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The influence of seed priming with ascorbic acid and foliar nutrition with boron in some productive traits of wheat plant (*Triticum aestivum* L.), Abu Ghraib cultivar.

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Abstract

An agricultural experiment was carried out in the city of Ramadi. The experiment relied on two factors: seed priming with ascorbic acid (vitamin C) at concentrations of (0, 10, 20, 40) mg.l^{-1}, indicated by (P_0, P_1, P_2, P_3), and boron foliar nutrition (B) at concentrations of (0, 3, 5) mg.l^{-1} which indicated by (B_0, B_1 and B_2) A formula for the boric acid H_3BO_3 (17.4% B) compound was used to spray plants. thus, number of experimental units is 36 experimental units. The experiment was carried out according to the randomized complete block design (RCBD) and with three replications. The results showed that all concentrations of seed priming with ascorbic acid and boron foliar nutrition and their interactions had a significant increase in all of the studied traits, and this effect was found to be dose-dependent. The highest significant differences were recorded at the concentration of 40 mg.l^{-1} of ascorbic acid and the concentration of 5 mg.l^{-1} of boron (14,000 spikes. Plant^{-1}; 4.530 gm. Plant^{-1}; 91.00 grains. Spike^{-1}; 50.29gm) the spike number, weight of the spike, number of grains in a spike, and weight of 1000 grains respectively.

Keyword: seed priming, ascorbic acid, boron, wheat plant, foliar nutrition.

I. Introduction

Wheat, which is known as the king of cereal crops, is one of the most important crops grown for food. Products made from wheat grain make up a significant portion of one of the primary meals eaten anywhere in the world (Shah et al,2019) It follows rice and maize in terms of output, and because it is highly adaptable to a wide range of climates and types of soil, it can be grown in any region of the world. As a result, the need for it continues to rise to meet the increasing requirements of a growing population (Zafar et al, 2022). Seed priming is one of the most important and effective techniques used to help them germinate and emerge quickly. It also increases the ability of seeds to withstand difficult environmental conditions. This is because it showed a positive effect on germination and the emergence of seedlings (Ali and Obaid, 2023a). In addition, priming enhances the growth of seedlings in a variety of agricultural climate conditions, which boosts yield, decreases expenses and time spent on re-seeding (Abdel-Hafeez et al, 2019), and is safe for the environment (Singh et al, 2020) and makes it less sensitive to influences from the outside (Bilska et al, 2019). Ascorbic acid (vitamin C) is a water-soluble vitamin that is small in size (Mohammed et al, 2022) It is an antioxidant abundantly available in plants (Akram et al, 2017). and is a non-enzymatic metabolic defense mechanism in plant cells (Ali and Obaid, 2023b) that helps to reduce the damage that is caused by the effect of oxidative stress by eliminating the toxicity and the harmful effects of effective oxygen in the chloroplast and cytosol, which reduces the intensity of stress (El-Beltagi et al, 2022). It is found that ascorbic acid has a major role in organizing the complex series of biochemical defense plant responses to induce protein synthesis and production of numerous chemical defense compounds (Alsudays and Sayed, 2020). Ascorbic acid also plays multiple title roles in plant growth as well as the division and expansion of plant cell walls and other developmental processes (Davodi et al, 2022). Additionally, there was evidence that ascorbic acid had a beneficial influence on the growth of wheat (Hassan et al, 2021). It was found that the seedlings treated with different concentrations of ascorbic acid showed improvements in the physiological characteristics of tomato plants (germination percentages, seedlings height, biomass of seedlings, and germination speed) as compared with controls (Farhat et al, 2021). The effect of treating maize seeds with ascorbic acid was studied by submerging them in solutions containing 20 and 40 milligrams per liter ($mg.l^{-1}$) of ascorbic acid for 24 hours (Bhatia and Gupta, 2022). The results demonstrated an acceleration in the rate of seed germination, as well as an increase in the wet and dry weight of the shoot and the root system of the seeds that had been treated with ascorbic acid (Asghar et al, 2021). The application of ascorbic acid by seed priming, foliar nutrition, and root system assisted wheat seedlings by maintaining growth, Saving the water percentage, cell membrane stability, and modifying osmosis. (Zafar et al, 2022) This was accomplished through the accumulation of proline and the activation of antioxidant enzymes.

Boron is one of the essential micronutrients that play a main part in the formation of the cell wall, the conversion of sugars, the fixation of nitrogen, the transportation of carbohydrates, the increase in cell division, nutrition, and the percentage of oil in seeds, in addition to its role in increasing the consumption efficiency of water and its role in balancing water relations, preserving flowers, forming pollen grains. Boron also plays a role in affecting the germination process (Farhat et al, 2021). Foliar nutrition of micronutrients is very functional when the roots are powerless to process or absorb nutrients (Asghar et al, 2021; Bozorgi et al, 2011] One of the obstacles to adding micronutrients to the soil is soil pollution, which is a major problem, so plant leaves must be sprayed. Because foliar nutrition enhances and accelerates nutrient consumption by penetrating stomata or leaf cuticles or entering cells, nutrient penetration is better than soil treatments (Zafar et al, 2022). The application of micronutrients through foliar nutrition to wheat crops has been the subject of several studies, all of which have found significant positive impacts on plant growth and yield indicators (Hassan et al, 2021). Khan et al (2010) conducted a field experiment to study the effect of wheat response to the application of micronutrients (zinc, manganese, copper, and boron). They discovered a significant increase in the number of spikes, the weight of a thousand grains, straw yield, grain yield, biological yield, and harvest index for different phases of wheat growth. As a result, the purpose of this study was to investigate the impact that priming wheat seeds of the Abu Ghraib variety with various concentrations of ascorbic acid and foliar nutrition with boron had on certain productivity parameters of wheat plants.

II. Materials and methods

An agricultural experiment was carried out in the city of Ramadi. The experiment relied on two factors: seeds priming by ascorbic acid (vitamin C), at concentrations (0, 10, 20, 40) $mg.l^{-1}$, represented by (P_0, P_1, P_2, P_3), and boron foliar nutrition at three concentrations (0, 3, 5) $mg.l^{-1}$ B is denoted by (B_0, B_1, B_2)was added to the plant as boric acid (H_3BO_3) (17.4% B). Total experimental units, 36. The experiment was carried out according to the randomized complete block design (RCBD) with three replicates. The soil analyses included taking soil samples before planting at a depth of 0-30 cm, then they were air dried, ground, and sifted with a sieve with a diameter of 2 mm. The pipette method was used to estimate the size distribution of soil particles according to the day method mentioned in (Abdel-Hafeez et al, 2019). Mix the soil well and samples were taken to conduct some analyses of the physical and chemical properties of the soil as visible in the table1. The EC, PH, Soluble potassium, calcium carbonate, and organic matter were estimated as stated by the methods described in Alam et al (2020) and the amount of available nitrogen and phosphorous was determined according to (Mohammed et al, 2022). Analysis was carried out in the Anbar Agriculture Directorate.

Field practices

The soil of the field was prepared by conducting the plowing process twice perpendicularly by the inverter plow and smoothed and smoothed by the masher. The field was divided into slabs, consisting of

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(36) slabs, the dimensions of which are 2 m x 2 m, and the area is 4 m 2. Seventy-two cm between the boards, to prevent water leakage and the transfer of fertilizers, an earthen space of 50 cm was left between the transactions. Urea nitrogen fertilizer was added at a rate of 240 kg/ha at two: the first batch (46% N) was added at the planting. The second batch was added after 45 days of cultivation. Triple superphosphate fertilizer 46% (P_2O_5) was added at a rate of 100 kg/ha, and K_2O (50% K) was added at a rate of 80 kg/ha at one time during planting for both seasons (Hassan et al, 2021). Wheat seed was obtained from Anbar University, College of Agriculture. Wheat seeds were seeded in a line distance of 20 cm between one jar and another with a depth of 5 cm, at a rate of three seeds per jar. It was reduced to one plant after 10 days of germination. The germination rate was 98%. Aphids were controlled using the pesticide at 25 ml of DDVB 50 per 20 liters of water. plants sprayed with a second spray of the pesticide after 15 days of the first spray. The bushes were removed by hand hoeing.

Seed priming

Four concentrations of 0, 10, 20, and 40 mg. l^{-1} of an ascorbic acid were prepared. For 24 hours, the seeds were soaked at a rate of 300 seeds per concentration in nylon mesh bags and closed them tightly to avoid evaporation and changes in their concentrations. then the seeds were washed well with distilled water several times and left to dry in the shade until they returned to their original moisture. By recording their weight before and after soaking, the seeds were kept after activating them in thick, sealed plastic containers in the refrigerator at 4 °C until they were planted (Shaher, 2015).

Nutrition times

The wheat plant was Sprayed with the nutritional solution after forty-five days, sixty days and seventy-five days of planting throughout the agricultural season, until the vegetation got completely wet. A manual sprayer was used in the spraying process with a capacity of 20 liters and the detergent solution was added as 0.15 cm^3.l to increase the spraying solution efficiency by reducing water surface tension and to ensure that the leaves are completely wet including the control treatment (Bilska et al, 2019).

TABLE (1): Some soil's chemical and physical characteristics before planting

Unit	The result	adjectives
Electrical Conductivity (EC)	2.90	S/m
reaction of Soil	7.80	pH
Total nitrogen	0.017	%
Soluble Phosphorus	6.60	mg/kg soil
Soluble Potassium	0.18	cmol/kg soil
Organic matter	4.30	g/kg soil
Sand	11.20	%
Silt	54.70	%
Mud	34.10	%
texture of soil	Alluvial mud mixture	--
Soluble boron	0.34	mg/kg soil
Lime	15	%
Gypsum	0	%

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The productive characteristics of ten intermediate plants from each experimental unit were calculated. The productive characteristics are the spike number (spike. plant^{-1}), the spike weight in a plant (gm.plant^{-1}), and the number of grains in a spike (grain.spike^{-1}), 1000 grains weight (gm).

Statistical analysis

Data were analyzed using analysis of variance with Genstat software, and differences between treatment means were assessed using the least significant difference (LSD) test at a significance level of 0.05.

III. Results and discussion

Number of spikes (spikes.plant^{-1})

Data presented in Table 2. revealed the positive effect of seed priming with different concentrations of ascorbic acid and boron foliar nutrition concentrations on the spikes number of wheat plants compared to control. For the effect of ascorbic acid, data showed that seed priming with ascorbic acid significantly increased the number of spikes with increasing ascorbic acid concentrations of 9.778, 10.667, 11.222, and 11.667 spikes. plant^{-1} for concentrations 0, 10, 20, and 40 mg.l^{-1}, sequentially. On the other hand, the maximum number of spikes (9.167 spikes. plant^{-1}) was obtained at 5 mg.l^{-1} of boron, while the numbers of spikes were 9.167 and 10,500 spikes. plant^{-1} at concentrations of 0 and 3 mg.l^{-1} respectively. The treatment of 40 mg.l^{-1} of ascorbic acid and 5 mg.l^{-1} of boron achieved the highest number of spikes (14.000 spikes. Plant^{-1}) as compared to the control which was 8.333 spikes. Plant^{-1}**.**

Active Ascorbic is the most important antioxidant to protect plants from oxidative stress and is involved in regulating the ability of Photosynthesis (Abdel-Hafeez et al, 2019), and increasing the outputs of photosynthesis generated more sugars that are ready for use to promote flowering growth, accordingly, it increased the spikes number (Ali and Obaid,2023a).

The remarkable role of boron in stimulating many vital processes and its role in the flowering and contract

stage, as well as its important function in raising the fertility rate, which reverberates positively increases the spike number (Noaema et al,2020), these result agreed with Rawashdeh, and Sala (2013) .

TABLE (2): The influence of seed priming with ascorbic acid and foliar nutrition with boron on the spikes number (Spike.plant^{-1}) of wheat plant (*Triticum aestivum* L.) Abu Ghraib cultivar

Concentration of boron mg B. l^{-1}	Concentrations of Ascorbic acid.mg.l^{-1}				Mean
	0	10	20	40	
0	8.333	9.000	9.333	10.000	9.167
3	10.000	10.000	11.000	11.000	10.500
5	11.000	13.000	13.333	14.000	12.833
LSD 0.05	0.9729				0.4865
	9.778	10.667	11.222	11.667	
LSD 0.05	0.5617				

The spike weight in a plant (gm. plant^{-1})

Seed priming with different concentrations of ascorbic acid had a significant effect on the weight of the spike (table 3). The weights of spikes were 2.891, 3.094, 3.307, and 3.590 g. plant^{-1} for concentrations 0,

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10, 20, and 40 mg.l^{-1}, sequentially. The highest weight of the spikes (4.019 gm.plant^{-1}) was recorded at a boron concentration of 5 mg.l^{-1}, and the weight of the spike was 3.267 gm.plant^{-1}at 3 mg.l^{-1}, while the lowest weight of spike was 2.376 gm.plant^{-1} in control. The interaction between ascorbic acid and boron concentrations indicated that there is a significant effect on the weight of spikes, the highest weight was 4.530 gm. Plant^{-1} at 40 mg.l^{-1} of ascorbic acid and 5 mg.l^{-1} of boron compared with control treatment, which was 2.007 gm.plant^{-1}.

Application of ascorbic acid improves wheat growth and it showed an increase in biomass of plants may be attributed to an increase in cell division and expansion by stimulating seeds with ascorbic acid. Ascorbic acid application improved some percentage of the water content of wheat. (Gupta and Berkowitz,1987) due to its property as an antioxidant that prevented membrane damage or protecting the membrane from oxidative damage, and because of its properties as an antioxidant (Singh et al, 2020). The increase in the spike mass was due to increased number of grains per spike obtained by the boron foliar spray (ZOZ et al, 2016).

TABLE (3): The influence of seed priming with ascorbic acid and foliar nutrition with boron on the spike weight in a plant (gm. plant^{-1}) of wheat plant (*Triticum aestivum L.*) Abu Ghraib cultivar

Concentration of boron mg B. l^{-1}	Concentrations of Ascorbic acid. Mg.l^{-1}				Mean
	0	10	20	40	
0	2.007	2.249	2.565	2.682	2.376
3	2.976	3.154	3.380	3.559	3.267
5	3.689	3.878	3.978	4.530	4.019
LSD 0.05	0.1772				0.0886
	2.891	3.094	3.307	3.590	
LSD 0.05	0.1023				

3- The number of grains in a spike (grain. spike^{-1})

Seed priming in ascorbic acid and foliar nutrition with boron and their interaction resulted in distinct increases in the number of grains per spike (table 4). Seed primed in 40 mg.l^{-1} of ascorbic acid produced a higher number of grains per spike (71.78 grain.spike^{-1}), followed by seed soaked in 20 mg.l^{-1} and 10 mg.l^{-1} ascorbic acid (66.78 and 63.56 grain. spike^{-1}). A minimum number of grains (58.78 grain. spike^{-1}) was obtained by seed primed in water. In addition, the maximum number of grains (78.83 grain.spike^{-1}) was obtained by foliar nutrition with 5 mg.l^{-1} of boron, while the numbers of grains per spike were 53.33 and 63.50 grains. Spike^{-1} at boron concentrations of 53.33 and 63.50 grains. Spike^{-1} respectively. The highest number of grains was 91.00 grains. Spike^{-1} produced by seed primed in 40 mg.l^{-1} of ascorbic acid and 5 mg.l^{-1} of boron.

An increase in the number of grain per spike after seed priming in ascorbic acid is attributed to its significant role in the growth and development of plants, being a catalyst and accompanying factor for several enzymes and in the bio-representation of several hormones, including gibberellins, which leads to the elongation of cells and thus increased the outputs of the photosynthesis process, which increased fertilization rates and decreased seed abortion, which positively affected the number of grains in the spike(Ali and Obaid,2023a). These results agreed with Rehman et al (2011) , Hussein (2016), and (Rhaman et al, 2021)

The foliar nutrition with boron caused an increase in the number of seeds due to the role of boron in stimulating the vital and reproductive processes in the flowering stage, as well as improving the stability of pollen grains, causing an increase in nutrition and an increase in the number of seeds accordingly, These results agreed with Vyakaranahal et al (2001).

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TABLE (4): The influence of seed priming with ascorbic acid and foliar nutrition with boron on the number of grains in a spike (grain.Spike^{-1}) of wheat plant (*Triticum aestivum* L.) Abu Ghraib cultivar

Concentration of boron mg B. l^{-1}	Concentrations of Ascorbic acid.mg.l^{-1}				Mean
	0	10	20	40	
0	49.33	53.33	54.67	56.00	53.33
3	57.33	62.67	65.67	68.33	63.50
5	69.67	74.67	80.00	91.00	78.83
LSD 0.05	2.282				1.141
	58.78	63.56	66.78	71.78	
LSD 0.05	1.317				

4- The weight of 1000 grains (gm)

The results in Table 5 indicate that there are significant variances among the various treatments and concentrations. The maximum weight of 1000 grains equivalent to 40.53 gm by seed priming with 40 mg.l^{-1} of ascorbic acid followed by the weight of 1000 grains (36.86 gm and 34.96 gm) at concentrations of 20 mg.l^{-1} and 10 mg.l^{-1} respectively and the lowest weight was priming with water equal to 32.98 gm. As well as the data indicate a positive effect of boron foliar nutrition with significant differences among tested concentrations on the weight of 1000 grains equivalent to 42.84 gm, 36.32 g, and 29.84 gm at concentrations of 5, 3, and 0 mg.l^{-1}, respectively. The maximum weight of 1000 grains equal to 50.29 gm resulted from the interaction treatment of 40 mg.l^{-1} of ascorbic acid and 5 mg.l^{-1} of boron as compared to the control, which was 24.74 gm . These results agreed with Rehman and Wei (2022) in their study on Wheat. The increase in weight 1000 grains occurred due to the accumulation of photosynthesis products, which led to gathering dry matter in the grain yield and boosting the weight of grains (Al-Dulemi and Diaa, 2017).

The effect of boron was significant on the weight of 1000 seeds. This is attributed to the role of boron in facilitating the movement of carbohydrates from source to downstream, thus increasing their fullness, through the union of borates with the hydroxyl radical in sugars to form a complex of boric acid esters, which movement is easier and faster to pass through cellular membranes than the polarized sugar molecules (Nama, 2009) and this agrees with Akuaku et al (2020) who found an increase in the weight of 1000 seeds when boron was sprayed foliar on sunflower plants. This is due to the boron's role in transferring of sugars, proteins, and biosynthetic materials from the leaves to the seeds, thus increasing the weight of 1000 seeds and the yield.

TABLE (5): The influence of seed priming with ascorbic acid and foliar nutrition with boron on the weight of 1000 grains (gm) of wheat plant (*Triticum aestivum* L.) Abu Ghraib cultivar

Concentration of boron mg B. l^{-1}	Concentrations of Ascorbic acid.mg.l^{-1}				Mean
	0	10	20	40	
0	24.74	28.95	32.14	33.53	29.84
3	35.06	35.83	36.62	37.78	36.32

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5	39.15	40.11	41.82	50.29	42.84
LSD 0.05	3.338				1.669
	32.98	34.96	36.86	40.53	
LSD 0.05	1.927				

IV. Conclusion

In the present study, the effect of wheat seeds (Abu Ghraib variety) priming at different concentrations of ascorbic acid and boron foliar nutrition on certain characteristics of wheat plants in a field located in the city of Ramadi, Al-Jazeera region, Iraq was investigated. The results indicated that all ascorbic acid concentrations, boron foliar fertilization, and their interactions increased significantly with concentrations increasing in all studied characteristics. The highest significant differences were recorded at the concentrations of 40 mg.l-1 of ascorbic acid and 5 mg.l-1 of boron for 1-The number of spikes, 2-The spike weight in a plant, The number of grains in a spike, and weight of 1000 grains respectively.

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