrogen fertilizer and amino acid spraying and their interaction on stem diameter of sunflower (mm)

Nitrogen Fertilizer	Amino Acids (S1)	Amino Acids (S2)	Mean Nitrogen Fertilizer
N0	21.00	23.67	22.33
N1	26.00	26.33	26.17
N2	27.00	28.67	27.83
Mean Amino Acids	24.67	26.22	
L.S.D (0.05)	N: 1.721	S: N.S	S×N: 2.433

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