EFFECT OF SOME AMINO ACIDS ON TILLERING AND YIELD OF THREE BREAD WHEAT CULTIVARS

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ABSTRSCT

The objective of this study was to investigate the effect of some amino acids on tillering and grain yield of bread wheat cultivars. A field experiment was carried out at the agricultural experiment station, College of Agriculture Engineering Sciences, University of Baghdad during the two winter seasons, 2016-2017 and 2017-2018. Randomized Complete Block Design within split plots arrangement was used in three replicates. The experiment included two factors, the first (main plots) was the wheat cultivars (IPA 99, Buhooth 22, and Abu-Graib3) and the second (sub-plots) was foliar application three amino acids (L-Tryptophan, L-Glycine, and L-Lysine) with concentrations 50 and 100 mg L^{-1} and the amino acid L-Cystine at 100 and 150 mg L^{-1} and control treatment. The treatments of foliar application were applied during two growth stages, the first was when the main stem had three leaves (ZGS: 13) and the second was when the plant entered the flowering stage (ZGS: 60). Results showed the significant superiority of Buhooth 22 in most growth traits, which produced the highest number of tillers.m^{-2} (556.30 and 568.15 tillers m^{-2}), number of spikes (476.74 and 494.19 spikes m^{-2}), weight of 1000 grains (31.09 and 32.43 g), and grain yield (5.39 and 5.15 Mg ha^{-1}) for the two seasons respectively. The treatment of foliar application L-Tryptophan at 50 mg L^{-1} was significantly superior in most traits of yield components which produced the highest values of the number of tillers (616.89 and 627.78 tillers m^{-2}), number of spikes (477.00 and 944.67 spikes m^{-2}), weight of 1000 grains (32.01 and 33.55g), and grain yield (5.77 and 5.33Mg ha^{-1}) in the two seasons, respectively. The response of wheat cultivar growth and yield to amino acids differed significantly.

Key words: number of tillers m^{-2}, number of spikes m^{-2}, weight of 1000 grains and grain yield.
Part of Ph.D. Dissertation of the first author

تأثير بعض الأحماض الأمينية في صفة التفريع والحاصل ومكوناته لثلاثة أصناف من حنطة الخبز

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المستخلص

نفذت تجربة حقلية خلال الموسمين الشتويين 2016-2017 و2017-2018 في محطة التجارب الزراعية D والتابعة لكلية علوم الهندسة الزراعية – جامعة بغداد وفق تصميم القطاعات الكاملة المعشاه RCBD وبترتيب الألواح المنشقة وبثلاثة مكررات، بهدف معرفة الأداء الفسيولوجي لثلاثة أصناف من حنطة الخبز تحت تأثير الاحماض الأمينية وعلاقتها بصفات النمو وانعكاسها بحاصل الحبوب ومكوناته. تضمنت التجربة عاملين، الأول (الرئيسي) الأصناف الثلاثة وهي (اباء 99 وبحوث22 وأبوغريب-3) والعامل الثاني (الثانوي) تضمنت رش الاحماض الامينية (L-Tryptophan وL-Glycine وL-Lysine) بتركيز (50 و100) ملغم لتر$^{-1}$، وL-Cystine بتركيز (100 و150) ملغم لتر$^{-1}$. استعملت معاملات الرش بمرحلتين الأولى عند امتلاك الساق الرئيس ثلاث أوراق (ZGS:13)، والثانية عند دخول النبات مرحلة التزهير (ZGS:60). اظهرت نتائج التجربة تفوق صنف بحوث 22 معنوياً في معظم صفات النمو إذ اعطى اعلى متوسط لعدد الفروع الكلية للمتر المربع الواحد (556.30 و568.15) فرع م$^{-2}$ لكلا الموسمين بالتتابع. ومتوسط عدد السنابل م$^{-2}$ (476.74 و494.19) سنبلة م$^{-2}$ وأثقل وزن لألف حبة بمتوسط بلغ (31.09 و32.43) غم واعلى حاصل حبوب بمتوسط (5.39 و5.15) ميكا غرام هـ$^{-1}$.تفوقت معاملة رش الحامض الاميني L-Tryptophan بتركيز50 ملغم لتر$^{-1}$ معنوياً في معظم صفات النمو للموسمين بالتتابع، إذ أعطت اعلى متوسط لعدد الفروع للمتر المربع بلغ 616.89 و627.78 فرع م$^{-2}$. تفوقت معاملة رش الحامض الاميني L-Tryptophan بتركيز 50 ملغم لتر$^{-1}$ معنوياً لصفات الحاصل ومعظم مكوناته، إذ اعطى اعلى عدد للسنابل بلغ 477.00 و494.67 سنبلة م$^{-2}$ وأثقل وزن لألف حبة بمتوسط بلغ 32.01 و33.55 غم واعلى متوسط لحاصل الحبوب بلغ 5.77 و5.33 ميكا غرام هـ$^{-1}$. كان تأثير التداخل بين عاملي الدراسة معنوياً في صفات النمو المدروسة والحاصل ومكوناته. نستنتج من الدراسة الى اختلاف استجابة الأصناف لمعاملات رش الاحماض الامينية في صفة التفريع والذي انعكس ذلك في صفات الحاصل ومكوناته.

الكلمات المفتاحية: عدد الفروع م$^{-2}$، عدد السنابل م$^{-2}$، وزن ألف حبة، حاصل الحبوب
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INTRODUCTION

Amino acids can have a positive effect on improving the growth and yield of wheat (*Triticum eastivum* L.) Production since foliar plants with amino acids plays a great role in stimulating physiological and biochemical processes. Tryptophan is one of the amino acids that activates the formation of natural auxins, playing a major role in stimulating the growth of roots in the plant; Moreover, Tryptophan is one of the most efficient physiological initiators and the main source of IAA in most living organisms (25, 27, and 30). Amino acids have an important role in many biological processes, as a component of proteins. Their importance and effectiveness lie in all plant growth stages since they contribute to increasing the cell ability to absorb water and nutrients from soil and increase the vegetative growth Kandi etal (24). Referred that foliar application the wheat crop with amino acids under the fertilizer level of 166, 214, and 262 kgN.ha^{-1} led to increasing plant height by 23.29% and chlorophyll content resulting in getting the highest degree of photosynthesis and increasing the grain yield (12). Foliar application Tryptophan with the concentrations of 25, 50 and 100 mg L^{-1} after 30, 45, and 75 days from planting caused an increase in plant growth, The concentration of 25 mg L^{-1} produced the highest number of tillers (16). foliar application Cystine at 150mg.l^{-1} increased most traits of wheat when compared to the concentration of 100 mgL^{-1}. The results showed that foliar application of Tryptophan and Cystine at all concentrations caused significant increases in all wheat traits of compared to the control treatment. Nilesh et al (28) mentioned that biological regulators represented a group of chemicals, including Cystine regulating plant physical and physiological activities. Many studies have carried out to investigate the effect of biological regulators on crop yield and quality. The results found by Zaboon et al (33) showed the significant differences between the two wheat cultivars (IPA 99 and Abu-Graib 3) in the number of tillers.m^{-2}, where IPA 99 produced the highest value, 404.90 tillers m^{-2}. The results found by AL- Hassan (5) showed that the Iraqi wheat cultivars (Iraq, Al-Fatih, Abu-Graib 3, and IPA95) were significantly differed in yield and yield components. The results of Abdulkarim (1) revealed differences among wheat cultivars in number of grains.spike^{-1} and weight of 1000 grains, where Buhooth 22 produced the highest grain number, 59.83 grains.spike^{-1}, while the cultivar, Hassad, recorded the highest weight of 1000 grains, 39.06 g. This study aimed to invistigate the physiological behavior of three cultivars of bread wheat under the influence of different concentrations of four amino acids and their impacts to the characteristics of the crop growth, yield and yield components.

MATERIALS AND METHODS

Two field crops experiments were carried out at the fields of College of Agriculture Engineering Sciences, University of Baghdad, Jadriya, during the two winter seasons, 2016-2017 and 2017-2018 according to the randomized complete block design whith split plot arrangement in order to study the physiological behavior of three wheat cultivars (IPA, 99, Buhooth 22, and Abu-Graib3) under the effect of some amino acids. Soil samples were taken from the depths of 0-30 cm before planting to determine the chemical and physical characteristics of the soil (Table 1).

Table 1. Physical and chemical characteristics of the soil

Characteristics		Season 2016-2017	Season 2017-2018
Soil structure	Sand	496	502
	Silt	260	290
	Clay	244	208
Soil texture		Sandy loam	Sandy loam
Soil pH		7.71	7.65
EC (dS.m^{-1})		2.80	2.30
Available Nitrogen mg.kg^{-1}		35.00	30.00
Available phosphor mg.kg^{-1}		10.20	8.22
Available Potassium mg.kg^{-1}		165.00	151.00
Organic matter %		1.19	1.10

The experimental field was plowed twice in both seasons (5/11/2016 and 5/11/2017) then leveled and divided into 81 experimental units with dimensions 2 x 2.5 m. The study included two factors: first (main plots) wheat cultivars (IPA 99, Buhooth 22, and Abu-Graib 3) and the second (sub-plots) amino acids (50 and 100 mg L^{-1} of L-Tryptophan, 50 and 100 mg L^{-1} of L-Glycine, 50 and 100 mg L^{-1} of L-Lysine, and 100 and 150 mg L^{1} of L- Cystine) in addition to the control treatment. Each experimental unit consisted of 12 rows with 2 m length and 0.2m between therows. The treatments units were isolated from each other by 2m. Fields of two seasons were seeded on 23/11/2016 and 23/11/2017 using sowing rate120 kg ha^{-1}. Two hundred kg $Nha^{-1}$of Urea fertilizer (46%N) was added to the soil in three batches: the first, when the plants had three leaves unfolded (ZGS: 13), the second when the plant had two nodes on the main stem (ZGS: 32), and the third at initiation of booting stage (ZCS: 40) according to the Zadok's et al (32). Triple superphosphate (46% P_2O_5) with 100 kg ha^{-1} was added at soil preparation. All crop and soil manage ments were carried out according to the recommendations of Jaddoa and Salih, (21). The experiment at field was irrigated when needed, an area of 0.3m 2 was harvested, and grain yield and its components were meajureal. The plants were harvested on 05/5/2017 and 11/5/2018 for the two seasons, respectively measuring the following: the average of the total number of tillers m^{-2}, spike length (cm), number of spikelets $Spike^{-1}$, number spikes m^{-2}, number grains $spike^{-1}$, 1000 grain weight, and grain yield ($Mg.ha^{-1}$). The data were statistically analyzed, using the soft war Genstae, version 7, and the means were compared using the least significant differences (LSD) under the probability level of 5%.

RESULTS AND DECISION

Number of tillers m^{-2}: The results in Table 2 showed significant differences among the cultivars and the foliar application treatments in this trait in both seasons. The plant of the cultivar Buhooth 22 were the superior, produced the highest averages (556.30 and 568.15 tillers m^{-2}) in both seasons respectively, but did not significantly differed from the cultivar IPA 99, which produced 549.63 and 561.78 tillers m^{-2} in the two seasons respectively. This variation in the number of tillers among genotypes could be due to the genetic constitution. This results agreed with other researchers (3, 4, 5, 14, 23, and 33). Significant differences were revealed among amino acids treatments foliar application 50 mg ha^{-1} of L-Tryptophan was superior to the other spraying treatments and producing the highest average of tillers number (616.89 and 627.78 tillers m^{-2} in both seasons respectively) and did not differed significantly from s foliar application L-Lysine at 50 mgL^{-1}, whereas the control treatment had the lowest averages of tiller number (431.44 and 445.11 tillers m^{-2} in the two seasons respectively). Table-2 revered that foliar application amino acids L-Tryptophan and L-Lysine at the concentration of $50mgL^{-1}$ led to an increment in the number of tillers (by 11.91 and 3.11 %) and (by 11.15 and 4.33%) compared to the treatments of foliar application L-Tryptophan and L-Lysine at $100mg.L^{-1}$ in both seasons. These results were consistent with the finding of El-Bassiouny (16) and El-Hosary et al (17). They referred to an increment in the number of tillers in wheat plants foliar application by the amino acid, Tryptophan with the concentration 50 mg L^{-1}. Foliar application higher concentrations of L-Glycine and L-Cystine produced an increase in the percentage of the tiller number average (Table 4). Moreover, the same Table reveal that foliar application higher concentrations of L-Glycine and L-Cystine gave an increase in the percentage of the tiller number average (11.80 and 13.72 %) in the first season and (11.55 and 13.50%) in the second season compared to the lower concentrations of these amino acids. The increment gained in the number of tillers when sprayed with amino acids might be due to the huge role of amino acids in stimulating the physiological and biochemical processes which involved in protein constitution and carbohydrate synthesis through constructing chlorophyll and stimulating photosynthesis as well as encouraging the action of many enzymes, coenzymes, and bases of Purine and Puridine (26, 10, 15, 19). The superiority of L-Tryptophan at the concentration of 50 mgl^{-1} might be attributed to the contribution of this amino acid in constructing IAA which in turn

stimulated the cell division and expansion and thus the growth increment (20, 30, 25). The interaction among cultivars and amino acids did not significant indicated that the response of cultivars in this experiment to amino acids was parallel in the number of tillers for both season

Table 2. Effect of amino acids and wheat cultivar on the number of tillers m^{-2} in the two seasons 2016-2017 and 2017-2018

Amino acids	Season 2016-2017 Cultivars			
	Ibaa 99	Buhooth 22	Abu-Graib3	Mean
Control	428.33	455.33	410.67	431.44
L-Tryptophan 50 mgl^{-1}	622.30	680.00	548.33	616.89
L-Tryptophan 100 mgl^{-1}	615.67	563.00	475.00	551.22
L-Glycine 50 mgl^{-1}	522.67	483.33	476.67	494.20
L-Glycine 100 mgl^{-1}	531.00	598.33	528.33	552.56
L-Lysine 50 mgl^{-1}	598.33	575.00	590.00	587.78
L-Lysine 100 mgl^{-1}	588.33	573.33	548.33	570.00
L- Cystine 100 mgl^{-1}	476.67	518.33	461.67	485.56
L- Cystine 150 mgl^{-1}	563.33	560.00	533.33	552.22
LSD 0.05	NS			43.73
Mean	549.63	556.30	508.04	
LSD 0.05	36.39			
Amino acids	Season 2017-2018 Cultivars			
	Ibaa 99	Buhooth 22	Abu-Graib3	Mean
Control	441.00	469.00	425.33	445.11
L-Tryptophan 50 mgl^{-1}	635.00	687.00	561.33	627.78
L-Tryptophan 100 mgl^{-1}	629.67	577.00	487.67	564.78
L-Glycine 50 mgl^{-1}	538.00	506.00	487.67	510.56
L-Glycine 100 mgl^{-1}	547.00	619.00	542.67	569.56
L-Lysine 50 mgl^{-1}	613.67	595.33	605.00	604.67
L-Lysine 100 mgl^{-1}	594.00	588.00	556.67	579.56
L- Cystine 100 mgl^{-1}	477.00	494.00	532.33	501.11
L- Cystine 150 mgl^{-1}	580.67	578.00	547.67	568.78
LSD 0.05	NS			43.78
Mean	561.78	568.15	527.37	
LSD 0.05	25.63			

Number of spikes m^{-2}

The results in Table 3 shows significant differences among cultivars and the treatments of foliar application with amino acids as well as the interaction between them. The cultivar, Buhooth 22 had the highest average of this trait in the two seasons (476.74 and 494.19 spike m^{-2}) respectively, but did not differ significantly from IPA 99. The differences between IPA 99 and Abu-Graib 3 were not significantly. These results confirmed results of other studies such as (5, 14, 22, 23, 33). The results in Table 5 illustrate the superiority of the treatment of foliar application 50 mg L^{-1} of L-Tryptophan with average (477.00 and 494.67 spikes m^{-2}, namely an increment by 30.52 and 28.82 %compared to the control treatment in two seasons respectively. This concentration did not differed significantly from foliar application 100 mgL^{-1} of L-Glycine, 50 or 100 mgL^{-1} of L-Lysine, or 150 mg L^{-1} of L-Cystine in the both seasons. This superiority could be due to the influence of this treatment for producing fertile tillers bearing spikes. This finding agreed with results of EL-Bassiouny (16), who found that the foliar application of Tryptophan caused increase in the number of spikes. The results in Table 5 indicate a significant interaction between studied factors indicating a difference in the response of cultivars to different amino acids and concentrations of amino acids for this trait. The amino acid, L-Tryptophan and L-Glycine with the concentrations (50 and 100 mgl^{-1}) and the cultivars IPA 99, Buhooth 22, and Abu-Graib3, for instance, the number of spikes m^{-2} decreased by 8.64 and 7.47% of IPA 99 when the concentration of L-Tryptophan increased from 50 to 100 mg l^{-1}, whereas, the number of spikes of the cultivar

Buhooth 22, at the same treatment, decreased by 6.90 and 8.85%, and for the cultivar Abu-Graib 3, at the same concentration also, the decrease percentages were 6.06 and 7.47% in the two seasons respectively. There was another type of interaction, which was the differences in the of the Buhooth 22 and Abu-Graib-3 compared to the cultivar IPA 99 when spraying the amino acid, L-Lysine, as well as between IPA 99 and Abu-Graib- 3 compared to Buhooth 22 when they were sprayed by L-Cystine, for example, the number of spikes m^{-2} of IPA 99 increased by 28.93 and 24.04% coincided with the increase in the concentration of spraying L-Cystine in the two seasons respectively.

Table 3. Effect of amino acids and wheat cultivar on the number of spikes m^{-2} in the two seasons 2016-2017 and 2017-2018

Amino acids	Season 2016-2017 Cultivars			
	IPA 99	Buhooth 22	Abu-Graib3	Mean
Control	383.67	401.67	311.00	365.44
L-Tryptophan 50 mgl^{-1}	493.33	531.00	406.67	477.00
L-Tryptophan 100 mgl^{-1}	450.67	494.33	382.00	442.33
L-Glycine 50 mgl^{-1}	462.67	445.33	460.33	456.11
L-Glycine 100 mgl^{-1}	477.67	469.67	472.00	473.11
L-Lysine 50 mgl^{-1}	439.33	505.67	418.00	454.33
L-Lysine 100 mgl^{-1}	486.33	494.33	373.00	451.22
L- Cystine 100 mgl^{-1}	399.67	482.00	341.33	407.67
L- Cystine 150 mgl^{-1}	515.33	466.67	439.00	473.67
LSD 0.05	73.79			35.80
Mean	456.52	476.74	400.37	
LSD 0.05	58.42			
Amino acids	**Season 2017-2018 Cultivars**			
	IPA 99	Buhooth 22	Abu-Graib3	Mean
Control	399.33	418.33	334.33	384.00
L-Tryptophan 50 mgl^{-1}	503.67	553.33	427.00	494.67
L-Tryptophan 100 mgl^{-1}	466.00	504.33	393.00	454.44
L-Glycine 50 mgl^{-1}	465.67	463.67	475.33	468.22
L-Glycine 100 mgl^{-1}	486.33	485.67	483.00	485.00
L-Lysine 50 mgl^{-1}	449.00	525.67	430.00	468.22
L-Lysine 100 mgl^{-1}	498.67	509.67	388.33	465.56
L- Cystine 100 mgl^{-1}	419.00	497.00	365.67	427.22
L- Cystine 150 mgl^{-1}	519.67	490.00	448.67	486.11
LSD 0.05	67.26			30.91
Mean	467.48	494.19	416.15	
LSD 0.05	56.69			

Number of grains spike^{-1}

Results in Table 4 reveald a significant superiority of IPA 99, which produced the highest number of, grains averaged 63.37 and 61.45 grain spike^{-1} followed by Buhooth 22 with averages of 55.92 and 55.48 grains Spike^{-1} in both seasons respectively. The results indicated that IPA 99 differed significantly from Au-Graib-3 in this trait in both seasons.These results were agreed with results of other researchers (5, 14, 7, 23, 22, 1, 33). foliar application amino acids showed a significant differences among the kind and concentrations of amino acids to this trait. foliar application L-Lysine at 100 mgl^{-1} was superior in both seasons (59.89 and 59.05 grains spike^{-1} respectively, but did not differed significantly from spraying L-Tryptophan at 50 mgl^{-1} in both seasons which produced averages of 59.43 and 57.89 grains spike^{-1} respectively, and from L-Glycine at 50 mg L^{-1} during the first season only when had an average of 59.04 grains Spike^{-1}. The control treatment produced the lowest number of grains in the two seasons (50.53 and 49.73 grains spike^{-1}) with decline percentage of 15.62 and 15.78% when compared to the superior treatment respectively. The positive effect of amino acids on this trait may be due to their role in constructing DNA, RNA, and proteins needed to form the enzymes strongly needed for vital activity and for increasing the cell division that would lead to an increases in the flowering time. In addition to their role of

stimulating the physiological processes at the flowering stage that would increase the pollen grain amount and eventually would reflex on the number of grains spike^{-1} could be occurred .It was showed from table 4 a significant differences among the amino acids when the different foliar application concentrations except for L-Cystine during the first season only. There was a significant effect of interaction between the two factors on this trait. This revealed that cultivars response differed in this trait due to difference kinds and concentrations of amino acids in both seasons. The number of grains.spike^{-1} of the two cultivars, IPA 99 and Buhooth 22 decreased significantly when the concentration of L-Tryptophan and L-Glycine increased from 50 to 100 mgL^{-1}, whereas, the number of grains per spike of Abu-Graib 3 increased when the plants were foliar application by 100 mg L^{-1} of Tryptophan and L-Glycine also in both season. The Table 4 reveal that the increment of L-Cystine concentration led an increment in the number of grains of IPA 99 and Abu-Graib 3. While in the variety decreased Buhooth 22 in both season.

Table 4. Effect of amino acids and wheat cultivar on the number of grains Spike^{-1} in the two seasons 2016-2017 and 2017-2018

Amino acids	Season 2016-2017 Cultivars			
	IPA 99	Buhooth 22	Abu-Graib3	Mean
Control	55.10	49.55	46.93	50.53
L-Tryptophan 50 mgl^{-1}	68.36	56.14	53.80	59.43
L-Tryptophan 100 mgl^{-1}	58.06	57.77	55.40	57.08
L-Glycine 50 mgl^{-1}	66.39	58.58	52.16	59.04
L-Glycine 100 mgl^{-1}	62.09	52.59	55.00	56.56
L-Lysine 50 mgl^{-1}	62.16	59.57	51.93	57.89
L-Lysine 100 mgl^{-1}	65.02	64.38	50.27	59.89
L- Cystine 100 mgl^{-1}	65.75	54.37	51.46	57.19
L- Cystine 150 mgl^{-1}	67.40	50.33	55.89	57.87
LSD 0.05	2.30			1.27
Mean	63.37	55.92	52.54	
LSD 0.05	1.34			
Amino acids	Season 2017-2018 Cultivars			
	IPA 99	Buhooth 22	Abu-Graib3	Mean
Control	54.11	48.40	46.67	49.73
L-Tryptophan 50 mgl^{-1}	64.12	58.45	51.09	57.89
L-Tryptophan 100 mgl^{-1}	59.20	54.00	52.81	55.34
L-Glycine 50 mgl^{-1}	63.95	57.47	50.44	57.29
L-Glycine 100 mgl^{-1}	59.96	50.60	54.11	54.89
L-Lysine 50 mgl^{-1}	60.11	59.00	51.24	56.79
L-Lysine 100 mgl^{-1}	63.85	63.27	50.04	59.05
L- Cystine 100 mgl^{-1}	63.47	54.53	51.11	56.37
L- Cystine 150 mgl^{-1}	64.26	53.57	56.09	57.97
LSD 0.05	2.27			1.29
Mean	61.45	55.48	51.51	
LSD 0.05	1.15			

Weight of a thousand grains (g)

Grain weight is one of the yield components, which influence directly to the plant yield influenced by the duration of grain filling and its rate, which depend heavily upon genotypes and environmental conditions. The results in Table 5 shows a significant differences resulted from the effect of each of wheat cultivars, amino acids and interaction between them. Buhooth 22 produced the highest avera ges of this trait (31.09 and 32.43) in the first and second seasons respectively and it was differed significantly from the other two cultivars, IPA 99 and Abu-Graib 3 during the first season and only from Abu –Graib 3 during the second season. The results in the Table 5 show a significant differences between IPA 99 and Abu- Graib 3 in this trait in both seasons. This results was consistent with the results of other researchers (3, 22, 23, 33). Table 5 shows that foliar application L-

Tryptophan at concentration of 50mgL^{-1} gave the heaviest weight of 1000 grains averaged 32.01 and 33.55g in the two seasons respectively, but did not differed significantly from spraying L-Lysin at 50mgL^{-1} in the first season. Thus the treatment of foliar application L-Tryptophan at 50mg.l^{-1} achieved an increments of 11.96 and 12.13% compared to the control which had the lowest weight of 1000 grains averaged 28.59 and 29.92 g in the two seasons respectively. foliar application L-Tryptophan at 50 mg L^{-1} resulted in a decrease in the number of grains spike^{-1}Compared to foliar application L-Lysine at the concentration of 100 mgL^{-1} accompanied by an increase in the weight of 1000 grains, the phenomenon that might be due to lower competition for photosynthesis products, These results are consistent with the results of Azimi et al (13) who referred to that foliar application Tryptophan achieved an increase in grain weight by 7% compared to the control treatment. It was clear from Table7 that foliar application the same amino acid at the concentration of 100 mgL^{-1} decreased the weight of 1000 grains. The effect of the interaction between the two factors was significant on the trait in both seasons indicating the differences in the cultivar response to amino acids application , thus the weight of 1000 grains of IPA 99 and Buhooth 22 decreased resulting from spraying each of L-Glycine and L-Cystin at 100 mg.l^{-1}, while the grain weight of Abu-Graib 3 increased as a result of spraying L-Glycine at 100 mg.l^{-1}, on the other hand, increasing the concentration of L-Tryptophan decreased the weight of 1000 grains of IPA 99 and Abu-Graib, while it increased the grain weight of Buhooth 22 in both seasons.

Table 5. Effect of amino acids and wheat cultivar on the weight of 1000 grains in the two season, 2016-2017 and 2017-2018

Amino acids	Season 2016-2017			
	Cultivars			
	IPA 99	Buhooth 22	Abu-Graib3	Mean
Control	29.54	28.31	27.91	28.59
L-Tryptophan 50 mgl^{-1}	34.03	32.38	29.61	32.01
L-Tryptophan 100 mgl^{-1}	31.39	35.46	28.29	31.71
L-Glycine 50 mgl^{-1}	30.45	33.68	30.12	31.41
L-Glycine 100 mgl^{-1}	29.96	30.47	31.32	30.58
L-Lysine 50 mgl^{-1}	29.84	32.73	32.27	31.61
L-Lysine 100 mgl^{-1}	29.83	28.55	29.37	29.25
L- Cystine 100 mgl^{-1}	30.73	28.55	29.75	29.67
L- Cystine 150 mgl^{-1}	30.82	29.69	31.74	30.75
LSD 0.05	0.74			0.43
Mean	30.73	31.09	30.04	
LSD 0.05	0.31			
Amino acids	Season 2017-2018			
	Cultivars			
	IPA 99	Buhooth 22	Abu-Graib3	Mean
Control	30.81	29.66	29.29	29.92
L-Tryptophan 50 mgl^{-1}	35.46	34.24	30.95	33.55
L-Tryptophan 100 mgl^{-1}	32.74	36.08	29.84	32.89
L-Glycine 50 mgl^{-1}	32.04	34.52	31.58	32.71
L-Glycine 100 mgl^{-1}	31.28	32.43	32.81	32.18
L-Lysine 50 mgl^{-1}	31.65	33.69	33.28	32.88
L-Lysine 100 mgl^{-1}	31.54	30.11	30.90	30.85
L- Cystine 100 mgl^{-1}	32.48	30.09	31.53	31.37
L- Cystine 150 mgl^{-1}	32.58	31.01	33.56	32.38
LSD 0.05	1.04			0.60
Mean	32.29	32.43	31.53	
LSD 0.05	0.50			

Grain yield (Mg ha^{-1})

Grain yield is considered accumulation of its component, such as the number of spikes area unit $^{-1}$, umber of grain.spike^{-1}, and weight of 1000 grains. It is determined by the ability of source to supply the nutrients on one hand and by the sink capacity to store these nutrients on the other. Some of them are related to the genetic factors and the others to the environmental influences. Results in Table 6 shows a significant differences among cultivars, due to foliar application amino acids. Buhooth 22 produced the highest yield (5.39 and 5.15 Mg ha^{-1}) at first and second seasons, respectively. but did not differed significantly from IPA 99. Buhooth 22, recorded an increases in grain yield by 20.04 and 19.21% compared to Abu- Graib 3 which gave the lowest yield of grains averaged 4.49 and 4.32 Mg ha^{-1} for both seasons. Results also showed that the differences between IPA 99 and Abu-Graib 3 was not significant in this trait in both seasons. The reason of the superiority of Buhooth 22 can be due to its superiority in the number of tillers (Table 2), number of spikes (Table 3), and weight of 1000 grains (Table 5), These results are consistent with the results of Kadom, (23) who found that Buhooth 22 produced the highest grain yield (5.46 and 5.14 Mg ha^{-1}) in the two seasons respectively, but did not differed significantly from IPA 99 in both seasons. The treatment of foliar application L-Tryptophan at 50mgL^{-1} was significantly superior in the two seasons (5.77 and 5.33 Mg.ha^{-1}) (Table 6), with an increment 47.57 and 42.13% compared to the control which produced the lowest averages (3.91 and 3.75 % Mg ha^{-1}). Results in the same Table shows that foliar application L-Tryptophan at 50 mgL^{-1} did not differed significantly from other two treatments of L-Lysine at 50 mgL^{-1} or L-Cystine at 150 mgL^{-1} in for both Seasons. Results of Table 8 showed that the differences in the grain yield produced from foliar application different concentrations of the amino acids were not significant except of L-Tryptophan, where increasing the amino acid concentration caused a decline in grain yield except L-Cystin in both seasons. When the concentrations of L-Tryptophan, L-Glycine, and Lysine increased the grain yield in both seasons decreased by (17.50 and 13.13%), (1.82 and 1.23%), and (7.98 and 0.39%) respectively. The grain yield increased by 7.50% and 7.43% in the two seasons respectively, when the L-Cystine concentration increased to 150mg l^{-1}. The reason of the increased of grain yield resulted from spraying L-Tryptophan could be due to increasing the number of tillers (Table 2) leading to an increment in the weight of 1000 grains (Table 5), as well as its contribution to the level increment of IAA, GA3, and interior cytokinnens in the plants, leading to improve growth and yield. This result consisted with results of EL-Bassiouny (16), who found that the treatment of foliar application Tryptophan at 50mgL^{-1} achieved the highest average of grain yield, and Nilesh et al (28) who reported that foliar application wheat plants with highest doses of L-Cystine produced highest grain yield. Low doses, did not show significant differences. Aldesuquyet al (8) revealed that sparing Glycinebetaine affected positively on the yield and its components. A significant interaction was found among cultivars and amino acids concentrations in grain yield. This showed that the response of wheat cultivars differed due to amino acids concentrations. There was an increases in the grain yield of IPA 99 accompanied by increasing the concentrations of L-Glycine and L-Cystine sprayed, in the contrast to Buhooth 22. The grain yield of Abu-Graib increased in both seasons when the concentration of L-Cystine increased, while the increment was limited in the second season when L-Glycine was used. Table 8 showed that the highest response percentage was 64.67%, compared to the control in the first season, due to application of Buhooth 22 with 50 mg l^{-1} of Tryptophan, while IPA 99 recorded the highest response percentage 49.46% at application of 50mgL^{-1} of Tryptophan Compared to the control treatment in the second season.

Table 6. Effect of amino acids and wheat cultivar on the grain yield (Mg ha^{-1}) in the two season, 2016-2017 and 2017-2018

Amino acids	Season 2016-2017			
	Cultivars			
	Ibaa 99	Buhooth 22	Abu-Graib3	Mean
Control	3.84	4.19	3.71	3.91
L-Tryptophan 50 mgl^{-1}	5.69	6.90	4.71	5.77
L-Tryptophan 100 mgl^{-1}	5.26	4.73	4.30	4.76
L-Glycine 50 mgl^{-1}	4.06	5.98	4.79	4.94
L-Glycine 100 mgl^{-1}	5.05	4.90	4.61	4.85
L-Lysine 50 mgl^{-1}	5.81	6.11	4.62	5.51
L-Lysine 100 mgl^{-1}	5.66	5.02	4.53	5.07
L- Cystine 100 mgl^{-1}	4.55	5.81	4.04	4.80
L- Cystine 150 mgl^{-1}	5.50	4.87	5.13	5.16
LSD 0.05	1.10			0.62
Mean	5.05	5.39	4.49	
LSD 0.05	0.58			
Amino acids	**Season 2017-2018**			
	Cultivars			
	Ibaa 99	Buhooth 22	Abu-Graib3	Mean
Control	3.74	4.06	3.46	29.92
L-Tryptophan 50 mgl^{-1}	5.59	5.98	4.44	33.55
L-Tryptophan 100 mgl^{-1}	5.13	4.59	4.16	32.89
L-Glycine 50 mgl^{-1}	4.01	5.89	4.63	32.71
L-Glycine 100 mgl^{-1}	4.94	4.69	4.72	32.18
L-Lysine 50 mgl^{-1}	5.25	5.52	4.44	32.88
L-Lysine 100 mgl^{-1}	5.51	5.26	4.40	30.85
L- Cystine 100 mgl^{-1}	4.40	5.64	3.69	31.37
L- Cystine 150 mgl^{-1}	5.02	4.76	4.96	32.38
LSD 0.05	0.96			0.52
Mean	4.84	5.15	4.32	
LSD 0.05	0.57			

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