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Effect of glutamine and proline spraying on some phenological and flour traits of soft wheat (*Triticum aestivum* L.) genotypes

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Abstract

A field experiment was carried out during the winter season of 2021 at one of the farmers' fields in (Al-Batira area) in soil with a silty loam soil tostudy to know the effect of spraying by glutamine and proline on some phenological characteristics and flour quality of genotypes of bread wheat (*Triticum aestivum* L.). The experiment was implemented in a split-plot method using a randomized complete block design (R.C.B.D).in a split plot arrangement .The treat ments .The experiment included a study of two factors; the first was spraying by the amino acids glutamine and proline concentrations and a control treatment spraying only distilled water; The second treatment was sprayed by glutamine amino acid at a concentration of 300 mg l^{-1}; the third treatment was sprayed amino acid proline at a concentration of 300 mg l^{-1}; the fourth treatment was a mixture of amino acid gluten + proline at a concentration of 150 mg l^{-1} for each. The sub bread included ten newly introduced genotypes from soft wheat, which are as follows; (Russian V10, ACSAD 1133, ADANE 99, ACSAD 59, ACSAD 901, Iranian, Wafiya, Jad (Germanian), Jihan ,and Bohouth22). The results showed; The cultivar ADANE 99 had took the longest possible two periods to reach from stages tillering to booting and from booting to flowering, which amounted to 47.58 days and 37.50 days, respectively; the plants of the cultivar Bohouth22 gave the longest period from flowering to maturity amounted to 57.42 days. The genotype ACSAD 1133 prodeuced it the highest averages for the wet and dry gluten ratio and the sedimentation test, about 31.68%, 11.42%, and 37.44 ml, respectively. The experiment indicates that the phenological characteristics and flour quality tests could be improved by spraying the amino acids glutamine and proline, especially during the elongation and flowering stage.

Keywords:

Introduction

The wheat crop (*Triticum aestivum* L.) occupies the first place in the world regarding cultivated area and production. It is more important among the grain crops for being the main food for more than 60 countries in the world, as it contributes to providing 20% of the human need for food (EL-fouly et al., 2011). It is considered the most important source of carbohydrates in most countries because it contains vitamins, fats, mineral salts, and essential amino acids that humans need (ELsahooke et al. 2021). They provide the human body with approximately 25% calories, carbohydrates, protein, and some acids. The increase in the cultivation of this crop took place to reach self-sufficiency, as the cultivated area in Iraq for the year 2020 reached about 2143 hectares, with a productivity of 6.3 million tons. While the cultivated area in Iraq for the year 2021 amounted to 857,400 hectares, it produced 6,238.00 tons, with an average of 2.91 t ha^{-1} (Central Organization for Statistics and Information Technology, 2021).

Most of the studies emphasized the use of good seeds for cultivars and increasing the efficiency of agricultural inputs (service and crop operations) and working to improve the quality of the crop led to increased productivity, despite the hard work by farmers using approved and newly introduced wheat cultivars in Iraq to increase productivity, it is still there is a real problem related to the specific characteristics of grains, especially gluten, which affects their ability to make bread, as most of the local cultivars suffer from weak gluten in their grains. As the functional properties of flour depend on gluten proteins to a large extent, which determines their suitability for different nutritional characteristics, that wheat gluten is 85-90%, as it plays a role in producing the best type of bread and consists of protein substances such as Gliadin and Glutenin, the size of the loaf of bread and the elasticity of the dough depends and the amount of its swelling and the degree of its fluffiness depends on the quantity of these two components, as the quality of wheat is good when given a loaf of large size and with an acceptable taste and aroma (Dewettinck et al., 2008).

The protein content and quality is the important measure for the different varieties of importance in determining the function of the final product, as the characteristics of the quality and protein composition of wheat are affected by the genetic factor and environmental conditions (Al-Jilawi, 2017). Therefore, attention, focus and work began to increase crop productivity in quantity and quality by adopting the best scientific methods to implement crop service operations and working on an integrated system in adding foliar nutrients and fertilizers that contribute to increasing productivity and improving quality (Rollin, 2014).

In recent years, attention has increased to the use of amino acids, including glutamine and proline, as glutamine is one of the most important amino acids that have a major role in protein formation, stimulating photosynthesis, and helping to repair damaged cells and work to strengthen immunity. Proline is one of the amino acids. It exists freely, contains a secondary methylation group, and is created due to the inability of tissues to build protein and catabolism. Changing the osmotic potential of the plant tissue leads to a large accumulation of proline in plant leaf cells (Sterevaal., 2008, Lotfietal2010).

This study aims to .the effect of spraying by glutamine and proline on some phenological characteristics and flour characteristics genotypes of soft wheat.

Materials and methods

Study site

A field experiment was carried out during the winter season 2021-2022 in the Governorate of Maysan (Al-Batira area, 20 km from the city center) in soil whose chemical and physical specifications are shown in Table (1) know the effect of spraying by glutamine and proline on some phenological characteristics and flour quality of genotypes of soft wheat.

Table (1) shows the soil's chemical and physical properties before planting in 2021-2022.

Property		Unit	Value
Chemical properties	Electrical conductivity (ECe)	des. m^{-1}	3.4

	pH	-	7.3
	Av. Nitrogen	$mg.\ g^{-1}$	3.55
	Av. Phosphorus		0.096
	Av. Potassium		0.026
Physical properties	Sand	$g\ kg^{-1}$ soil	260
	Silt		600
	Clay		140
	Soil texture	-	Silty loam

*The analyzes were carried out in the laboratory of College of Marine Sciences, University of Basra.

Experience factors

The experiment involved studying two factors:

The first: Main panels - Sprayed the amino acids proline and glutamine as follows:

A- The control treatment is spraying with distilled water only, symbolized by A0.

B- The amino acid glutamine spray at 300 mg l^{-1}, symbolized by A1.

The first: - Sprayed the amino acids proline and glutamine as follows:

C- The amino acid proline spray at 300 mg l^{-1}, symbolized by A2.

D- Spray a mixture of amino acid glutamine and proline at a concentration of 150 mg l^{-1} for each, symbolized by A3.

The spraying is in two batches; the first is at elongation, and the second is at the flowering stage.

The second: Secondary Panels includes 10 genotypes cultivars of soft wheat (Russian V10, ACSAD 133, ADANE 99, ACSAD 59, ACSAD 901, Iranian, Wafiya, Jad (Germanian), Jihan, Bohouth22).

Experiment design:

The treatments were distributed in a split-plot method using a randomized complete block design (R.C.B.D) with three replicates. Each replicate contains 40 experimental units. The spray treatments were placed in the main plots, and the genotypes were placed in the subplots. The combination was randomly distributed among the factors on the experimental plots, as the number of experimental units was 10 x 4 x 3 = 120.

Studied characteristics

After completing the cultivation process, following up the growth phases, and harvesting, threshing, and cleaning the grains for each experimental unit separately, the following characteristics were calculated.

The number of days from tillering to a booting

It was calculated from stage 50% tillering to 50% booting, according to field observation.

Number of days from booting to flowering

The number of days from the stage of 50% booting to the stage of 50% flowering in the plant was calculated according to the field observation.

Number of days from flowering to maturity

It was calculated from the stage of 50% flowering until the full maturity of the plant (yellowing of the plants, the hardness of the grains, and the ease of their disintegration when the spikes are rubbed) (Mohiuddinand Croy, 1980).

Wet gluten content %

The percentage of wet gluten was calculated for the flour of wheat samples using the Glutomatic gluten index device equipped by the Swedish company Perten in the quality control laboratories affiliated with the Ministry of Trade, the General Company for Grain Manufacturing. The examination was carried out by weighing 10 grams of flour for each sample separately, and it was placed in the container of the device automatically for five Minutes after the end of the washing process; the piece of gluten was transferred and weighed in a sensitive scale, making sure that no part of it remains inside the container. The results are recorded in grams and converted into a percentage.

Dry gluten content (%)

The piece of gluten that was obtained from the determination of the wet gluten content was dried at a temperature of 105 °C for four minutes in the Glutork 2020 device; then, the sample was weighed in a sensitive balance, and the result was recorded and converted into the percentage of the flour sample.

Sedimentation test (ml)

The sediment value of wheat flour was estimated according to Zleney (1974) according to the standard method ICC Standard NO116/1. Place 3.2 g of flour in a graduated glass cylinder with a capacity of 100 ml, then add 50 ml of distilled water solution to it, after which the cylinder is closed and shaken manually to mix the contents. Then 25 ml of diluted lactic acid solution was added, and the cylinder continued to be moved several times, after which it was left for five minutes vertically, and then the sediment volume, which represented the sedimentation value of the wheat sample, was read.

Results and Discussion

Number of days from tillers to booting (day)

The results in Table (2) showed that there were significant differences between some cultivars in the number of days from tillering to booting, where the plants of ADANE 99 cultivar took the longest possible period to reach the booting reached 47.58 days, while cultivar Bohouth 22 recorded the least period from tillering to botting amounted to 37.83 days and without a significant difference for the genotype of ACSAD 133, which gave 37.92 days.

Table (2) effect of genotypes and amino acid spraying and their interaction on the number of days from tillers to booting (day)

A/G		Genotypes (G)										Average
		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	
Amino acids (A)	A0	40.67	37.33	48.33	38.33	38.67	42.67	44.33	43.00	44.33	35.33	41.13
	A1	41.33	37.00	44.67	41.67	38.33	41.33	43.00	46.33	42.00	40.33	41.53
	A2	39.00	37.67	49.33	39.00	40.67	39.67	45.67	45.67	44.33	39.00	41.53
	A3	42.67	39.67	48.00	40.33	44.67	41.00	42.00	39.33	45.67	36.67	41.53
Average		40.92	37.92	47.58	39.83	40.58	41.17	43.75	43.58	44.08	37.83	

Treatments	A	G	A*G
LSD 0.05	NS	2.34	NS

Number of days from booting to flowering (day)

The results showed in Table (3) that there were significant differences between the genotypes in the number of days from booting to flowering. Cultivar ADANE 99 took the longest period of 37.50 days, while the plants of genotype ACSAD 133 recorded the shortest possible time to reach the flowering stage, which amounted to 25.17 days. Perhaps the superiority of the above cultivar is due to the difference in genotypes in terms of their requirements of temperature and photoperiod, and this indicates the size of the genetic variation between the introduced genotypes and the approved cultivars included in the experiment and the nature of the difference in the genetic capabilities of each of them. This result agreed with what Al-Hamdawi (2017) mentioned, which shows differences between wheat cultivars in this characteristic.

As for the spraying treatments of amino acids, they were spraying plants with proline at a concentration of 300 mg l^{-1} gave the longest duration of 29.93 days without a significant difference from the mixed amino acid concentration consisting of (150 mg l^{-1} glutamine with 150 mg l^{-1} of proline) which lasted for 29.07 days, while the plants sprayed with the amino acid glutamine gave the least period of 28.77 days without a significant difference from spraying with distilled water only, which averaged 28.53 days. The reason for this may be due to the role played by the amino acids in improving the hormonal balance (increasing the stimuli at the expense of the inhibitors), which was reflected in the increase in the number of flowers, stimulation of the process of fruit setting, an increase in the rate of fruit set, and the reduction or prevention of the fall of the fruit set, all of which accelerate the push of the plant to the speed of transition from the stage vegetative growth to the stage of flowering and fruit formation, this result agreed with what Al-Dulaimi reached. (2018).

Table (3) effect of genotypes and amino acid spraying and their interaction on Number of days from booting to flowering (day)

A/G		Genotypes (G)										Average
		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	
Amino acids (A)	A0	31.33	24.00	35.67	28.33	27.67	25.67	24.00	31.33	24.67	31.67	28.53
	A1	30.67	25.00	37.00	24.67	28.00	25.67	32.67	31.33	30.00	27.00	28.77
	A2	31.00	25.33	38.33	31.00	29.00	26.33	30.33	31.00	29.67	30.67	29.93

	A3	27.67	26.33	39.00	29.67	28.33	27.33	23.67	31.67	30.33	29.67	29.07
Average		30.17	25.17	37.50	28.42	28.25	26.25	27.67	31.33	28.67	29.75	
Treatments			A			G			A*G			
LSD 0.05			1.10			2.56			NS			

Number of days from flowering to maturity (day)

The results indicated in Table (4) that there was a significant difference between the genotypes in the characteristic of the number of days from flowering to maturity, as the plants of the Bohouth 22 cultivar gave the longest period from flowering to maturity amounted to 57.42 days, with a significant difference from the other cultivars, while the cultivar ADANE 99 gave the lowest period to reach maturity, which reached maturity 46.33 days. Cultivars may differ due to genetic differences, the nature of growth, and the time required to reach this stage, which differs from one cultivar to the other, and is governed by a state of balance between the period from emergence to flowering and from flowering to maturity. The lengthening of one of them is at the expense of the other, and these results agreed with what was found (2013) by Noworolnik and Hassan (2013), who pointed out the difference between cultivars. These results agreed with the findings of Al-Dulaimi (2013) and Al-Dulaimi (2018), who noticed the difference between the studied cultivars in the number of days from flowering to maturity.

The results showed in the same Table that the addition of amino acids to the plants led to the presence of significant differences between the spraying treatments of amino acids, as the addition of amino acids with mixed concentrations of (150 mg l^{-1}-glutamine and 150 mg l^{-1} proline) recorded the longest period from flowering to maturity amounting to 54.40 days. A comparison with the control treatment (spraying with distilled water) gave the least ripening period of 50.30 days. The reason for this may be that spraying amino acid mixed leads to prolonging the vegetative growth period. Thus this is reflected in the extension of the period of seed filling.

It was observed that there was a significant interaction between the cultivars and the spraying of amino acids, as the combination between the cultivar gave (Bohouth 22 × proline). The longest period from flowering to maturity amounted to 58.00 days, while the combination between the ADANE 99 cultivar and spraying with distilled water gave the least period from flowering to maturity, which amounted to 44.00 days. The reason may be that the addition of proline improved the growth of wheat plants, which makes these results consistent with the results of The study of Al-Qazzaz (2010) showed that spraying with proline acid improved the growth of wheat plants, whether subjected to stress or not.

Table (4) effect of genotypes and amino acid spraying and their interaction on Number of days from flowering to maturity (day)

A/G		Genotypes (G)										Average
		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	
Amino acids (A)	A0	48.33	48.33	44.00	48.00	45.00	56.33	50.33	50.67	49.33	55.67	50.30
	A1	49.67	48.67	44.67	50.33	47.67	51.00	47.00	49.00	49.33	54.67	49.37
	A2	50.67	49.33	44.33	54.33	55.33	52.67	48.33	50.33	51.00	58.00	51.60
	A3	51.33	50.33	52.33	56.00	52.00	56.67	55.67	49.67	52.33	61.33	54.20
Average		50.00	49.17	46.33	52.17	50.00	54.17	50.33	49.92	50.50	57.42	

Treatments	A	G	A*G
LSD 0.05	2.33	2.26	4.53

Wet gluten content (%)

The results showed in Table (5) that the wheat cultivars differed significantly among themselves in this characteristic, as the flour of ACSAD 133 cultivar was distinguished by giving it the highest average percentage of wet gluten, amounting to 31.68%, with a significant difference from the rest of most other genotypes, while the Russian V10 cultivar gave the lowest average percentage of gluten Wet reached 26.53%, with a non-significant difference from the German Jad and Jihan cultivars, which gave average wet glutens of 26.57 and 26.73%. The variation of cultivars in their wet gluten content may be attributed to the difference in the genetic composition of the cultivars and their difference in the percentage of protein. Protein is one of the good indicators of the quality of the cultivar. This result agreed with the results of Tayyar (2010), Fadl et al. (2010), Al-Azzawi (2017), and Abdelaleem and Al-Azab (2021). Also, it was noted from the results that there were significant differences when spraying wheat varieties with amino acids, as the mixed concentration of glutamine and proline gave the highest average wet gluten amounted to 28.80, with a non-significant difference from the concentration of glutamine only, which gave average wet gluten amounted to 28.61%, while the concentration spraying with distilled water gave the lowest average The percentage of wet gluten was 26.15%. Delegation attributes the reason to the plant's optimal use of spraying amino acids, which are considered the main component of proteins, including gluten proteins (Al-Azzawi, 2016), especially at this stage when an almost complete halt characterizes vegetative growth. Therefore all materials manufactured from photosynthetic structures move from sources to sinks (the spikes) and agree. These results are in line with those reported by Popko et al. (2018).

Table (5) effect of genotypes and amino acid spraying and their interaction on Wet gluten content (%)

A/G		Genotypes (G)										Average
		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	
Amino acids (A)	A0	25.10	30.04	24.65	25.17	28.74	24.74	26.16	24.65	24.47	27.49	26.15
	A1	27.35	31.47	28.64	29.41	27.45	30.76	26.45	27.65	28.26	26.16	28.61
	A2	26.46	32.10	26.89	27.71	29.79	25.39	26.93	27.56	27.89	27.51	27.57
	A3	27.20	33.10	28.19	28.20	30.35	27.91	29.57	27.06	25.67	28.54	28.80

Average	26.53	31.68	27.09	27.62	29.08	27.20	27.28	26.73	26.57	27.43	
Treatments	**A**				**G**			**A*G**			
LSD 0.05	0.81				1.53			NS			

Dry gluten content (%)

It was noted from the results of Table (6) that wheat cultivars differed significantly in their content of dry gluten, as the genotype excelled ACSAD 133 by giving it the highest average dry gluten, amounted to 11.42%, while the cultivar recorded the lowest average of 8.88%. The reason for the superiority of some cultivars in the proportion of dry gluten over other cultivars may be due to the difference in the percentage of protein (in grains and flour) as well as their difference in the content of wet gluten, which is retained by wet and dry gluten in most of the varieties included in the study, and this is due to the ability of the genotypes to accumulate protein In the grain, which eventually leads to an increase in the gluten complex, this result agreed with the results of Al-Saadi and Jaryan (2017) and Seddik et al. (2016) who indicated that wheat varieties differed in the content of their flour from dry gluten.

The results also showed in the same Table that there were significant differences between the added concentrations of amino acids to the cultivars, as spraying gave the cultivars with the mixed concentration (150 mg l^{-1} glutamine and 150 mg l^{-1} proline) the highest percentage of dry protein amounted to 10.59%, without a significant difference from the other concentrations. At the same time, the concentration of spraying with distilled water gave the lowest average dry gluten percentage of 8.68%. It was found from the results of the interaction that there was a significant interaction between the cultivars and the concentrations of spraying with amino acids. The combination gave the genotype (ACSAD 133× treatment of no addition spraying with distilled water) the lowest average of 7.99%, slightly different from the combinations of other cultivars. This result was consistent with the factors mentioned in the discussion.

Table (6) effect of genotypes and amino acid spraying and their interaction on Dry gluten content (%)

A/G		Genotypes (G)										Average
		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	
Amino acids (A)	A0	8.30	9.04	7.99	8.38	9.60	8.58	9.00	8.41	8.37	8.93	8.68
	A1	9.99	11.29	9.86	10.07	9.16	11.61	8.60	8.57	8.98	9.10	9.99
	A2	9.81	12.15	9.45	9.58	11.04	8.50	8.72	9.23	10.16	8.89	9.59
	A3	10.20	13.19	9.95	8.95	11.96	11.13	9.19	10.67	8.94	9.54	10.59
Average		9.57	11.42	9.31	9.24	10.44	9.96	8.88	9.22	9.11	9.12	

Treatments	A	G	A*G
LSD 0.05	0.49	0.66	1.32

Sedimentation test (ml)

The results showed in Table (7) that the sedimentation test is significantly affected by the different cultivars, as the cultivar, ACSAD 133 gave the highest average sedimentation value amounting to 37.44 (ml), while the cultivar Bohouth 22 gave the lowest average sedimentation value amounting to 22.09 ml. The reason for the superiority of ACSAD 133 cultivars may be attributed to their superiority in the percentage of flour protein and the content of wet and dry gluten, which in turn affected the formation of a gluten complex that is characterized by strength and durability and its swelling with aqueous solution in the medium of dilute acid in the sedimentation value test.

The concentrations of adding amino acids also differed significantly, as the concentration gave a mixture of 150 mg l^{-1}-glutamine and 150 mg l^{-1} proline; the highest average sedimentation value amounted to 29.16 ml and a non-significant difference from the concentration of glutamine. While the concentration sprayed with distilled water gave the lowest average of 23.53 ml. The reason may be that it is indicated that the amino acids work to increase the efficiency of the photosynthesis process. It was found that the concentration of amino acids works to increase and accelerate protein synthesis and encourage plant growth and productivity (Alaru et al., 2003). The plant can produce amino acids, but this synthesis of them is great energy, so using the acids as a spray on the plant provides the plant with energy and its development, structure, and increase, especially in critical times of plant growth. These results agreed with what Irena and Cavidas (2013) and Popko et al. (2018) mentioned.

It was shown from the same Table the interaction between the two factors, the genotypes, and amino acids, as the combination gave the cultivar ACSAD 133× a mixture of 150 mg l^{-1} glutamine and 150 mg l^{-1} proline) the highest average sedimentation value amounted to 40.16 ml. While the combination of (the cultivar Bohouth 22× spraying treatment with distilled water) gave the lowest average, which amounted to 20.20 ml. The superiority of the two mentioned combinations can be attributed to what was mentioned in the discussion of the single factors (Table 7).

Table (7) effect of genotypes and amino acid spraying and their interaction on Sedimentation test (ml)

A/G		Genotypes (G)										Average
		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	
Amino acids (A)	A0	21.45	34.93	25.49	22.14	20.32	20.91	27.45	21.50	29.38	20.20	23.53
	A1	21.75	36.52	28.01	26.35	32.44	27.15	30.77	29.09	29.05	25.92	28.51
	A2	20.80	38.15	29.84	27.42	26.17	21.41	25.67	23.79	26.39	20.19	25.49
	A3	30.26	40.16	30.59	27.24	30.67	26.75	29.48	27.69	23.79	22.05	29.16
Average		23.57	37.44	28.48	25.79	27.40	24.05	28.34	25.52	27.15	22.09	

Treatments	A	G	A*G
LSD 0.05	0.88	0.70	1.40

Conclusion is required here.

the phenological characteristics and flour quality tests could be improved by spraying the amino acids glutamine and proline, especially during the elongation and flowering stage.

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