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Role of arginine in improving the traits of several wheat varieties

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Abstract

The problem of this study is the low productivity of the wheat crop in Iraq. To encounter this problem, modern, environmentally friendly technologies must be used, including amino acids such as arginine, which help in improving growth and yield and thus increase the productivity of this crop quantitatively and qualitatively per unit area. An experiment was conducted in a field in the Saqlawiyah-Anbar region in 2021 during the winter season, to look into how different arginine concentrations affect specific growth traits and yield of different wheat varieties. Randomized complete block design was utilized in the split plot arrangement with three replications, main plots had two concentrations of arginine (100,200 mg l^{-1}), while subplots contained three varieties of wheat (Abu Gharib, Sham 6, and Ebaa 99). The study's findings demonstrated the superiority of the variety Ebaa 99 in most growth traits and yield, including the flag leaf area, tillers number and spike grains, the weight of 1000, and grain yield. The dosage of 200 mg L^{-1} produced the highest averages for the plant height traits (87.24 cm), tillers number (811.7 tillers. m^{-2}), and grain yield (5.23 mcg. ha-1). Plant spraying treatment with arginine at a dosage of 100 mg L^{-1} was superior to the number of grains per spike and achieved an average (of 44.58 grains). Regarding the interactions between the study variables, spray plants of the variety Ebaa 99 with arginine at a dosage of (100 mg. l^{-1}). This led to maximum grain yield during the study season. The results indicated that the APA 99 variety was significantly superior in terms of vegetative growth, yield, and its components. Accordingly, these characteristics together contributed to an increase in the total yield. APA 99 responded significantly to higher concentrations of arginine compared to other cultivars.

Keywords

arginine; grain yield; number of grains; vegetative growth; wheat varieties

Introduction

Wheat is among the most important cereal crops since it is planted extensively and over a wide region due to its critical significance in ensuring food security. As a result, it is among the most significant and extensively grown cereal crops worldwide. According to (1), Iraq is expected to produce 6238 tons of wheat in total in 2020, with an area cultivated for the winter season being 8574 dunam However, this crop's productivity is still low due to several barriers, some of which are technical due to a lack of knowledge and expertise in the use of contemporary technologies and a lack of interest in spraying nutrients that significantly improve physiological traits and their favourable impacts. These barriers include environmental ones, such as high temperatures or a lack of water that is uncontrolled, and some of them

are environmental by understanding each variety's behaviour, performance, and responsiveness to various growth variables, one of the crucial techniques to achieving food security is the use and adoption of several kinds. Plant breeders and farmers are racing to develop more and more with time. Global populace growth is accelerating, necessitating increased food production in exchange for dwindling arable land (2,3,4). Numerous studies have demonstrated that spraying amino acids, particularly arginine, at crucial growth phases significantly improves growth traits due to its direct impact on the division and elongation of the plant's meristem area (5,6). Along with its role in the production of enzymes, energy storage, and an increase in carbon metabolism, which is reflected in the physiological processes occurring confidential the plant and enhances the production of cells and carbohydrates, the increase in yield is also a result of these factors. A repository of organic nitrogen that plants need in huge amounts to produce amino acids and proteins, arginine is also a protein amino acid that has a percentage of nitrogen and carbon (7). This study aimed to verify the optimal arginine concentration and its effect on the growing features and production of various bread wheat varieties.

Materials and Methods

In the Al-Saqlawiyah district of the Anbar governorate, a field study aimed in the winter season of 2021 to examine the effects of different arginine concentrations on growth features then the yield of numerous wheat varieties. The study contained two factors: the first was treatments that involved spraying arginine at two concentrations (100, 200 mg l^{-1}), added to a control treatment that involved spraying distilled water over the main plots split plots and three replications in that sequence, where the concentrations of arginine were sprayed on the plant in the morning until it was completely saturated, after being diluted with distilled water at a dosage of 100, 200 mg $l^{-1.}$ Three different wheat varieties (Abu Ghraib, Sham 6, and Ebaa 99) that were planted in subplots were the second factor.

The experimental land was tilled, leveled, and divided into 27 experimental parts each repeater of 9 experimental parts. Each experimental part had 5 lines with a total distance of 1*2= 2 m^2 and a 20 cm arrangement among them. Wheat seeds were planted in swarm lines, and a pre-plant application of triple super phosphate fertilizer (46 percent P_2O) at a rate of 100 kg ha^{-1}, blended by the soil in a single batch, was applied to all experimental units. For all treatments, nitrogen fertilizer was added as urea at an amount of (200 kg ha^{-1} N) in two batches, first at establishing and the second subsequently at the boot phase (8). Following what was advised and where needed further crop service operations were also carried out.

Data collection

1. Plant height: The measurement that was taken of the distance between the base of the principal stem spike and the base of the plant was used to calculate the average height of ten plants.
2. Area of the flag leaf cm^2: According to the formula below, the rate of ten flag leaves on the chief tillers was determined: flag leaf area = flag leaf length x width at the center x .0.95
3. Tillers Number (m^2): At the 100 % flowering stage, the total number of tillers was counted using an area of each experimental unit of 0.20 m^2, which was then converted to square meters.
4. Spike Number (spike.m^{-2}) was estimated using the area of each experimental unit, which was one square meter, once the crop had reached maturity.
5. Grains Number per spike (grain $spike^{-1}$): according to the rate grains number for ten spikes.
6. Weight of 1000 grains (gm) Weighing was done on each sample for every experimental unit. After a seed counter counted 1000 grains for that unit.
7. Grain yield, mcg ha^{-1}: was used the square meters per experimental unit that were randomly selected, and it was then converted to gm m^{-1} and Mg ha^{-1}.

The computer's GenStat application was used to statistically evaluate the data, and the least significant alteration (L.S.D.) under the five percent possibility threshold was used to compare the results. (9).

Results

Plant Height (cm)

Table (1) shows outcomes that nearby are noticeable alterations in the averages of the cultivated varieties' plant height traits, with the Sham 6 variety excelling during the growing season through the highest mean plant height (94.47 cm) and the Aba 99 variety recording the lowest characteristic average, which was reached at 77.71 cm. Regarding the amino acid arginine, when sprayed onto wheat plants at a dosage of 200 mg.l^{-1}, it significantly affected the plants. vegetative parts and it achieved a higher average in this feature of (87.24 cm) in comparison to the dosage of 100 mg l^{-1}, plant height was recorded as low as 84.94 cm. It did not significantly differ from the Comparative treatment, which achieved an average of (85.34). Arginine, an amino acid, is added at a dosage of 200 mg. L^{-1} sprayed on the Sham 6 variety plants noted the maximum plant height of 94.83 cm, indicating that the interaction among the factors studied also had a substantial impact on the averages of this feature. The variety Ebaa 99 was sprayed with 100 mg.L^{-1} concentration. The attribute with the lowest mean is arginine (75.00 cm) Table (1).

Area of the flag leaf cm^2

According to the results mentioned in Table 2, there are considerable alterations among the varieties produced for the feature flag leaf with Aba 99 producing the highest mean flag leaf area (43.73 cm^2) and Abu Ghraib recording the lowest mean (36.51 cm^2). The same table's data also demonstrate that spraying Ebaa 99 variety plants with arginine at a dosage of 200 mg L^{-1} generated the maximum

Table 1. Effect of varieties and arginine and the interaction on plant height (cm)

Arginine. mg. L $^{-1}$	Verities			Mean
	Ebaa 99	Sham 6	Abu	
0	76.90	94.37	84.77	85.34
100	75.00	94.20	85.63	84.94
200	81.23	94.83	85.67	87.24
L.S.D. 5%		1.65		1.52
Mean	77.71	94.47	85.36	
L.S.D. 5%		0.80		

area of the flag leaf (46.10 cm^2), whereas Abu Ghraib cultivar plants without spraying gave the lowest average of 33.17 cm^2. As for arginine levels, they had no discernible influence on this feature.

Table 2. Effect of varieties and arginine and the interaction on flag leaf area (cm^2)

Arginine mg. L^{-1}	Verities			Mean
	Ebaa 99	Sham 6	Abu Ghraib	
0	42.60	38.50	33.17	38.09
100	42.50	40.80	37.30	40.20
200	46.10	40.20	39.07	41.79
L.S.D 5%			0.095	N. S
Mean	43.73	39.83	36.51	
L.S.D 5%		0.055		

Number of tillers

The data in Table 3 data demonstrated that the research components and their interactions have a substantial impact on this feature. Of all the types, Aba 99 had the most tillers 840.4 tiller m^{-2}, while Sham 6 had the lowest average of 693.8 for this characteristic a similar table also showed a significant relationship between the concentration of amino acid arginine and the number of tillers. The comparative treatment produced the lowest rate tillers number (628.9 tillers m^{-2}) and the highest average in this trait (811.7 tillers m^{-2}) at a dosage of 200 mg L^{-1}. When the amino acid arginine was sprayed on the variety Ebaa 99 at a dosage of 200 mg L^{-1}, the number of tillers increased steadily until it reached 975.0 tillers m^{-2}, while Table 3 showed that the comparison plants of the variety Abu Ghraib presented the low rate for this attribute totaling to 584.7 tillers m^{-2}.

Table 3. Effect of varieties and arginine and the interaction on tillers Number

Arginine mg L^{-1}	Varieties			Mean
	Ebaa 99	Sham 6	Abu Ghraib	
0	691.3	610.7	584.7	628.9
100	855.0	695.0	811.7	787.2
200	975.0	775.0	685.0	811.7
L.S.D 5%		15.55		13.39
Mean	840.4	693.6	693.8	
L.S.D 5%		8.26		

Number of spikes

Table 4 demonstrates that the varieties under study and their interactions have a considerable impact on the number of spikes, whereas the concentration of arginine had no significant impact on spikes number m^{-2}. The Sham 6 variety reported the greatest average spike number of 395 m^{-2}, while the Abu Ghraib variety had the lowest average count of spikes at 304 m^{-2}. The outcomes of the identical table also demonstrated that spraying Sham 6 variety plants with arginine at a dosage of 200 mg L^{-1} was significantly greater than the other interventions because Sham 6 variety plants produced the highest mean of 403 spikes per m^2. In comparison to the Abu Ghraib variety, plants produced fewer spikes (288) per square meter

Table 4. Effect of varieties and arginine and the interaction on Spike Number

Arginine mg L^{-1}	Verities			Mean
	Ebaa 99	Sham 6	Abu Ghraib	
0	370	389	288	349
100	383	393	313	363
200	400	403	313	372
L.S.D 5%		10.00		N. S
Mean	384	395	304	
L.S.D 5%		3.33		

square.

Number of grains per spike

The results shown in Table 5 reveal that the grown varieties, arginine concentrations, and their interactions with the traits of how many grains are in each spike varied significantly from one another. By obtaining the highest average for this attribute, totaling 47.44 grains spike^{-1}, the variety Ebaa 99 excelled over the other varieties, however, the variety Sham 6 created the lowest average in this trait (39.27 grains spike^{-1}). The results of Table 5 also showed that the highest average grain number of spikes was recorded when arginine was sprayed on the vegetative part of the plant at a dosage of (100 mg L^{-1}) (44.58 grains spike^{-1}). It did not exhibit a notable deviation from the dosage (200 mg.L^{-1}), which found an average of 44,40 grains spike^{-1} at 37.87 grains spike^{-1}, the comparator treatment had a low average grains number per spike. Regarding the interaction, the findings of the Table are the same show that spraying arginine at a dosage of 200 mg L^{-1} on plants of the variety Abu Ghraib was superior because it resulted in the maximum average grains number per spike that was equal to 47.90 grains per spike^{-1}. As for the grains number per spike decreased among the comparison

Table 5. Effect of varieties and arginine and the interaction on the Number of grains per spike

Arginine mg L^{-1}	Verities			Mean
	Ebaa 99	Sham 6	Abu Ghraib	
0	42.13	36.30	35.17	37.87
100	55.10	41.30	37.33	44.58
200	45.10	40.20	47.90	44.40
L.S.D 5%		1.87		1.81
Mean	47.44	39.27	40.13	
L.S.D 5%		0.79		

plants of the same variety and produced the lowest average. It obtained 35.17 grains per spike for this trait.

1000 grains weight (gm)

The findings in Table 6 revealed that the varieties under study, and their interactions had a considerable impact on this feature, but that the concentrations of arginine had no significant impact on the 1000 grains weight. The variety Ebaa 99 exceeded giving the highest average weight of 1000 grains, which came to 52.54 gm, while Abu Ghraib provided the least favorable average for this feature, which came to 34.48 gm. Plants of the variety Ebaa 99 sprayed with arginine at a dosage of 100 mg L^{-1} had the highest rate of 1000 grains weight, at 57.50 g, according to the results in the same table. In contrast, control plants of the variation Abu Ghraib had a low average weight, at 32.17 g.

Table. 6. Effect of varieties and arginine and the interaction on 1000 grains Weight (gm)

Arginine mg L^{-1}	Verities			Mean
	Ebaa 99	Sham 6	Abu Ghraib	
0	46.73	41.83	32.17	40.24
100	57.50	43.20	32.97	44.56
200	53.40	40.80	38.30	44.17
L.S.D 5%		1.91		N. S
Mean	52.54	41.94	34.48	
L.S.D 5%		0.74		

Grain yield (mcg ha^{-1})

Table 7 presents, the significant differences between the varieties. Ebaa 99 produced the maximum rate grain yield of 5.70 mcg ha^{-1}, significantly more than any other variety. In comparison, Abu Ghraib produced the lowest average yield of a grain of 3.69 mcg ha^{-1}. When arginine was sprayed at 200 mg/l on the vegetative part of the plant, the grain yield was 5.23 mcg ha^{-1} compared to the control treatment, which had the lowest yield of 4.49 mcg ha^{-1}. Regarding the interaction of the study variables, the spraying treatment on plants of the variety Ebaa 99 showed the maximum mean for the trait of study, which was 6.13 mcg ha^{-1}, while the comparison treatment with Abu Ghraib variety plants and no spraying had the last rate for the characteristic 3.35 mcg ha^{-1} (Table 7).

Table 7. Effect of varieties and arginine and the interaction on Grain yield (mcg ha^{-1})

Arginine mg. L^{-1}	Verities			Mean
	Ebaa 99	Sham 6	Abu Ghraib	
0	5.20	4.91	3.35	4.49
100	6.13	5.41	3.50	5.01
200	5.78	5.69	4.23	5.23
L.S.D 5%			0.07	0.06
Mean	5.70	5.34	3.69	
L.S.D 5%		0.04		

Discussion

In plant height characteristics table (1), the superiority of the Sham 6 variety could be a result of the extent to which wheat varieties respond differently to environmental factors, especially temperature, and light, as well as the extent to which these varieties differ in plant height characteristics (10, 11, 12). As for arginine treatment, it may be due to its role in promoting cell division and elongation, which has a positive effect on the plant height. This result is consistent with the findings of (13) who discovered that amino acids sprayed on plants have a significant effect on plant height. The genetic differences among the varieties and their capacity to support vegetative development when environmental conditions differ may be the cause of the variation between the varieties in the characteristic of leaf area (Table 2).

The Number of tillers (Table 3), did not significantly distinguish it from the Abu Ghraib variety. Genetic differences between varieties may be the reason for superiority. In addition, the importance of amino acids in enhancing physiological processes may be the reason for the high rates of tiller intake, as this acid is necessary for the production of carbohydrates and proteins by enhancing the process of photosynthesis and creating vital enzymes (14, 15).

This superiority in the number of spikes (Table 4), may result from genetic variation that produces differences in growth traits, as the number of spikes generated for each variety was a reflection of this variation. This is in line with the results of other authors, indicating variation in the number of spikes in different wheat varieties (16). As for the number of grains per spike Table (5), the Ibaa 99 variety is superior in terms of leaf area and number of tillers (tables 2 and 3), the role it plays in developing the process of photosynthesis, producing nutrients, and improving the performance of plant parts may be the reason for this. The number of grains per spike increases, which certainly represents an increase in the quantity of grains per spike. Since many growth factors influence this feature (17), this result is consistent with those of (18), who observed a difference in grain number among several cultivars. The role of the amino acid arginine in enhancing the metabolism of carbon and the accumulation of nutritive along with their movement to the reproductive organs, which led to a rise in their number, is what caused the rise in the number of grains per spike when this acid was sprayed at a dosage of 100 & 200 mg L^{-1}, these findings support the observation made by (19) that spraying the amino acid on plants increases the number of grains. The superiority of the Ibaa 99 variety in the weight of 1000 grains table (6), may be attributed to the increase in the area of the flag leaf and the number of tillers per square meter (tables 2, 3), which in turn leads to an increase in the products of carbon metabolism transferred to the final grain sink and an increase in their weight (20). It was found that the average weight of 1000 grains varies between wheat varieties, and this result supports their results. The variety Ebaa 99 may have produced more grain than other varieties because of its superiority in the number of grains per spike and the 1000-grain weight (Table 5 and 6), which had a favorable impact on the total amount of grain produced (Table 7). The outcome is in contrast with other research which discovered, the various grain yields among them (21, 22). Also, the high concentration of arginine has

a role in promoting vegetative growth, increasing carbon metabolism, and enhancing the absorption of mineral elements, and this is the reason for this. Increasing plant-forming elements and transferring them to the final seed, makes the grains fuller and heavier, which has a positive effect on productivity per unit area (23, 5).

Conclusion

The study's results indicated that cultivar APA 99 distinguished out significantly in terms of vegetative growth, yield, and its component elements, all of which contributed to the high overall yield. Furthermore, APA 99 responded better to high concentrations of arginine than other cultivars, and arginine spraying greatly improved yield components. Conducting subsequent studies that include other concentrations of amino acids with new varieties in addition to varieties grown in different locations. To know the effect of vegetative and productivity characteristics within different environments in Iraq.

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Authors' contributions

AH and IM put forth ideas and designed experiments. YA performed the experiments. AT and ASH drafted the manuscript. ASH conceived and coordinated the overall study. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Conflict of interest: Authors do not have any conflict of interest to declare.

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