ISSN NO: 2771-8840
Date of Publication: 06-01-2023

# Growth response, yield, and quality of bread wheat, *Triticum aestivum* L. For spraying with ascorbic acid and tocopherol

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**Abstract:** A field experiment was carried out at the Agricultural Research and Experiment Station affiliated with the College of Agriculture - University of Basra during the winter of 2021-2022. To study the response of growth and yield of bread wheat to spraying with ascorbic acid and tocopherol. The study included spraying four concentrations of ascorbic acid 0.150. 300. 450 mg $l^{-1}$ was given the codes A0, A1, A2, A3, and four concentrations of tocopherol acid were sprayed, which are 0. 100. 200. 300 mg $l^{-1}$ has been given the symbols T0, T1, T2, T3. The experiment was applied according to a randomized complete block design (R.C.B.D) using a factorial experiment method with three replications, where wheat seeds (Bohooth-22) were sown on 15.11.2021 at a seeding rate of 140 kg $ha^{-1}$. The harvest took place on 15.04.2022. The results of the statistical analysis showed the significant superiority of spray concentrations with ascorbic acid at a concentration of 300 mg $l^{-1}$ in terms of yield and quality, as it recorded the highest average for total chlorophyll, percentage of protein in grains, percentage of wet gluten and vitamin C, which amounted to 262.4 mg $m^2$, 13.79, 34.41%, and 111.6%. As for the biological yield, it recorded the highest average when concentrated at 450 mg $l^{-1}$, amounting to 13.16 Meg ha-$^{1}$. As the results showed that spraying with tocopherol acid at a concentration of 200 mg $l^{-1}$ led to a significant increase in the average percentage of protein in grains and the proportion of wet gluten, which amounted to 13.29% or 34.50%, while the concentration was 100 mg $l^{-1}$, had the highest mean of vitamin C reaching 107.5%. The effective interaction between ascorbic acid and tocopherol significantly affected some growth, yield, and quality traits as it was given at a concentration of 450 mg $l^{-1}$ of ascorbic with a concentration of mg $l^{-1}$ of tocopherol had the highest mean of vitamin C reaching 118.5 mg $l^{-1}$.

## Introduction

Wheat crop (*Triticum aestivum* L.) belongs to the Poaceae family. It is one of the important grain crops and is considered one of the most important crops at the global level, as it ranks first in the ranks of food crops, followed by yellow corn and rice. It occupies more than half of the cultivated lands, and more than two-thirds of the population depends on it for living in the world; in Iraq, the wheat crop is one of the most important winter crops, as its cultivation is widespread in the northern, central, and southern regions. It is considered the main food for most of the population of Iraq, as it is a major source of carbohydrates because it contains a high percentage of starch. The crop also contains a good percentage of protein, cellulose, and fat. It also contains some mineral elements (Qasim et al., 2019).

Despite the increased demand for the wheat crop due to the increase in the population, and wheat is used in many foods and pastry industries, local production began to shrink and decline due to various environmental stresses such as water stress, salt stress, and oxidative stress, although Iraq is one of the original countries. Due to the emergence of wheat and the availability of factors for the success of cultivation of this crop, productivity is still low compared to global productivity, reaching 3.48 Meg $ha^{-1}$ (USDA, 2020), while in Iraq, it amounted to 2.74 Meg $ha^{-1}$ (Central Organization for Statistics and Technology Information 2019).

Ascorbic acid is one of the antioxidants that reduce environmental stress and increase plant tolerance to salinity, drought, and cold, which effectively affects the functional and structural fields in the plant (Helal et al., 2005) and protects the plant from photo-oxidation and its participation in the construction of ethylene, gibberellins, and anthocyanins. Moreover, because of the role that ascorbic acid can play in increasing the efficiency of the photosynthesis process and reducing respiration, its effective role in protecting chloroplasts, and its effective role in resisting free radicals ROS, especially H2O2, which are produced during the process of carbohydrate metabolism, Cell structure and its ability to expand and delay the onset of aging (Barth Conklin, 2006). The use of acid has increased spraying on the vegetative system of plants because it is an antioxidant that encourages the vegetative and fruitful growth of different plants, in addition

ISSN NO: 2771-8840
Date of Publication: 06-01-2023

to its role in reducing various stresses and stimulating respiration and cell division processes, from the harmful effects of drought by improving the plant content of carbohydrates, proteins, chlorophyll pigment, soluble sugars, carbohydrates, nitrogen elements, phosphorus and potassium (Hussein and Khursheed, 2014). Research also indicates the role of ascorbic in improving quality characteristics (Al-Rubaie, 2019).

Tocopherol is an important antioxidant that protects plants from environmental stresses, especially photo-oxidation, drought, low-temperature damage, and heavy elements. It also plays a major role in breaking the dormancy phase and seed germination (Celia, 2011), as tocopherol plays an important role in transmitting signals between cells by regulating the amounts of jasmonic acid in the leaves by modifying lipid peroxidation and gene expression, which affects plant development and its response to stress, control of the degree of lipid oxidation in chloroplasts, and determination of the accumulation of lipid hydroperoxides. Tocopherol also has an important role in protein synthesis by regulating gene transcription, mRNA stability, and protein translation. It is also believed that tocopherol increases the activity of enzymes, including those responsible for signal transduction, by affecting membrane proteins (Fryer, 1992).

Due to the lack of studies on this topic in local conditions, this study was conducted, which included the response of growth, yield, and quality of bread wheat to spraying with ascorbic acid and tocopherol due to the lack of local production of wheat per unit area compared to global productivity and finding solutions to reduce the salt and water stress that the wheat crop is exposed to with the aim of:

1- Increasing wheat crop productivity and their tolerance to salt stress.

2 - Improving the quality and productivity of the wheat crop.

## Materials and Methods

A field experiment was carried out at the Agricultural Research and Experiment Station affiliated with the College of Agriculture - University of Basra, which is 30 km north of the governorate, during the winter season 2021-2022, in loamy soil to study the response of growth, yield and quality of bread wheat to spraying with ascorbic acid and tocopherol. The complete random block design was followed by a factorial experiment method with three replications. The area of the experimental unit was $4m^2$ with dimensions (2×2m), and it contained ten lines, the distance between one line and another was 20 cm inside one board. Then the cultivar (Bohooth-22) was planted on 15.11.2021. The soil was fertilized by adding nitrogen fertilizer at a rate of 120 kg N $ha^{-1}$ (Al-Abdullah, 2015) in the form of urea (46% nitrogen) and added in two batches, the first after the emergence of seedlings and the second in the elongation stage. Phosphate fertilizer, triple superphosphate (20)% at a rate of 120 P2O5 $ha^{-1}$ (Al-Halfi 2015) in one batch before planting, then the rest of the soil and crop service operations were carried out according to scientific recommendations. The data were analyzed according to the analysis of variance using GenStat software; then, the mean was compared using the least significant difference of 0.05.

## Results and discussion

### 1- Total chlorophyll of flag leaf (mg $m^2$)

The average carbon representation of the leaf is associated with the amount of light rays, and this trait is associated with yield inside and outside the leaf, as well as the chlorophyll content of the leaf. The results shown in Table (1) showed significant differences between the concentrations of ascorbic acid and tocopherol acid and the interaction between them in the total chlorophyll content of flag leaf of wheat crop.

The results of Table (1) showed that there was a significant effect of the concentration of ascorbic acid 300 mg $l^{-1}$ (A2), as the highest mean for this characteristic was 4.262 mg $m^2$, compared with the comparison treatment 0 mg $l^{-1}$ (A0), which gave the lowest value of 167.6 mg $m^2$. The reason may be due to the increase in the leaf area and activation of the carbon metabolism process. Also, spraying with ascorbic acid leads to an increase in the chlorophyll content of leaves, and these results are consistent with the findings by Khursheed and Hussein (2014) in their studies on wheat plants and Aati (2016) in their studies on date palm trees.

It is noted from Table (1) that the concentration of tocopherol acid 300 mg $l^{-1}$ (T3) recorded the highest average for this characteristic, amounting to 238.2 mg $m^2$, and superior to concentration 0 mg $l^{-1}$ (T0) with an average of 172.9 mg $m^2$. These results agreed with what was reached by (Rudy and Mohamed, 2018) in their study on bean plants. As for the interaction effect, the combination A2T2 recorded the highest value for

ISSN NO: 2771-8840
Date of Publication: 06-01-2023

this characteristic, amounting to 302.2 mg $m^2$, while the comparison treatment for interaction T1A0 recorded the lowest value amounting to 116.4 mg $m^2$.

Table (1) Effect of concentrations of ascorbic acid, tocopherol, and their interaction on total chlorophyll content of flag leaf (mg $m^2$)

| Tocopherol acid concentration (ppm) | Ascorbic acid concentration (ppm) | | | | Average tocopherol |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | |
| T0 | 142.2 | 159.7 | 219.3 | 170.4 | 172.9 |
| T1 | 116.4 | 196.2 | 236.9 | 227.2 | 194.2 |
| T2 | 190.1 | 199.1 | 302.2 | 254.1 | 236.4 |
| T3 | 221.6 | 220.1 | 291.0 | 220.2 | 238.2 |
| Average ascorbic | 167.6 | 193.7 | 262.4 | 218.0 | |
| 0.05<L.S.D | Ascorbic 15.92 | | Tocopherol 15.92 | | Interaction 31.83 |

**2- Biological yield (Meg $ha^{-1}$)**

The biological yield is defined as the amount of dry matter produced by the plant during the growing season resulting from the difference between the processes of photosynthesis and respiration. Table (2) results indicate the significant effect of ascorbic acid and tocopherol concentrations and their interaction on the biological yield of wheat crops.

It was noted from the results of Table ((2) that spraying with concentration A3 recorded the highest biological yield of 13.16 Meg $ha^{-1}$, compared with the control treatment A0, which recorded the lowest yield of 10.83 Meg $ha^{-1}$. The individual yield and then the increase in the total yield. These results agreed with Al-Halfi and Zaboun (2016) in their study on wheat and Allaq and Al-sabag (2019) on the Mung bean plant. The results of Table (2) showed that there was a significant effect of spraying with tocopherol acid, as the concentration T3 recorded the highest average of 12.75 Meg $ha^{-1}$ compared with the comparison treatment that gave the lowest value of 11.67 Meg $ha^{-1}$ that tocopherol supports photosynthesis, protein building and processes Biometabolism, which led to improving plant growth and increasing the components of the biological yield. The two treatments, T1 and T2, did not differ significantly.

As for the effect of the interaction between the two treatments, it was significant in the biological yield, as the treatment A3 T0 recorded the highest biological yield, amounted to 14.33 Meg $ha^{-1}$, and the lowest value was recorded for the factorial treatment T0 A0 which amounted to 9.00 Meg $ha^{-1}$.

Table (2) Effect of concentrations of ascorbic acid, tocopherol, and their interaction on Biological yield (Meg $ha^{-1}$)

| Tocopherol acid concentration (ppm) | Ascorbic acid concentration (ppm) | | | | Average tocopherol |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | |
| T0 | 9.00 | 11.67 | 11.67 | 14.33 | 11.67 |
| T1 | 10.33 | 11.67 | 12.67 | 12.00 | 11.67 |
| T2 | 12.33 | 12.67 | 12.67 | 13.00 | 12.67 |
| T3 | 11.67 | 13.00 | 13.00 | 13.33 | 12.75 |
| Average ascorbic | 10.83 | 12.25 | 12.50 | 13.16 | |
| 0.05<L.S.D | Ascorbic 1.087 | | Tocopherol 1.087 | | Interaction 2.173 |

**3- The percentage of protein in grains (%)**

Protein is one of the basic foodstuffs and varies according to varieties and environmental conditions. Table (3) showed a significant effect of the concentrations of ascorbic acid and tocopherol and their interaction on the percentage of protein in grains.

ISSN NO: 2771-8840
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Table (3) shows that ascorbic concentrations had a significant effect on the protein yield, as the concentration A2 recorded the highest average in protein character in grains, amounting to 13.79% without a significant difference from the concentration A1. The comparison treatment A0 recorded the lowest average, which amounted to 10.95%. The reason may be due to the role of ascorbic acid in increasing the concentration of nutrients in the leaves and then their transmission and aggregation in the grains. The plant's leaf area is reflected positively in increasing the percentage of protein in grains, and these results agreed with what was obtained by Abdul-Qados, (2014) in his study on the soybean plant and Tamimi (2017) in his study on the wheat plant.

It is noted from Table (3) that the concentration T2 exceeded the other concentrations, as it gave the highest protein percentage of 13.29%, and the concentration T0 recorded the lowest value of 11.54% from damage. These results agreed with Cha et al. (2015) and Faisal (2019) in their study on date palms. The results of Table 3 showed the significant effect of the interaction between the two study factors, as the interaction treatment A2 T2 was significantly superior to the rest of the interaction treatments and gave the highest average protein percentage of 14.12%, while the lowest percentage of protein was obtained in the two comparison treatments T0A0 for the two study factors of 9.85%.

Table (3) Effect of concentrations of ascorbic acid, tocopherol, and their interaction on the percentage of protein in grains (%)

| **Tocopherol acid concentration (ppm)** | **Ascorbic acid concentration (ppm)** | | | | **Average tocopherol** |
|---|---|---|---|---|---|
| | **A0** | **A1** | **A2** | **A3** | |
| **T0** | **9.85** | **11.04** | **13.36** | **11.90** | **11.54** |
| **T1** | **11.36** | **13.54** | **14.08** | **12.84** | **12.95** |
| **T2** | **11.27** | **13.87** | **14.12** | **13.92** | **13.29** |
| **T3** | **11.32** | **13.26** | **13.62** | **13.04** | **12.81** |
| **Average ascorbic** | **10.95** | **12.93** | **13.79** | **12.92** | |
| **0.05<L.S.D** | **Ascorbic 0.208** | | **Tocopherol 0.208** | | **Interaction 0.416** |

**4- Percentage of wet gluten in grains (%)**

Table (4) shows a significant effect of the concentrations of ascorbic acid and tocopherol acid and the interaction between them on the percentage of wet gluten in grains. Table (4) shows that spraying plants with concentration A2 recorded the highest percentage of wet gluten, amounting to 34.41%, compared with the control treatment with concentration A0, which recorded the lowest value of 29.09%. The reason may be due to the increase in the proportion of protein and the role of ascorbic acid in increasing the concentration of nutrients in the leaves and then their transmission and aggregation in the grains, and these results agreed with Al-Samarrai and Al-Alawi (2016) in their study on the maize plant.

It is also noted from Table (4) that the concentration T2 recorded the highest average in this characteristic, amounting to 34.50%, compared to the control treatment T0, which recorded the lowest average, amounting to 28.88%. One of the enzymatic antioxidants contributes to increasing the cell membrane's stability, thus affecting the balance of absorption of important nutrients and thus increasing the characteristics of the yield, including gluten. The results agreed with Al-Hamdani et al. (2019) in their study on the wheat plant.

The table indicates that there are differences between the interactions between the concentrations of ascorbic acid and tocopherol acid, where the interaction treatment A2 T2 achieved the highest percentage of wet gluten for cereals amounting to 37.48%, while the interaction between the two comparison treatments A0 T0 recorded the lowest percentage of wet gluten amounting to 26.57%

Table (4) Effect of concentrations of ascorbic acid, tocopherol, and their interaction on a percentage of wet gluten in grains (%)

| **Tocopherol acid concentration (ppm)** | **Ascorbic acid concentration (ppm)** | | | | **Average tocopherol** |
|---|---|---|---|---|---|
| | **A0** | **A1** | **A2** | **A3** | |

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| | | | | | |
|---|---|---|---|---|---|
| **T0** | **26.57** | **28.56** | **32.46** | **27.95** | **28.88** |
| **T1** | **30.69** | **35.37** | **31.67** | **31.73** | **32.36** |
| **T2** | **30.29** | **36.67** | **37.48** | **33.57** | **34.50** |
| **T3** | **28.84** | **33.38** | **36.04** | **32.08** | **32.58** |
| **Average ascorbic** | **29.09** | **33.49** | **34.41** | **31.33** | |
| **0.05<L.S.D** | **Ascorbic 0.033** | | **Tocopherol 0.033** | | **Interaction 0.066** |

**5- Determination of vitamin C (ascorbic acid) in leaves (%)**

Measurement of vitamin C is important because it is a reducing agent for reactive oxygen species such as hydrogen peroxide (H2O2), which is the substance of the reaction of the antioxidant ascorbate peroxidase, which is important in stress resistance in plants. The results of Table (5) showed that there are significant differences between the concentrations of ascorbic acid and tocopherol acid and the interaction between them in the vitamin C characteristic in the leaves of wheat crops.

Table (5) showed that spraying with ascorbic acid at a concentration of A2 recorded the highest average of vitamin C, amounting to 111.6%, compared with the comparison treatment with a concentration of A0, which recorded the lowest value of 88.9%. These results are because ascorbic acid reduces free radicals and thus reduces the damage caused by oxidative stress. It also plays a role in protecting the living components of the cell from inappropriate environmental stresses. These results agreed with Cha et al. (2015) in their study on wheatو and Faisal (2019) in his study on date palm trees. It is noted from Table (5) that the concentration of tocopherol acid T1 recorded the highest average for this characteristic, amounting to 107.5%, compared with the control treatment T0, which recorded the lowest value of 94.1%.

The results showed a significant interaction between ascorbic acid and tocopherol acid concentrations. The treatment factor for interaction, T2A3, recorded the highest mean for this characteristic, amounting to 118.5%, which did not differ significantly from the factorial treatment T1A3, which gave the same percentage in the determination of vitamin C in the leaves of the wheat plant, while the treatment recorded the interaction coefficient T0A0, the lowest values for this characteristic amounted to 72.0%. These results agreed with what Cha et al. (2015) stated.

Table (5) Effect of concentrations of ascorbic acid, tocopherol, and their interaction on a percentage of vitamin C (%)

| **Tocopherol acid concentration (ppm)** | **Ascorbic acid concentration (ppm)** | | | | **Average tocopherol** |
|---|---|---|---|---|---|
| | **A0** | **A1** | **A2** | **A3** | |
| **T0** | **72.0** | **99.0** | **111.0** | **94.5** | **94.1** |
| **T1** | **94.5** | **99.0** | **118.0** | **118.5** | **107.5** |
| **T2** | **94.5** | **94.5** | **112.5** | **118.5** | **105.0** |
| **T3** | **94.5** | **103.5** | **105.0** | **108.0** | **102.8** |
| **Average ascorbic** | **88.9** | **99.0** | **111.6** | **109.8** | |
| **0.05<L.S.D** | **Ascorbic 9.48** | | **Tocopherol 9.48** | | **Interaction 18.96** |

**References**

1. Abdul Qados, A.M. S. 2014. "Effect of Ascorbic Acid antioxidant on Soybean (*Glycine max* L.) Plants grown under water stress conditions." International Journal of Advanced Research in Biological Sciences, 1 (6): 189-205.
2. Al-Abdullah, S. A. M. 2015. The effect of nitrogen addition on N, P, and K uptake and their distribution in plant parts and the growth and yield of three cultivars of wheat, *Triticum aestivum* L. Ph.D. thesis. College of Agriculture University of Basra.

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Date of Publication: 06-01-2023

3. Al-Halfi, A. H., and Zboun, N. H. 2016. The response of bread wheat yield and its components to boron and vitamin C spraying. Iraqi Journal of Agricultural Sciences, 47 (5): 1171-1180.
4. Al-Qaisi, W. A., and Al-Arkwazi, A. L. A. 2017. Effect of foliar spraying with hydrogen peroxide and vitamin C on two barley cultivars' enzymatic and non-enzymatic antioxidants. Journal of the University College of Science, 9 (1): 28-39.
5. Al-Rubaie, S. H. A. 2019. Response of two oat cultivars to spraying of ascorbic acid, salicylic acid, and potassium silicate. Ph.D. dissertation. College of Agriculture University of Basra.
6. Al-Sabbagh, T. M. B., and Makiya, K. A. 2019. Effect of soaking seeds with cobalt and ascorbic acid on mash yield, components, and quality under water stress conditions. Iraqi Journal of Soil Sciences, 19 (1): 159-168.
7. Al-Samarrai, I. K., and Hassan, H. M. A. 2016. Effect of foliar spraying with ascorbic and salicylic acid on the non-enzymatic antioxidant activity of C3 and C4 plants under sodium chloride stress. Diyala Journal of Iraqi Agricultural Sciences, 44 (6): 655-669.
8. Barth, C.; De Tullio, M. and Conklin P. L. 2006. The role of ascorbic acid in controlling flowering time and the onset of senescence. Journal of Experimental Botany, 57(8): 1657-1665.
9. Cela, J., Chang, C. and Mannes. 2011. Accumulation of Y- Rather than α- Tocopherol Alters Ethylene Signaling Gene Expression in the vte4 Mutant of Arabidopsis thaliana.Plant and Cell Physiology.,52:1389-1400
10. Central Agency for Statistics and Information Technology. 2019. Agricultural Statistics Directorate. Ministry of Planning and Development Cooperation. The Republic of Iraq.
11. Cha J.Y, Kim, W.Y, Kang, S.B Kim .J. I, Baek, DJung, I. J, Ki Kim,H.J Nakajima, M Asami, T Sabir,J. S. Park, H.Clee, S.Y m, M.RLi,N Bohnert, H. J.; Bressan, R. A.; Pardo,J.M. and Yun,D.J. 2015. The novel thiol-reductase activity of Arabidopsis YUC6 confers drought tolerance independently of auxin biosynthesis. Nature Commun, 6 (8041):1-13.
12. Faisal, H. A., and Abdullah, A. A. 2020. A review of some antioxidants and their physiological roles in date palm trees. Basra Journal of Date Palm Research, Vol. 19 (2): 34-58.
13. Fryer, M. J .1992. The antioxidant effects of thylakoid Vitamin E (tocopherol). Plant, Cell is Environments 15(4), 381-392.
14. Helal, F.A:S.T. Farag and S.A.EI-Sayed. 2005. Studies of Growth, Yield and Its Components and Chemical Composition under Effect of Vitamin C, Vitamin B1, Boric Acid and Sulpher on pea (*Pisum sativum* L.) plants Journal of Sciences Mansoura University. Vol. 30(6): 3343-3354.
15. Hussein K Zhwan, Khursheed Mohammed Qader, 2014. Effect of foliar application of Ascorbic on Growth yield components and some chemical constituents of wheat, journal of plant growth 52(8)546-564.
16. Qasim, A., N.I. and Muhammad, J.M. 2019. Alpha-Tocopherol Fertigation Confers Growth Physic-Biochemical and Qualitative yield Enhancement in Field Grown Water Deficit Wheat (*Triticum aestivum* L.).Scientific reports.9 (1):1-15
17. Sadkhan, M. A. A. 2016. The effect of spraying with environmental anti-stress agents on some physiological, anatomical, and productive characteristics of date palm, Al-Halawi cultivar. Ph.D. thesis. Albasrah University. College of Agricultural Sciences.
18. Tamimi, A.J. H. 2017. Effect of irrigation periods and spraying of vitamin E and C on the growth and yield of cattle. Al Furat Journal of Agricultural Sciences, 9 (4): 1201-1219.
19. USDA. 2020. Word agriculture production, foreign agricultural service. Office global analysis, Washington, Circular Series WAP: 1-18.