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Evaluation of yield, baking and farinographic tests of several genotype of bread wheat (*Triticum aestivum* L.) under the influence of spraying with different concentrations of glutamic acid and arginine.

Ammar Abdullah Mohammad Al-Jumaili[1], Salam Naji Hamagharib Rojbayany[2]
[1,2] *Department of Laboratory, General Company for Grain Board- Kirkuk - Ministry of Trade , Iraq.*

[*] *Corresponding author: E-mail:* aljumailiammar6@gmail.com, Salamroj23@gmail.com

ABSTRACT

The experiment aimed to investigate the effect of spraying a combination of glutamic acid and arginine (0 glutamic + 0 arginine, 200 mg L^{-1} glutamic and 200 mg L^{-1} arginine, 100 mg L^{-1} glutamic + 100 mg L^{-1} arginine, 100 mg L^{-1} glutamic + 200 mg L^{-1} arginine, 200 mg L^{-1} glutamic + 100 mg L^{-1} arginine, and 200 mg L^{-1} glutamic + 200 mg L^{-1} arginine) on nine wheat genotypes (Al-Fayyad, Mawaddah, Buhouth 22, Babylon 113, Gomeza 9, Giza 164, Sakha 61, Sakha 95, and Misr 3), focusing on yield, extraction percentage, ash content, and Pelshinki test, as well as farinograph tests (water absorption percentage, dough development time, stability, and departure time). A complete randomized block design with split plots was used, where the main plots included the combinations of glutamic acid and arginine. The results showed significant influence of the introduced genotypes (Misr 3, Gomeza 9, and Giza 164) Compared other genotypes. For the yield trait, the genotype Gomeza 9 exhibited the highest average (7.95 tons ha^{-1}), followed by Misr 3 and Giza 164 with averages of (7.88 and 7.85 tons ha^{-1}, respectively). The genotype Misr 3 also showed significant superiority in the extraction percentage, ash content, Pelshinki test, and farinograph tests (water absorption percentage, dough development time, stability, and departure time) with averages of (79.26%, 2.00%, 119.61 minutes, 67.22%, 4.78 minutes, 3.27 minutes, and 8.05 minutes) in that order. The spraying treatment (200 mg L^{-1} glutamic acid + 200 mg L^{-1} arginine) was influence for all studied traits. The interaction between the study factors indicated that the genotype Misr 3 significantly outperformed the other genotypes. Therefore, future attention can be given to these two introduced genotypes with replanting in different seasons and locations to determine their stability within the region and its environmental conditions.

KEY WORDS: Genetic compositions; spraying with glutamic acid and arginine; yield; baking traits; farinograph tests.

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تقييم الحاصل والخبيز وفحوصات الفارينوكراف لعدة تراكيب وراثية من حنطة الخبز (*Triticum aestivum* L.) تحت تأثير الرش بتراكيز مختلفة من حامضي الكلوتاميك والآرجنين.

عمار عبد الله محمد الجميلي[1]، سلام ناجي حمه غريب الروژبياني[2]
[1،2] قسم المختبر، الشركة العامة لتجارة الحبوب، وزارة التجارة – العراق

الملخص

هدفت التجربة الى معرفة تأثير الرش بتوليفة من حامضـــي الكلوتاميك والآرجنين (كلوتاميك 0 + آرجنين0 و كلوتاميك 200 ملغم لتر$^{-1}$ و آرجنين 200 ملغم لتر$^{-1}$ و كلوتاميك 100 ملغم لتر$^{-1}$ + آرجنين 100 ملغم لتر$^{-1}$ و كلوتاميك 100 ملغم لتر$^{-1}$+ آرجنين 200 ملغم لتر$^{-1}$ و كلوتاميك 200 ملغم لتر$^{-1}$ + آرجنين 100 ملغم لتر$^{-1}$ و كلوتاميك 200 ملغم لتر$^{-1}$ + آرجنين 200 ملغم لتر$^{-1}$) في تسـع تراكيب وراثية من حنطة الخبز (الفياض و مودة وبحوث 22 وبابل 113 وجميزة9 و جيزة 164 وسـخا 61 و سخا 95 ومصر3)، لصفات الحاصل و النسبة المئوية للأستخلاص والرماد و وأختبار بلشنكي وفحوصات الفارينوكراف (النسبة المئوية للأمتصاص الطحين للماء، زمن الوصول، الأستقرارية، زمن المغادرة) وبأستخدام تصميم القطاعات العشوائية الكاملة بنظام الألواح المنشقة، إذ شملت الألواح الرئيسية توليفات حامضي الكلوتاميك والآرجنين بينما شملت الألواح الثانوية التراكيب الوراثية، وبينت النتائج تفوق معنوي للتراكيب الوراثية المدخلة (مصر3 وجميزة9 وجيزة 164) على بقية التراكيب الوراثية ففي صفة الحاصل تفوق التركيب الوراثي جميزة 9 بإعطائة اعلى متوسط (7.95) طن ه$^{-1}$ يليه التركيبان الوراثيان مصر3 وجيزة 164 بمتوسطين (7.88 و 7.85) طن ه$^{-1}$ ، أما التركيب الوراثي مصر3 سجل تفوق معنوي بالصفات النسبة المئوية للأستخلاص والرماد و وأختبار بلشنكي وفحوصات الفارينوكراف (النسبة المئوية للأمتصاص الطحين للماء، زمن الوصول، الأستقرارية، زمن المغادرة) بمتوسطات بلغت (79.26% و2.00% و 119.61 دقيقة و67.22 % و4.78 دقيقة و 3.27 دقيقة و 8.05 دقيقة)

حســـب الترتيب، بينما تفوقت معاملة الرش (200 ملغم لتر$^{-1}$ حامض الكلوتاميك + 200 ملغم لتر$^{-1}$ حامض الآرجنين) لجميع الصفات المدروسة، اما التداخل بين عاملي الدراسة اذ سجل التركيب الوراثي مصر 3 تفوقاً معنوياً على بقية التراكيب الوراثية، وبذلك يمكن الاهتمام مستقبلاً بهذين التركيبين المدخلين مع اعادة الزراعة لمواسم ومواقع مختلفة لمعرفة مدى أستقرارهما ضمن المنطقة وظروفها البئية.

الكلمات المفتاحية: التراكيب الوراثية؛ الرش بحمض الجلوتاميك والأرجينين؛ الحاصل؛ صفات الخبز؛ اختبارات الفارينوجراف.

INTRODUCTION

Iraq, a rich agricultural country with its fertile land and diverse environments, is one of the key nations striving to increase the production of bread wheat (*Triticum aestivum* L.), which is important cereal crop overripe under various climatic situation in various parts of the

world (AL_Zaidi, 2024).The area cultivated in 2021 reached(2,366,056) hectares, with a production rate of 4,233,714 tons according to statistics from (the Central Organization for Statistics and Information Technology 2022). Numerous factors have led to the deterioration of this crop, its quality, and a decrease in its yield per unit area compared to global production. Newly developed local wheat varieties in Iraq are characterized by low protein and gluten content, which affects bread-making quality. The functional quality of flour depends on gluten proteins, and the protein content and quality are important criteria for classifying wheat varieties due to their significance in the quality of the final product (Al-Desouki, 2008).

Consequently, attention has focused on new high-yield wheat varieties and the use of scientific methods in crop management, adopting an integrated system for adding foliar nutrients that help increase production, improve quality, reduce economic costs, and protect the environment (Hristov, 2010). The use of nutrients such as amino acids is one of the essential requirements that achieve qualitative improvement and increase yield per unit area. These acids help reduce the amount of fertilizers used, as plants can produce amino acids but require significant energy consumption. When amino acids or some of them are sprayed on the leaves, it provides energy that facilitates the synthesis of amino acids, especially during critical times that the plant undergoes (Zhang Y., 2004).

Glutamic acid is Modern plant technologies by adding nutrition through leaves such as amino acids can be used to improving plant growth and development through improving physiological processes (Nazem et al., 2024). It also acts as an osmotic balance factor in the cytoplasm of guard cells, improving the opening and closing of stomata. Additionally, it plays a role in chlorophyll formation, carbohydrate synthesis, and contributes to increased plant growth and dry weight, thereby enhancing the plant's ability to absorb essential elements and balance them, supporting growth and yield (AL-Modhafer, 2009). On the other hand, arginine is an aliphatic amino acid symbolized by (Arg) and is considered a protein amino acid that the body cannot synthesize. In plants, it is found in structural proteins but in insufficient quantities to meet the plant's needs (Abdel Hafaz, 2007). It is an important element for plant growth and plays a role in many physiological processes and acts as an

inhibitor of the enzymes responsible for ethylene production, which are activated when the plant is exposed to salt and drought stresses. Due to the ease of arginine absorption, it reduces the levels of abscisic acid that inhibit growth and cell division in the plant while increasing the biosynthesis of gibberellins and auxins, thereby promoting cell division and expansion (Nordin A., 1997). Based on the above, the current study aims to determine optimal levels of glutamic acid and arginine when sprayed on several genotypes of wheat for advanced results for yield qualities, baking properties, and farinograph tests

MATERIALS AND METHODS

A field experiment was conducted during the winter agricultural season (2022-2023) in Kirkuk Governorate, at the Al-Sayyada site - the Agricultural Research and Experimentation Station affiliated with the College of Agriculture, University of Kirkuk (Longitude 44.42° East and Latitude 35.16° North). The experiment was carried out in sandy clay soil, and its properties are detailed.

Some physical and chemical characteristics of the experimental soil before planting

No.	Feature	Value	Unit
		2023- The first season 2022	
1	Soil (PH)	7.4	\
2	Electrical conductivity (Ec)	2.72	$^{1-}$DC .M
3	Organic matter (O.M)	0.89	gm kg^{-1} soil
4	Avaliable Nitrogen N)	27	
5	Avaliable phosphorus (P)	7	mg kg^{-1} soil
6	Avaliable potassium (K)	145	
7	Sand	056	
8	Silt	372	gm kg^{-1}
9	Clay	68	
10	Calcium carbonate CaCo3	24	\
11	Calcium sulphate CaSo4	12	\
12	O.M	0.89	\
13	Soil texture	sandy loam	\

Soil analysis was conducted in the Soil Department Laboratory at the College of Agriculture, University of Tikrit. Land preparation operations before planting included two perpendicular plowings with disc harrows (24 discs) , leveling, smoothing the land, and creating ridges between the beds. The experiment was designed using a randomized complete block design with split plots and three replications. The combinations of glutamic acid and arginine were placed in the main plots (Glutamic 0 + Arginine 0, Glutamic 200 mg L^{-1}, Arginine 200 mg L^{-1}, Glutamic 100 mg L^{-1}+ Arginine 100 mg L^{-1}, Glutamic 100 mg L^{-1}+ Arginine 200 mg L^{-1}, Glutamic 200 mg L^{-1}+ Arginine 100 mg L^{-1}, Glutamic 200 mg L^{-1} + Arginine 200 mg L^{-1}), The combinations were sprayed in the fragment formation phase (GSZ22) and in the pre-endothelial phase (GSZ39) according to (Zadoks et al., 1974). while the genetic compositions were randomly assigned within the subplots, as detailed in Table (2). The amount of seed used was 160 kg ha $^{-1}$. Phosphate fertilizer (DAP) was applied as a

single application at the time of planting at a rate of 320 kg ha $^{-1}$, and urea fertilizer (46% N) was applied at a rate of 200 kg ha $^{-1}$ in two splits: the first application was made after the tillering stage, and the second during the booting stage (Sibahi, 2011).

The seeds of the wheat genetic compositions were manually sown on (23/11/2022), and an irrigation was provided for germination immediately after sowing, followed by repeated irrigations based on soil moisture and as needed. Additionally, a herbicide (2,4-D) was applied for weed control. The harvesting of the genetic compositions took place on (11/5/2023) after the signs of maturity appeared, with the ears turning yellow.

Names, numbers, and source of genotypes used in the study.

Seq	Genotypes	Proportion	Sources
1	Al-Fayyad	(ACSAD 875 // URES *2 / PRIS)	Certified/Prof. Dr. Jassim Mohammed Aziz Al-Jubouri
2	Mawaddah	ATHS / NEEV 133	Certified/Seed Inspection and Certification Department/Kirkuk
3	Buhouth 22	CMSS96Y03236M-050M-040M-020M-050sy-IM-0Y /2011	Certified/Seed Inspection and Certification Department/Kirkuk
4	Babylon 113	Atomic Energy Organization / Dr. Muhammad Abdel Khaleq MEXIPAK/R23	Certified / Seed Inspection and Certification Department / Center
5	Gomeza 9	Entrance from Republic of Egypt	Certified/Agricultural Research Station/Kafr El-Sheikh
6	Giza 164	Entrance from Republic of Egypt	Certified/Agricultural Research Station/Kafr El-Sheikh
7	Sakha 61	Entrance from Republic of Egypt	Certified/Agricultural Research Station/Kafr El-Sheikh
8	Sakha 95	Entrance from Republic of Egypt	Certified/Agricultural Research Station/Kafr El-Sheikh
9	Misr 3	Entrance from Republic of Egypt	Certified/Agricultural Research Station/Kafr El-Sheikh

The traits of the yield, quality and type of grains were studied. The characteristic of the grain yield ton h^{-1} (calculated on the basis of the grain weight of the area of the middle line of the experimental unit after harvesting it with the addition of the grains of the harvested area above, then the weight was converted ton h^{-1} (Donald and Hamblin, 1976), the characteristic of the extraction ratio % (500 g of wheat varieties samples were taken for the purpose of grinding after cleaning and screening the grains well, and the grain moisture was adjusted to the internationally approved standard moisture level of about (14) %, then the grains were ground using a laboratory mill type (r/min25000 Shanghai-Speed: , 200 (RRH-A) after completing the grinding process by calculating the weight of the flour resulting from grinding a known weight using the following equation: Flour extraction (%) = (weight of net flour / weight of wheat prepared for grinding) x100 (Bass, 1990)

Ash content % (The ash content in the flour was estimated by following the standard method No. (0.8 - 0.1) (A.C.C for the year 1998) by placing (5) g of flour at a temperature of (550) °C using a Muffle Furnace type 308Gall encamp -Tactical until the white color appears grayish or until the

weight is stable, a minute Pelshinki test (This test is one of the methods for estimating the strength of wheat and its suitability for bread production and is based on calculating the time period for the decomposition of a ball of fermented dough for wheat flour and is affected by the quantity and quality of gluten, and the method mentioned by (Al-Abdullah, 2016) was used by weighing (4) g of flour and then placing it in a container and adding (2.25) ml of yeast suspension solution (10) %, and the suspended matter is mixed with the flour to form a cohesive, non-sticky dough, which is shaped by hand and the dough ball is placed in a bowl and covered with warm water at a temperature of (30) C. The amount of water is approximately (200) ml, and the bowl is placed in an incubator at a temperature of (30) C or in a water bath at the same temperature, and the time required from the time the ball is immersed in the water until it begins to disintegrate is calculated. The following is the characteristic of gluten and the strength of wheat based on the results of this test.

Ranges of the Pelshinki test.

Seq	The quality of gluten and the quality of soft wheat	Time calculated in the Belshanki test (min)
1	Very weak	Less than 30
2	Weak	30 -50
3	Average power	50 – 100
4	Powerful	100 – 175

Farinograph tests: Flour water absorption % (which is the amount of water needed to form a dough with a resistance of 500 Brabender units), arrival time min (which is the time that starts from the moment of adding water and turning on the device until the curve reaches the line of 500 Brabender units), stability min (which is the time from the moment the curve enters the line of 500 units until it exits it, i.e. the period between the arrival time and the time of the curve leaving the line of 500 Brabender units), departure time min (which is the time calculated from the time of adding and turning on the device until the curve leaves the line of 500 Brabender units and is equal to the sum of the stability time and the arrival time. All farinograph tests were conducted according to the standard method (21 - 54, A.A.C.C, 2000). The data were analyzed using the used design and the significant differences between the means were tested according to Duncan's multiple range test at a probability level of (0.05) (AL-zubdy, 2016), using the SAS program.

RESULTS AND DISCUSSION

Grain yield (ton ha^{-1}):

The Genetic structure Gomeza 9 prevailed over the rest of the genetic structures included in this study by giving the highest average for the grain yield trait (6.25) tons ha^{-1}, followed by the genetic structure Misr3 with an arithmetic average (6.15) tons ha^{-1}, while the genetic structure Fayyad recorded the lowest average for the trait (4.38) tons ha^{-1} as shown in Table (1). The superiority of this genetic structure is due to its superiority in (the traits of the yield and its components, spike length

and number of plant spikes) in addition to the genetic differentiation between the genetic structures in the efficiency of utilizing more of the carbon building products (El- said, 2016; Al-Salem, 2018; Al-Mafarji *et al*., 2024). The results of the treatment with glutamic acid and arginine acid and their combinations recorded significant differences, as the combination (glutamic acid 200 mg L^{-1} + arginine acid Arginine 200 mg L^{-1}) The highest average for the trait (7.08) tons ha^{-1} compared to the control treatment plants, which recorded the lowest average for the trait (3.90) tons ha^{-1}. Spraying amino acids at two different times during the vegetative growth period on the plant leaves and directly helped facilitate their absorption and this was reflected in increasing the effectiveness of carbon construction, which led to stimulating the enzymes that synthesize proteins and carbohydrates and increasing dry matter in the estuary (grains). These results were consistent with both (AL-Fahdawi, 2021; Baqir, 2019). It was noted from the results obtained from Table (1) that there are significant differences between the interaction of the study factors, as the genetic structures of Gomeza 9, Giza 164 and Misr 3 outperformed under the influence of the combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) by an average of The calculations reached 7.95, 7.85 and 7.88 tons ha^{-1} respectively, while the genotype Fayyad with the comparison treatment recorded the lowest arithmetic mean of 3.00 tons ha^{-1}. It was found that there was a direct increase between the increase in concentrations of glutamic acid and arginine for the grain yield trait in addition to the genetic genes related to the introduced combinations and their interaction with environmental conditions. All of this was in agreement with both (El-said, 2016; Kandil, 2017).

Table 1. Effect of the combination (glutamic acid and arginine) on wheat genotypes for grain yield (tons ha^{-1}).

The combination / Genotype	**(Glu.0 +Arg.0) mg L^{-1}**	**(Glu.200 +Arg.0) mg L^{-1}**	**(Glu.0 +Arg.200) mg L^{-1}**	**(Glu.100 +Arg.100) mg L^{-1}**	**(Glu.100 +Arg.200) mg L^{-1}**	**(Glu.200 +Arg.100) mg L^{-1}**	**(Glu.200 +Arg.200) mg L^{-1}**	**Genotypes Average**
Al-Fayyad	3.00 z	4.87 y	3.49 z	3.91 z	4.33 cd	5.03 wx	6.03 no	**4.38 i**
Mawaddah	3.90 z	5.16 uv	4.03 g	4.59 ab	4.89 y	5.32 t	6.31 jk	**4.88 f**
Buhouth 22	3.45 z	5.06 vw	3.69 i	4.19 ef	4.64 az	5.21 tu	6.21 klm	**4.63 g**
Babylon 113	3.26 z	5.02 wx	3.60 i	4.12 fg	4.55 ab	5.11 uvw	6.19 lm	**4.55 h**
Gomeza 9	4.49 b	6.91 cd	5.02 wx	6.05 h	6.39 j	6.97 c	7.95 a	**6.25 a**
Giza 164	4.23 de	6.76 fg	4.91 y	5.82 qr	6.12 nm	6.79 ef	7.85 a	**6.07 c**
Sakha 61	4.16 ef	6.52 i	4.71 z	5.54 s	5.83 pqr	6.58 hi	7.60 b	**5.85 e**
Sakha 95	4.26 cde	6.66 gh	4.85 y	5.73 r	5.92 pq	6.66 gh	7.70 b	**5.97 d**
Misr 3	4.36 c	6.84 def	4.94 xy	5.93 op	6.26 kl	6.87 cde	7.88 a	**6.15 b**
Averages of combination	**3.90 f**	**5.98 b**	**4.36 e**	**5.10 d**	**5.44 c**	**6.06 b**	**7.08 a**	

*Different letters mean there is a significant difference.

2 .Extraction percentage:(%)

The genetic composition Misr 3 was significantly superior, achieving an arithmetic mean of 79.26%, while the composition Mawaddah gave a lower arithmetic mean of 76.78% for the trait. The

disparity between the genetic compositions in this trait may be due to the superiority of the genetic composition Misr 3 in the trait of the area of the flag leaf, which led to an increase in the carbon metabolism process and thus an increase in the percentage of dry matter produced and converted into grains, on the one hand, and on the other hand, the physical nature of the grains in terms of size, hardness, grain hydration percentage, and milling efficiency. These results were consistent with the results of (AL-Nimrawi, 2021; ALoush, 2021). The combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) significantly outperformed all combinations, recording the highest arithmetic average (79.47)%, while the control treatment had the lowest arithmetic average for the extraction rate, reaching 76.86%. This is due to the fact that the spraying process with the highest concentration of glutamic acid and arginine led to recording a difference in the growth period from germination until 50% of the spikes were ejected, which helped increase the effectiveness and efficiency of the carbon metabolism process and produce a higher amount of dry matter and transfer it to the estuary during the grain filling period. These results were consistent with the researchers (Abd El-Rheem, 2021; Marwa, 2022). The genotype Misr 3 with the combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) was significantly superior with an arithmetic mean of 81.01%, while it was superior to all interactions, while the interaction between the combination and the control treatment gave the lowest arithmetic mean for the extraction ratio trait of 75.83%, and the variation in the response of varieties to the effect of glutamic acid at these stages expresses the efficiency of the variety in redistributing the products of photosynthesis. These results were consistent with the results of (Mukhlef, 2019).

Table 2. Effect of the combination (glutamic acid and arginine) on wheat genotypes for grain Extraction Ratio (%).

The combination / Genotype	**(Glu.0 +Arg.0) mg L^{-1}**	**(Glu.200 +Arg.0) mg L^{-1}**	**(Glu.0 +Arg.200) mg L^{-1}**	**(Glu.100 +Arg.100) mg L^{-1}**	**(Glu.100 +Arg.200) mg L^{-1}**	**(Glu.200 +Arg.100) mg L^{-1}**	**(Glu.200 +Arg.200) mg L^{-1}**	**Genotypes Average**
Al-Fayyad	77.03 yz	78.10 uvw	77.42 yz	77.64 xyz	78.55 klm	79.14 efg	79.55 bcd	78.23 de
Mawaddah	75.83 z	76.25 z	76.13 z	76.42 z	77.21 yz	77.63 xyz	77.98 vwx	76.78 j
Buhouth 22	76.11 z	77.91 vwx	76.42 z	76.72 yz	78.02 uvw	78.61 klm	79.11 fgh	77.56 h
Babylon 113	75.96 z	76.81 yz	76.50 z	76.82 wxy	77.71 xyz	77.89 vwx	78.74 klm	77.20 i
Gomeza 9	76.73 z	77.06 yz	77.05 yz	77.34 yz	77.37 nop	79.11 fgh	79.21 efg	77.84 fg
Giza 164	76.95 yz	77.74 wxy	77.31 yz	77.82 z	78.18 rst	78.90 ijk	79.34 cde	78.03 ef
Sakha 61	77.42 yz	78.42 nop	77.75 wxy	78.00 uvw	78.95 ijk	79.19 cde	79.81 bcd	78.53 c
Sakha 95	77.62 xyz	78.53 mno	78.14 uvw	78.26 opq	79.12 efg	79.46 cde	80.31 b	78.77 b

Misr 3	78.07 uvw	78.88 ijk	78.32 opq	78.81 ijk	79.80 bcd	79.96 bcd	81.01 a	79.26 a
Averages of combination	76.86 g	77.74 d	77.23 f	77.54 e	78.43 c	78.90 b	79.47 a	

*Different letters mean there is a significant difference.

3 .Ash percentage:(%)

The genetic composition Misr 3 significantly outperformed all genetic compositions with an arithmetic mean of (2.00)%, while the composition Mawada gave a lower arithmetic mean of (1.72)%, that the difference in genetic compositions in this trait may be due to the nature of their genetic genes and their ability to absorb mineral elements and the influence of environmental factors, and these results were consistent with (Al-Gayashi, 2020; Marwa, 2022),

The combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) showed a significant effect on all combinations with an arithmetic mean of 1.89%, while the control treatment achieved the lowest arithmetic mean of 1.76%, that the mechanism of action of glutamic acid and arginine as a result of spraying wheat plant leaves had a positive effect in increasing the absorbed amounts of mineral elements, which led to To increase the area of the flag leaf and increase the efficiency of photosynthesis and the accumulation of dry matter, as the increase in the ash percentage and the flour extraction percentage are directly proportional, and these results are consistent with the study of (AL-Mohammadi, 2018; Aljoani, 2020), who found significant differences in the ash percentage as a result of the effect of spraying glutamic acid and arginine. The genetic composition Misr 3 with the combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) recorded a significant superiority over all interactions except for the Fayyad composition for the same combination with an arithmetic average of 2.16%, while the interaction between the Mawada composition and the control treatment gave the lowest arithmetic average of 1.53%.

Table 3. Effect of the combination (glutamic acid and arginine) on wheat genotypes for grain Ash percentage (%).

The combination / Genotype	**(Glu.0 +Arg.0) mg L^{-1}**	**(Glu.200 +Arg.0) mg L^{-1}**	**(Glu.0 +Arg.200) mg L^{-1}**	**(Glu.100 +Arg.100) mg L^{-1}**	**(Glu.100 +Arg.200) mg L^{-1}**	**(Glu.200 +Arg.100) mg L^{-1}**	**(Glu.200 +Arg.200) mg L^{-1}**	**Genotypes Average**
Al-Fayyad	1.75 lmn	1.91 def	1.83 ghi	1.89 def	1.92 def	1.93 def	2.06 abc	1.88 bc
Mawaddah	1.50 t	1.75 jkl	1.71 mno	1.73 lmn	1.74 lmn	1.75 jkl	1.77 jkl	1.72 hi
Buhouth 22	1.80 ijk	1.85 ghi	1.81 fgh	1.82 ijk	1.83 ijk	1.86 cde	1.86 cde	1.82 de
Babylon 113	1.72 lmn	1.83 ghi	1.91 def	1.84 ghi	1.90 def	1.90 def	1.91 def	1.84 cd
Gomeza 9	1.72 lmn	1.81 ijk	176 klm	1.80 ijk	1.81 ijk	1.84 ghi	1.86 cde	1.80 def
Giza 164	1.66 qrs	1.78 ijk	1.70 pqr	1.76 efg	1.77 efg	1.80 ijk	1.81 ijk	1.74 hgi

Sakha 61	1.75 lmn	1.77 ijk	1.70 pqr	1.75 lmn	1.78 ijk	1.78 ijk	1.81 ijk	1.75 hgi
Sakha 95	1.72 lmn	1.80def	1.78 ijk	1.77 jkl	1.78 efg	1.80 ijk	1.80 ijk	1.77 efg
Misr 3	1.78 efg	1.93 cde	1.78 efg	1.81 ijk	1.85 fgh	2.11 ab	2.14 a	2.00 a
Averages of combination	1.76 e	1.80 ed	1.78 ed	1.79 ecd	1.83 cb	1.86 ab	1.88a	

*Different letters mean there is a significant difference.

4 .Pelshinki test (minute) :

The genetic composition Misr 3 outperformed with the highest average of 119.61 minutes and with a significant difference from the rest of the compositions, while the composition Moudah gave the lowest arithmetic average (71.54) minutes. This difference is due to the genetic nature of the genetic compositions, which was reflected in the variation in this trait, in agreement with (Siddiqi, 2020; Aljoani, 2020). The superiority of the combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) was noted over all combinations, recording the highest arithmetic average (141.13) minutes, while the control treatment had the lowest arithmetic average for the Pelshinki test trait, reaching 53.13 minutes. This may be attributed to the direct role of glutamic acid and arginine in increasing and improving the quality of gluten in grains. Especially when added in the highest combination compared to the rest of the combinations, this is consistent with both (Al-Shamary, 2019; Abd El-Rheem, 2021). Also, the interaction between the combinations and genetic compositions was significant through the superiority of the genetic composition Misr 3 with the combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) significantly and on all interactions with an arithmetic mean of 174.00 minutes, while the interaction between the composition Mawada and the control treatment gave the lowest arithmetic mean of 33.00 minutes.

Table 4. Effect of the combination (glutamic acid and arginine) on wheat genotypes for grain Belchenki Test (Min).

The combination / Genotype	**(Glu.0 +Arg.0) mg L^{-1}**	**(Glu.200 +Arg.0) mg L^{-1}**	**(Glu.0 +Arg.200) mg L^{-1}**	**(Glu.100 +Arg.100) mg L^{-1}**	**(Glu.100 +Arg.200) mg L^{-1}**	**(Glu.200 +Arg.100) mg L^{-1}**	**(Glu.200 +Arg.200) mg L^{-1}**	**Genotypes Average**
Al-Fayyad	55.00 z	93.00 vwx	63.33 yz	107.66 uvw	120.00 qrs	131.66 mno	135.00 ijk	100.81 d
Mawaddah	33.00 z	62.66 yz	52.33 z	67.00 yz	89.33 wxy	97.00 vwx	102.00 uvw	71.90 h
Buhouth 22	52.00 z	75.66 yz	65.33 yz	87.00 wxy	121.00 pqr	131.00 mno	144.00 def	96.57 ef
Babylon 113	52.00 z	76.66 yz	65.00 yz	122.00 opq	109.33 tuv	121.66 pqr	134.33 jkl	97.28 def
Gomeza 9	41.00 z	74.00 yz	67.00 yz	68.00 yz	118.00 qrs	121.00 pqr	136.00 hij	89.28 g
Giza 164	46.00 z	71.66 yz	64.33 yz	81.00 xyz	127.00 nop	131.00 mno	145.00 def	95.14 f

Sakha 61	46.33 z	77.00 yz	77.00 yz	117.00 rst	149.66 def	150.33 def	154.66 bcd	110.28 cb
Sakha 95	85.00 xyz	94.00 vwx	90.66 wxy	108.00 uvw	132.66 klm	142.00 ghi	144.00 def	113.76 cb
Misr 3	72.00 yz	81.66 xyz	73.33 xyz	118.33 qrs	154.00 bcd	163.00 bc	174.00 a	119.47 a
Averages of combination	53.59 g	78.48 e	68.70 f	97.33 d	124.55 c	132.07 b	141.00 a	

*Different letters mean there is a significant difference.

Farinograph tests :

5 .Flour water absorption ratio:(%)

The genetic composition Misr 3 recorded the highest average of 67.22%, with a significant difference from the rest of the compositions for the trait of flour water absorption ratio, with the exception of the compositions Giza 164 and Sakha 95, while the composition Mawada gave the lowest arithmetic average (66.60)%, the reason for the differentiation of some genetic compositions in this trait is that absorption increases with the increase in protein and the improvement of the gluten trait (Ibrahim, 2015), and these results were consistent with (Abu - AL-Nadr, 2019; Mukhlef, 2019).

The combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) outperformed all combinations by giving the highest arithmetic average (68.31)%, while the control treatment had the lowest arithmetic average for the water absorption rate of flour, which amounted to 65.62%. Spraying amino acids at two different times during the vegetative growth period on wheat plant leaves directly helped in facilitating their absorption, which was reflected in increasing the effectiveness of carbon structure and stimulating enzymes that synthesize protein and carbohydrates. Also, the higher the flour contains a high percentage of weak gluten, the lower its water absorption rate (Al-Abdullah, 2016). These results were consistent with both (Al-Shamary, 2019; Aloush, 2021). As for the interaction between combinations and genetic compositions, the genetic composition Misr 3 outperformed the combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) significantly and over all interactions except the genetic composition Sakha 61 for the same combination with arithmetic means of 69.54 and 69.26% respectively, while the interaction between the composition Sakha 61 and the control treatment gave the lowest arithmetic mean of 65.06%.

Table 5. Effect of the combination (glutamic acid and arginine) on wheat genotypes for grain Ratio of flour absorbency to water (%).

The combination / Genotype	**(Glu.0 +Arg.0) mg L^{-1}**	**(Glu.200 +Arg.0) mg L^{-1}**	**(Glu.0 +Arg.200) mg L^{-1}**	**(Glu.100 +Arg.100) mg L^{-1}**	**(Glu.100 +Arg.200) mg L^{-1}**	**(Glu.200 +Arg.100) mg L^{-1}**	**(Glu.200 +Arg.200) mg L^{-1}**	**Genotypes Average**
Al-Fayyad	65.60 vwx	66.75 ghi	66.24 klm	66.53 hij	67.01 ghi	67.17 ghi	67.80 cde	66.71 bc

Mawaddah	65.23 z	66.73 ghi	66.16 nop	66.51 hij	66.96 ghi	67.13 ghi	67.48 efg	66.60 c
Buhouth 22	65.71 tuv	66.76 ghi	66.29 klm	66.56 hij	67.03 ghi	67.22 ghi	67.81 cde	66.77 abc
Babylon 113	66.01 nop	66.80 ghi	66.30 klm	66.58 hij	67.04 ghi	67.29 efg	67.83 cde	66.83 abc
Gomeza 9	65.84 stu	66.82 ghi	66.32 klm	66.60 ghi	67.06 ghi	67.33 efg	68.02 cde	66.85 abc
Giza 164	65.90 rst	66.83 ghi	66.36 hij	66.60 ghi	67.09 ghi	67.40 efg	68.67 abc	66.98 abc
Sakha 61	65.96 pqr	66.85 ghi	66.44 hij	66.62 ghi	67.10 ghi	67.44 efg	68.90 abc	67.04 ab
Sakha 95	65.06 yz	66.75 ghi	66.45 hij	66.01 nop	67.11 ghi	67.43 efg	69.26 ab	66.86 abc
Misr 3	66.26 klm	66.96 ghi	66.47 hij	66.73 ghi	67.12 ghi	67.46 efg	69.54 a	67.22a
Averages of combination	65.72 f	66.80 c	66.33 de	66.52 d	67.06 bc	67.32 b	68.36 a	

*Different letters mean there is a significant difference.

6 .Arrival time (minute):

The genotype Misr3 significantly outperformed all genotypes, achieving the highest average of 4.78 minutes, while the genotype Mawada gave the lowest arithmetic average (3.96) minutes. The increase in the concentration of glutamic acid and arginine may have led to a longer arrival time due to the flour containing a high percentage of protein and good quality gluten, which takes longer to reach the curve (500) Brabander units (Steffonlani, 2010) and agreed with both (Abd El-Rheem, 2021; AL-Fahdawi, 2021). The combinations (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}), (glutamic acid 200 mg L^{-1} + arginine acid 100 mg L^{-1}) and (glutamic acid 100 mg L^{-1} + arginine acid 200 mg L^{-1}) outperformed the rest of the combinations by giving the highest arithmetic mean (4.61, 4.37 and 4.36) minutes respectively, while the control treatment had the lowest arithmetic mean for the arrival time trait, reaching 4.08 minutes. The superiority of the genotype Misr 3 was observed when interacting with the combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) significantly (5.50) minutes, respectively, for all interactions, while the genotype Mawada declined with the control treatment during the first season, achieving the lowest arithmetic mean of 3.21 minutes.

Table 6. Effect of the combination (glutamic acid and arginine) on wheat genotypes for grain Arrival time (Min).

The combination / Genotype	**(Glu.0 +Arg.0) mg L^{-1}**	**(Glu.200 +Arg.0) mg L^{-1}**	**(Glu.0 +Arg.200) mg L^{-1}**	**(Glu.100 +Arg.100) mg L^{-1}**	**(Glu.100 +Arg.200) mg L^{-1}**	**(Glu.200 +Arg.100) mg L^{-1}**	**(Glu.200 +Arg.200) mg L^{-1}**	**Genotypes Average**
Al-Fayyad	3.71 z	4.00 yz	3.75 z	3.94 yz	4.12 wxy	4.22 tuv	4.51 stu	4.03 f
Mawaddah	3.21 z	3.98 yz	3.65 z	3.70 z	3.78 z	4.12 uvw	5.03 def	3.96 f
Buhouth 22	3.75 z	4.27 stu	3.83 z	4.00 ya	4.23 tuv	4.23 tuv	5.20 bcd	4.21 e

Babylon 113	4.20 uvw	4.47 stu	4.18 uvw	4.43 stu	4.64 jkl	5.07 cde	5.11 cde	4.58 cd
Gomeza 9	3.41 z	4.08 wxy	3.54 z	3.81 yz	4.25 wxy	4.25 tuv	5.20 bcd	4.02 f
Giza 164	3.52 z	4.06 wxy	3.93 yz	3.97 yz	4.31 stu	4.55 stu	5.03 def	4.19 e
Sakha 61	3.41 z	4.12 wxy	3.78 yz	4.31 stu	4.35 stu	4.60 stu	4.91 efg	4.21 e
Sakha 95	3.82 yz	4.25 tuv	4.19 uvw	4.75 ghi	4.83 fgh	5.02 def	5.17 bcd	4.57 cd
Misr 3	3.94 yz	5.14 bcd	3.96 yz	4.25 stu	5.17 bcd	5.26 bcd	5.50 a	4.78 b
Averages of combination	4.08 ed	4.27 cd	4.13 e	4.19 ecd	4.36 c	4.37 c	4.61 a	

*Different letters mean there is a significant difference.

7 .Stability (minute) :

When following the arithmetic averages of the study factors and their binary interactions for the stability trait shown in Table (7), it was noted that the genetic composition Misr 3 was significantly superior to all genetic compositions with an arithmetic average of 3.27 minutes, while the composition Mawada gave a lower arithmetic average (2.63) minute. This difference is due to the genetic nature of the genetic compositions. The superiority of the genetic composition Misr 3 in the stability trait came as a result of its superiority in the two traits of protein ratio and gluten ratio. The compositions that were characterized by high values for these traits excelled in the stability value. These results agreed with what was mentioned by (Ibrahim, 2015; Baqir, 2019)

The combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) also outperformed all combinations, recording the highest average My calculation (4.72) minutes, while the control treatment had the lowest arithmetic mean for the stability trait, which amounted to 1.79 minutes. The genetic compositions whose leaves were sprayed with the highest combination of glutamic acid and arginine recorded a significant superiority in the sedimentation value trait, and with the presence of association between the sedimentation value and stability traits, as the stability value increases with the increase in the sedimentation value. These results were consistent with the results of both (Abu-AL-Nadr, 2019; Marwa, 2022). The interaction between combinations and genotypes was significant by recording the genotype Misr 3 with the combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) with the highest arithmetic mean and significant variation on all interactions with an arithmetic mean of 5.81 minutes, while the interaction between the combination Mawada and the control treatment gave the lowest arithmetic mean of 1.20 minutes.

Table 7. Effect of the combination (glutamic acid and arginine) on wheat genotypes for grain stability (Min).

The combination / Genotype	**(Glu.0 +Arg.0) mg L^{-1}**	**(Glu.200 +Arg.0) mg L^{-1}**	**(Glu.0 +Arg.200) mg L^{-1}**	**(Glu.100 +Arg.100) mg L^{-1}**	**(Glu.100 +Arg.200) mg L^{-1}**	**(Glu.200 +Arg.100) mg L^{-1}**	**(Glu.200 +Arg.200) mg L^{-1}**	**Genotypes Average**
Al-Fayyad	1.81 z	2.67 wxy	2.42 yz	2.59 xyz	2.85 rst	3.11 mno	4.41 e	2.84 cd

Mawaddah	1.20 z	2.73 wxy	2.37 yz	2.56 yz	2.87 rst	3.09 nop	3.63 f	2.63 e
Buhouth 22	1.51 z	2.76 wxy	2.35 yz	2.60 xyz	2.89 rst	3.18 lmn	4.57 c	2.83 cd
Babylon 113	1.71 z	2.73 wxy	2.44 yz	2.63 xyz	2.94 qrs	3.24 klm	4.14 f	2.835 cd
Gomeza 9	1.72 z	2.81 tuv	2.42 yz	2.65 xyz	2.94 qrs	3.31 jkl	4.25 de	2.87 c
Giza 164	1.81 z	2.83 tuv	2.46 yz	2.66 xyz	2.96 qrs	3.39 hij	5.28 b	3.05 b
Sakha 61	2.01 z	2.84 tuv	2.46 yz	2.68 xyz	2.99 pqr	3.45 fgh	5.31 b	3.109 b
Sakha 95	2.00 z	2.87 rst	2.53 xyz	2.70 wxy	3.01 pqr	3.49 fgh	5.13 b	3.106 b
Misr 3	2.32 z	2.89 rst	2.54 xyz	2.70 wxy	3.06 opq	3.56 fgh	5.81 a	3.27 a
Averages of combination	1.79 g	2.79 d	2.44 f	2.64 e	2.94 c	3.31 b	4.72 a	

*Different letters mean there is a significant difference.

8 .Departure time (minute):

The genetic composition Misr 3 outperformed by giving the highest average of 8.05 minutes, with a significant difference from the rest of the compositions for the departure time trait, while the composition Mawaddah gave the lowest arithmetic average (6.59) minutes. The reason may be due to the genetic nature of the genetic composition and its ability to convert carbon metabolism products (carbohydrates) into grains, which provided sufficient opportunity to accumulate the largest amount of good quality protein. All of this helped to increase the departure time, which was agreed upon by both (Shalaby, 2018; AL-Dulaimi, 2018).

The combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) outperformed all combinations by giving the highest arithmetic average (9.07) minutes, while the control treatment had the lowest arithmetic average for the departure time trait, which amounted to 5.30 minutes. This trait is calculated by adding the time taken for the arrival time and stability time traits, which recorded the highest concentration for the combination of glutamic acid and arginine, the highest time, as indicated in Tables (6) and (7). Therefore, it is natural that the highest calculated time for this trait is recorded with the highest combination, which is what was indicated by (Abd El-Rheem, 2021; Mital, 2022).

As for the interaction coefficients between combinations and genetic compositions, they were significant by recording the highest arithmetic average, as the genetic composition Misr 3 outperformed the combination (glutamic acid 200 mg L^{-1} + arginine acid 200 mg L^{-1}) significantly and over all interactions with an arithmetic average of 10.32 minutes, while the interaction between the composition Gomeza 9 and the control treatment gave the lowest arithmetic average of 4.05 minutes.

Table 8. Effect of the combination (glutamic acid and arginine) on wheat genotypes for grain Departure time (Min).

The combination / Genotype	(Glu.0 +Arg.0) mg L^{-1}	(Glu.200 +Arg.0) mg L^{-1}	(Glu.0 +Arg.200) mg L^{-1}	(Glu.100 +Arg.100) mg L^{-1}	(Glu.100 +Arg.200) mg L^{-1}	(Glu.200 +Arg.100) mg L^{-1}	(Glu.200 +Arg.200) mg L^{-1}	Genotypes Average
Al-Fayyad	5.81 z	6.89 wxy	6.17 z	6.71 xyz	7.37 opq	7.05 uvw	8.12 ghi	6.87 ef
Mawaddah	4.90 z	6.71 xyz	5.79 z	6.21 t-u-v	7.03 uvw	6.87 wxy	8.64 cde	6.59 g
Buhouth 22	5.50 z	6.83 wxy	6.18 yz	6.64 yz	7.03 uvw	7.41 opq	9.77 ab	7.05 cde
Babylon 113	5.90 z	7.71 mno	7.16 rst	6.62 yz	7.94 jkl	8.01 hij	9.24 bcd	7.51 b
Gomeza 9	4.05 z	6.35 yz	6.15 tuv	6.48 yz	6.90 vwx	8.51 efg	8.04 ghi	7.50 b
Giza 164	5.87 z	6.93 wxy	6.40 yz	6.98 vwx	7.86 ijk	7.94 ijk	8.77 cde	7.25 bcd
Sakha 61	5.42 z	7.15 rst	6.46 yz	6.82 wxy	7.59 nop	8.37 fgh	9.42 bc	7.32 bc
Sakha 95	4.46 z	7.63 nop	6.52 yz	7.55 nop	7.84 jkl	8.66 cde	9.30 bcd	7.28 bcd
Misr 3	6.67 xyz	7.81 klm	6.83 wxy	7.71 mno	8.20 ghi	8.82 cde	10.32 a	8.05 a
Averages of combination	5.30 f	7.07 cd	6.63 e	6.80 ed	7.31 c	7.93 b	9.07 a	

*Different letters mean there is a significant difference.

CONCLUSIONS

The results showed that there were significant differences in this study between the genetic compositions used in most of the studied traits, which indicates the presence of genetic differences in their ability to respond and represent and absorb amino acids, as the genetic composition of Gomeza 9 and Misr 3 outperformed in the yield trait, while the genetic composition of Misr 3 outperformed significantly in the traits of extraction percentage, ash, Pelshinki test and varinograph tests (percentage of flour absorption of water, arrival time, stability, departure time). The mechanism of spraying wheat plant leaves with amino acids can be adopted due to its effective role in increasing the traits of the yield and its components and its positive effect in increasing the productivity of the crop per unit area by adopting the introduced genetic compositions and testing them with several factors within the conditions of the region.

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