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The relation between tillering and accumulated temperature by influence by spraying some amino acid for three bread wheat cultivars

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Abstract

Two field experiments were conducted at station affiliated to College of Agricultural Engineering Sciences University of Baghdad during the two winter seasons 2016- 2017 and 2017 and 2018 according to the Randomized Complete Block Design (RCBD) of three replicates within the split-plot arrangement. The objective of the study was to check the physiological act of three bread wheat varieties affected by amino acids reflecting on the characteristic of tillering relating to the heat accumulation and how that reflects on the grain yield. The experiment included two factors: first, the main plots, included three wheat varieties (Iba 99, Buhooth 22, and Abu-Graib 3) and the second, the sub-plots, was the Amino acids, L-Tryptophan, L-Glycine, and L-Lysine at two concentrations (50 and 100 mg.L^{-1}) of each and L-Cystin at two concentrations (50 and 150 mg.L^{-1}). The treatments of spraying amino acids were applied twice: the first was at the stage of three leaves on the main stem (ZGS:13) and the second was at the stage of entering plants the flowering stage (ZGS:60). Results show the significant superiority of Buhooth 22 in the number of tillers. $plant^{-1}$. It produced the highest number of tillers per plant and the highest number of tillers per square meter in the two seasons, respectively. The highest number of tillers. $plant^{-1}$ in the two seasons was produced when plants entered the elongation stage ZGS: 31. Buhooth 22 produced the highest grain yield. The treatment of spraying 50mg.L^{-1} Tryptophan was significantly superior in the characteristics of tillering and grain yield in the two seasons. It produced the highest number of tillers. $plant^{-1}$ during the whole growth season. The plants of all varieties required an accumulated temperature of 325 GDD (Growing Day Degrees) to commence tillering and 660- 900 GDD to maximize the number of tillers. $plan^{-1}$. These temperatures almost represent one-third of the total accumulated temperature (2250-2650 GDD) during the complete growth seasons in both seasons. The effect of the interaction between the two studied factors was significant in the characteristics of tillering and grain yield. We conclude from the study the necessity of adopting the accumulated parameter to determine when the plant enters the specified growth stage, in addition to the response of the varieties to the treatment of spraying the amino acids reflecting on the grain yield.

Keywords: Wheat, Number of tillers. $plan^{-1}$, Growing Day Degrees, Grain yield.
Part of Ph.D. Dissertation of the first author*

Introduction

Grain yield generally depends upon a number of the contributing factors including tillering that considered an important characteristic in wheat *Triticum eastivum* L. About fifty percent of the wheat tillers bear spikes under the normal conditions and participate in the canopy that is important to the photosynthesis, they represent a depot for photosynthesis products which are redistributed to the grain after the spike formation (Baqir, 2011). Tiller number depends upon the competition for the growth factors such water, nutrients, and light where the compensation mechanism, depending on nutrient availability and season condition, appears when the number of plants is low (El-Naggar and El-Ghamry, 2007). The varieties differ in their tillering ability, however, not all tillers produce spikes as many of them die based on the available resource. We can say that later formed tillers die earlier and the non-producing survival ones supply nutrients and carbohydrates to the grain-producing tillers (Jaddoa et al, 2017). Cereal plant passes through growth different stages including the tillering stage within a series system described as the Zadoks decimal scale. It constructed of ten main primary stages each divided into ten secondary stages. This scale is used as a guide for studied parameters

during research procedures. There is also another scale known as GDD with which the specific growth stage the plant reached can be predicted that is beneficial in understanding the needs and appropriate dictions for yield managements (Jaddoa et al, 2017). Studies improved that amino acids play a positive role in enhancing vegetative growth (Dreccer et al, 2000). through increasing the cell capability for absorbing water and soluble materials from the growth media (Sharma-Natu and Ghildiyal, 2005). Adding amino acids is one of the modern agricultural field practices important for increasing wheat productivity and narrowing the gap between production and consumption. EL-Bassiouny (2005) found that spraying Tryptophan at concentrations 25, 50 and 100 mgL^{-1} after 30, 45 and 75 days of sowing wheat increased the plant growth where the concentration of 25 $mg.^{-1}$ gave the highest number of tillers.m^{-2} (605 tillers.m^{-2}) that did not differ significantly from the concentration of 50 $mg.L^{-1}$ producing 583 tillers.m^{-2}. El-Hosary et al (2013) found an increase in the number of tillers resulted from spraying different concentrations of Tryptophan and Cystin. Spraying 50$mg.l^{-1}$ of Cystin achieved the highest number of tillers averaged 6.01 and 7.56 tillers. $plant^{-1}$ in two seasons while the treatment of spraying 50$mg.^{-1}$ Tryptophan gave the highest values of spike length averaged 12.14 cm in the second season and spraying 100 $mg.L^{-1}$ was the best concentration in the first season giving 9.43 cm. Spraying 150 $mg.L^{-1}$ Cystin recorded the highest values of the most growth traits of wheat compared to the concentration of 100 $mg.L^{-1}$ of the same acid. Results also showed that the foliar application of all used concentrations of Tryptophan and Cystin increased all growth traits significantly compared to the control treatment. Nilesh et al (2012) mentioned that bio-regulators are a group of chemicals, including Cystin that affect plant activities including physical and physiological activities. Many studies have conducted about the effect of bio-regulators on crop yield quality and quantity. These study was conducted with the aim of probing the contribution of tillering to the grain yield and the total heat accumulated during the growing season that is required for tillering and maximizing the number of tillers per plant and its relation to the grain yield of three wheat varieties.

Materials and Methods

Two field crop experiments were carried out at the fields of college of Agriculture, University of Baghdad, Jadiriyah, during the two winter seasons, 2016-2017 and 2017-2018 according to the randomized complete block design (RCBD) in order to study the physiological behavior of three wheat cultivars (Iba 99, Buhooth 22, and Abu-Graib3) under the effect of some amino acids and yeast powder. Soil samples were taken to the depths of 0-30 cm before planting to determine the chemical and physical characteristics of the field soil and were analyzed at the laboratories of the University of Baghdad, College of Agricultural Engineering Sciences, Department of Soil and Water Resources and the results were illustrated in Table 1 below.

Table 1: some physical and chemical characteristics of the soil

Characteristics		Season 2016-2017	Season 2017-2018
Soil structure ($g.kg^{-1}$)	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 soil was irrigated for the first time on 15/10/2016 and 15/10/2017 in the two seasons respectively aiming of allowing the weed seeds to germinate and their seedling to grow to be controlled easily. The land devoted to the experiment was plowed twice in a perpendicular way using a moldboard plow on 5/11/2016 and 5/11/2017 and then smoothed by rotovator, next it was leveled, finally it was divided into 81 experimental units dimensioned 2 x 2.5 m. The study included two factors: first the wheat cultivars (Ibaa 99, Buhooth 22, and Abu-Graib 3) and the second

the 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- Lysin , and 100 and 150 mg.L^{-1} of L- Cytine) in addition to the treatment of control (without spraying). Each experimental unit consisted of 12 lines lengthen 2 m separated from each other by 20 cm. The seeds were planted on 23/11/2016 and 23/11/2017 in the two seasons respectively, using the seeding rate of 120 kg. ha^{-1}. Two hundred kg. $ha^{-1}$of urea fertilizer (46%N) was added to the soil in three batches: the first, when the plant had three leaves unfolded (ZGS: 13), the second when the plant had two nodes on the main stem (ZGS: 32), and the third when the plant entered the stage of booting (ZCS: 40) according to the Zadoks et al (1974). Tertiary superphosphate (46% P2O5) at 100 kg P2O5.ha^{-1} was added as one batch at soil preparation. All crop service operations were carried out according to the recommendations (Jaddoa and Salih, 2013). The crop- service operations were made according to recommendations and an area of 0.3m^2 was sample to assessing the grain yield and the yield components in each experimental unit, finally, the plants were harvested on 11/5/2017 and 11/5/2018 in the two seasons respectively.

Preparing amino acids concentrations: The concentrations of the amino acids L- Tryptophan and L-Cystine (produced by the Fluke company) were prepared by dissolving each amino acid using NaOH 50% with a little amount of ethanol 50% added to distilled water in a flask and mixed using a hotplate magnetic stirrer until materials were completely dissolved, then the volume was completed to one litter to obtain the required concentration. The amino acids L- Glycine and L- Lysine (produced by Fluke) were dissolved in NaOH 50% and distilled water, without alcohol.

Application methods and dates

L- Tryptophan, L- Glysine, L- Lysine, and L- Cystine were sprayed at the same growth stage and same concentrations:

- The stage of full three leaves at ZGS:13
- The stage of the beginning flowering at ZGS:60

Average of the tiller number: Number of tillers. $plant^{-1}$: at distance of 15 cm length was selected from each experimental unit to take samples every two weeks (W) starting from entering the stage ZGS:23 until the full maturity ZGS:93 as the following equation:

$$\text{average of the tiller number} = \frac{\text{total tiller numer in a15 cm distance}}{\text{number of plant in the 15 cm distance}}$$

Accumulated temperature: The Day Degrees (DD) was calculated starting from the sowing date until the that stage of ZGS: 93 according the following equation:

$$\mathrm{DD} = \frac{\mathrm{Max.T+Min.T}}{2} - \text{Base temp. (C°)}$$

Where: DD: Day degrees, Max.T: Maximum temperature, Min.T: Minimum temperature, Base temp: the base temperature.

Accumulated temperature was calculated as the following:

$AT = DD1 + DD_2 + \ldots\ldots\ldots\ldots DD_n$

Where: At: Accumulated temperature, n: an integer referring to the number of days (Anderson and Garlinge, 2000)

Grain yield (Mg. ha^{-1}): assessed for the plants harvested from the selective area (0.3m^2) of each experimental unit where the straw was removed from the grain weighted, then the yield was converted from g.m^{-2} into Mg.ha^{-1} at the moisture 12- 13% (A.O.A.C, 1975).

The gained data were statistically analyzed, using the soft war Genstae, version 7, according to the randomized complete block design with the order of split plots and the results were compared based on the least significant difference (L.S.D.) under the probability level of 5%.

Results and Discussion

Number of tillers. $plant^{-1}$: Figure 1 illustrates the average number of tillers per plant of each variety (under the effect of the interaction between the grand means of eight-time durations and the mean of eight treatments of amino acids plus the control) in the two seasons. Buhooth 22 produced the highest number of tillers followed by Iba 99 while Abu-Graib 3 produced the lowest number of tillers. $plant^{-1}$ in the two seasons. These results are confirmed by the two figures 2a and 2b which demonstrate the variety behavior during the growth season commencing at the tillering stage (ZGS: 22) and ending at full maturity stage (ZGS: 93). The plants of Buhooth 22 produced the highest number of tillers. $plant^{-1}$ differing significantly from the two other varieties for the most durations in the two seasons where the maximum number of tillers was obtained at the elongation stage (ZGS:31) giving 5.06 and 5.52 tillers. $plant^{-1}$ on average in two the seasons.

Concerning Figure 3 representing the average number of tillers. $plant^{-1}$ affected by the amino acids (under the effect of the interaction between the average of varieties and the average of eight-time durations) in the two seasons, it is noticed that the

maximum number tillers. plant^{-1} was obtained by spraying 50 mg.L^{-1} L- Tryptophan especially in the second season while the control treatment gave the lowest number of tillers averaged 2.65 and 2.86 tillers. plant^{-1} in the two seasons respectively. Figure 3 shows that increasing the concentration of the same amino acid increased the number of tillers except for L-Tryptophan in the two seasons. When the concentration of amino acid L-Glycine, L-Lysine, and L-Cystine the number of tillers. plant^{-1} increased by 22.22 and 53%, 4.80 and 4.97, and 23.72 and 26.91 % in the two seasons respectively.

Figures 4a and 4b represent the number of tillers. plant^{-1} effected by the amino acids recorded every two weeks in two seasons reveals that spraying 50 mg.L^{-1} L-Tryptophan produced the highest number of tillers. plant^{-1} surpassing the control at the full maturity stage (ZGS:93) by 64.75 and 58.19 % in the two seasons respectively.

It is shown in the Figures 4a and 4b that the behavior of the effect of spraying amino acid on the number of tillers was represented as a positive increase with an increasing the concentrations of the amino acids (L-Glycine, L-Lysine, and L-Cystine) increased the number of tillers per plant, while the relationship between spraying L-Tryptophan and the trait was negative in both seasons. Figures 4a and 4b show a significant difference in the number of tillers. plant^{-1} among the different concentrations of the same amino acid for all durations except for the L-Lysine at the stage (ZGS:23) (W_1) in the two seasons. Figures 4a and 4b also illustrate that all amino acids achieved the highest number of tillers. plant^{-1} at the commence of the stem elongation stage stem elongation. One node on the main stem (ZGS:31). This is in line with the results found by Jaddoa (1986) and Jaddoa (1997) in barley, Baqir (2011), and AL-Hassan (2007 and 2011) in wheat. They reported that the maximum number of tillers coincided with the beginning stage of main stem elongation (ZGS:31) then the tiller number production decreased.

Figures 4a and 4b show that the tiller production pattern can be divided into three parts: first represents an extreme liner increase in the number of tillers production started from the early tillering stage to the maximum number of tellers.plant^{-1} at the elongation stage (ZGS:31), second part represents a gradual decrease in the number of tillers starting from beyond the elongation stage (ZGS:31) till the beginning of the flowering stage (ZGS:61), and the third part is the stability stage of tiller production i.e. the stage beyond the beginning of the flowering stage (ZGS:61) to the full maturity stage (ZGS:93). This is consistent with results found by Baqir (2011) and AL- Hassan (2011).

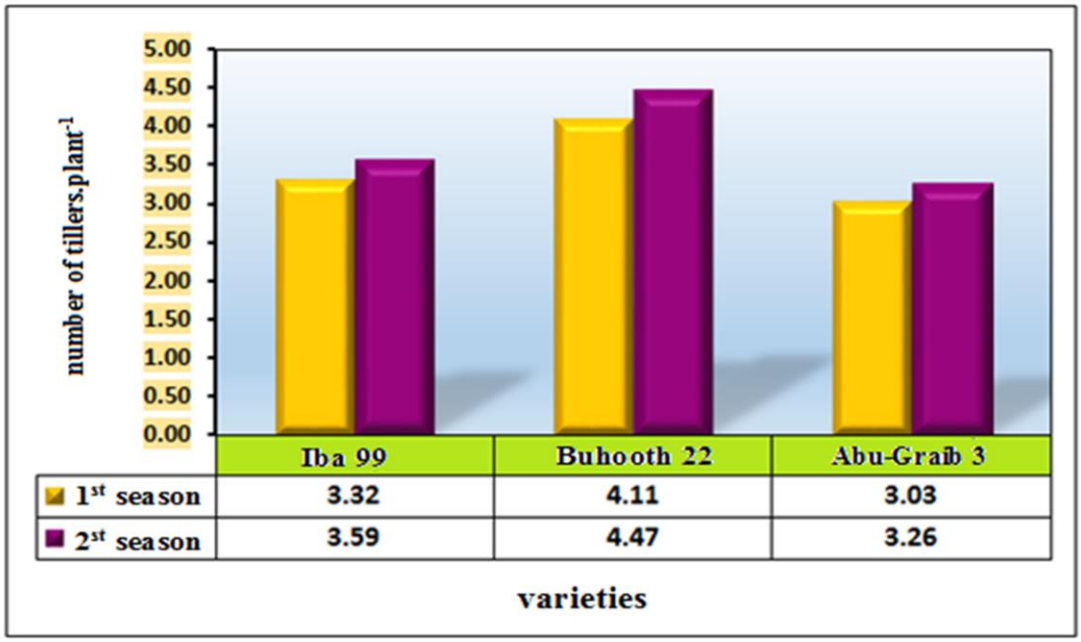
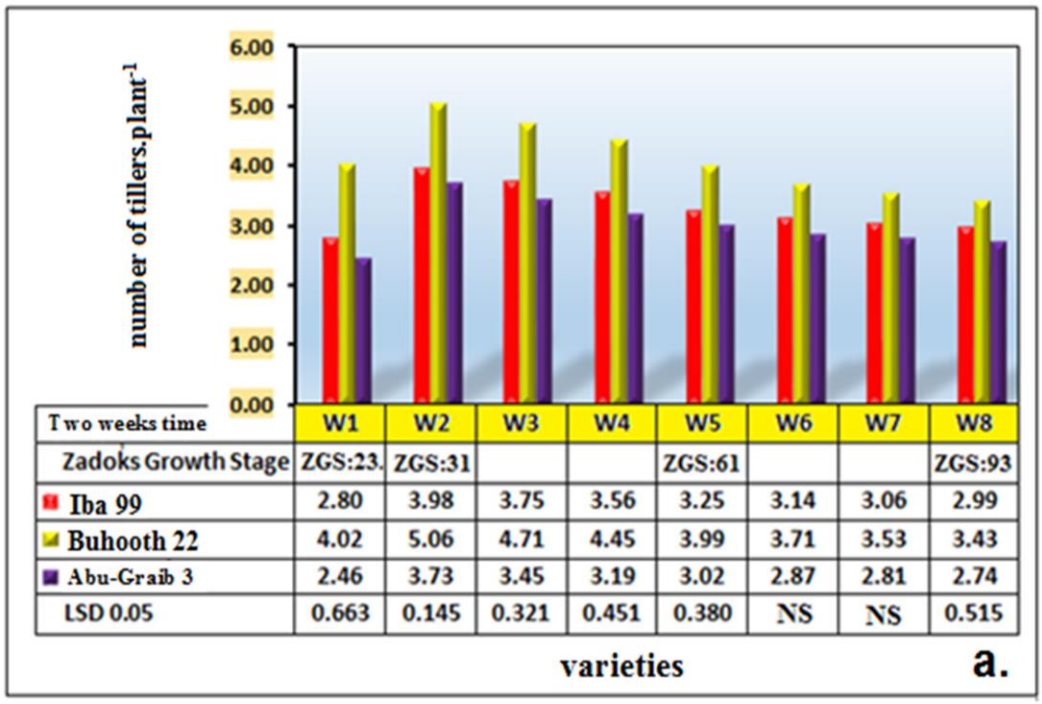
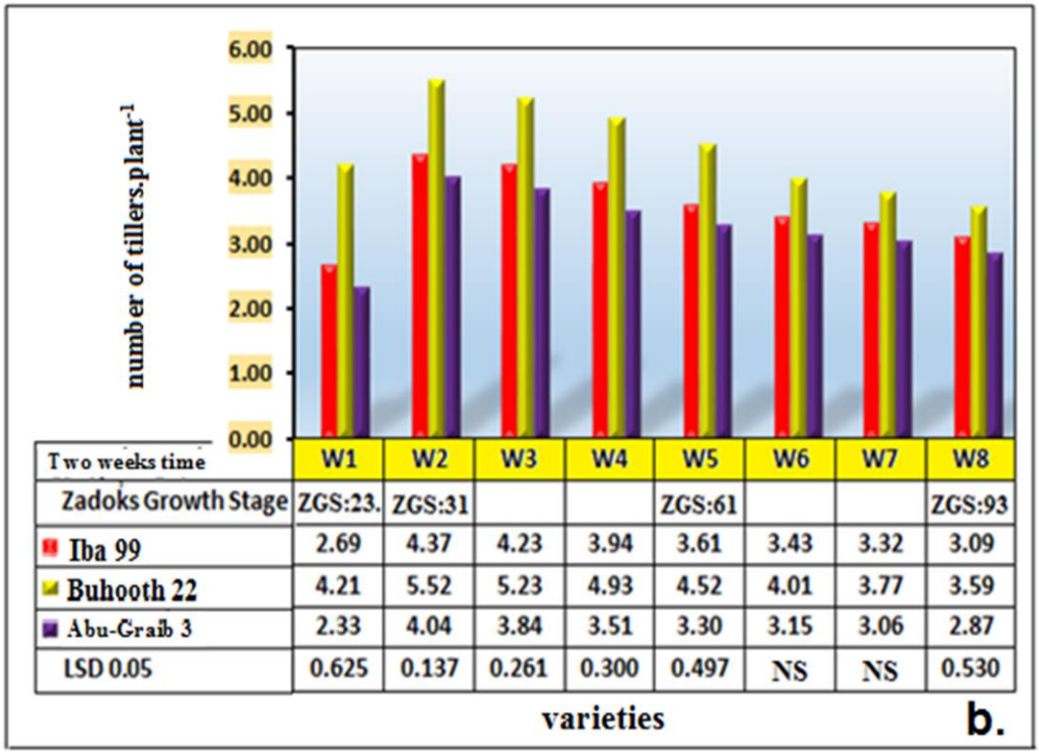


Figure 1. the average number of tillers. plant^{-1} (affected by the general interaction between eight time durations and eight amino acid treatments + control) in the two seasons 2016-2017 and 2017-2018.



Two weeks time	W1	W2	W3	W4	W5	W6	W7	W8
Zadoks Growth Stage	ZGS:23.	ZGS:31			ZGS:61			ZGS:93
Iba 99	2.80	3.98	3.75	3.56	3.25	3.14	3.06	2.99
Buhooth 22	4.02	5.06	4.71	4.45	3.99	3.71	3.53	3.43
Abu-Graib 3	2.46	3.73	3.45	3.19	3.02	2.87	2.81	2.74
LSD 0.05	0.663	0.145	0.321	0.451	0.380	NS	NS	0.515

varieties a.



Two weeks time	W1	W2	W3	W4	W5	W6	W7	W8
Zadoks Growth Stage	ZGS:23.	ZGS:31			ZGS:61			ZGS:93
Iba 99	2.69	4.37	4.23	3.94	3.61	3.43	3.32	3.09
Buhooth 22	4.21	5.52	5.23	4.93	4.52	4.01	3.77	3.59
Abu-Graib 3	2.33	4.04	3.84	3.51	3.30	3.15	3.06	2.87
LSD 0.05	0.625	0.137	0.261	0.300	0.497	NS	NS	0.530

varieties b.

Figure 2. the average number of tillers. plant^{-1} of the varieties per two weeks (affected by eight treatments of amino acids + the control treatment) in two seasons a. 2016-2017 and b. 2017-2018.

If we look at the combinations between the sprayed amino acids and the varieties affected by three time durations (Figures 5a and 5b), we will notice the superiority of spraying 50 mg.L^{-1} on Buhooth 22 producing 5.06 and 5.48 tellers.$plant^{-1}$ in the two seasons respectively, while the lowest number of tillers was obtained from the combination between the control treatment and Abu-Graib 3 producing 2.22 and 2.42 tellers.$plant^{-1}$ in the two seasons respectively. It is observed from figures 5a and 5b that increasing spraying the same amino acid (L-Glycine or L-Cystine) stimulated the increase in the number of tellers. $plant^{-1}$ for the three varieties (Iba 99, Buhooth 22 and Abu-Graib 3) in both seasons, on the contrary, the number of tillers decreased when the concentration of spraying L-Tryptophan was increased indicating that the difference here was in the quantity of response for the amino acid. On the other hand, the response to increasing L-Lysine was different. It was in the direction of the response varied between the two varieties (Iba 22 and Abu-Graib 3) compared to Buhooth 22 in the two seasons, for instance, the number of tillers. $plant^{-1}$ was increased when Iba 22 and Abu-Graib 3 were sprayed with L-Lysine, while the number of tillers of Buhooth 22 plants decreased when they were sprayed with the same amino acid.

It seemly that the tiller emergence in wheat is correlated linearly with heat accumulation. The true that confirmed by the results illustrated in Figure 6 and 7 It shows the accumulated temperature in the wheat varieties commenced from the sowing date through the beginning of the tillering and then the maximum tillering stages and ending with the full maturity. The plants of the three varieties entered the stage of 3-4 tillers when the heat accumulation in the plant were 543.86 and 753.67 Cº in the two seasons respectively, while the heat accumulation required to maximize the number of tillers was about 661.78 and 905.65 Cº, which form about the one-third of the total heat accumulation (2251.19 and 2651.32 Cº) required to reach the complete maturity in two seasons respectively.

This is consistent with what obtained by AL- Hassan (2007 and 2011) and Baqir (2011) in wheat plants. They referred that the varieties of wheat and sorghum need one-third of the total heat accumulation to reach full maturity.

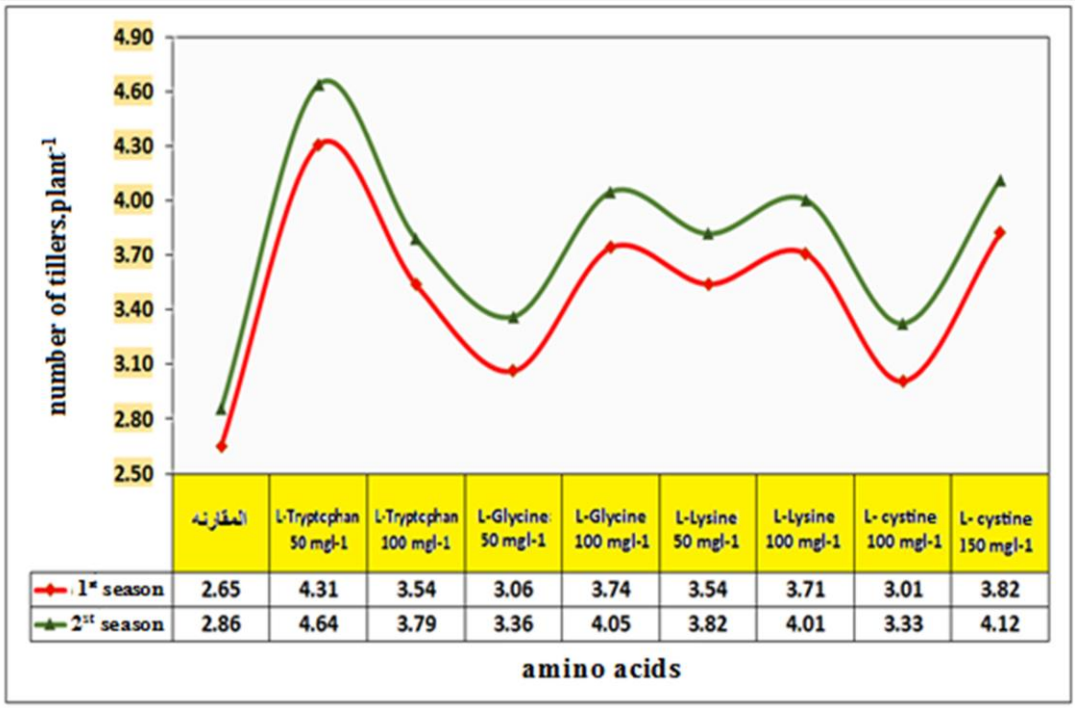
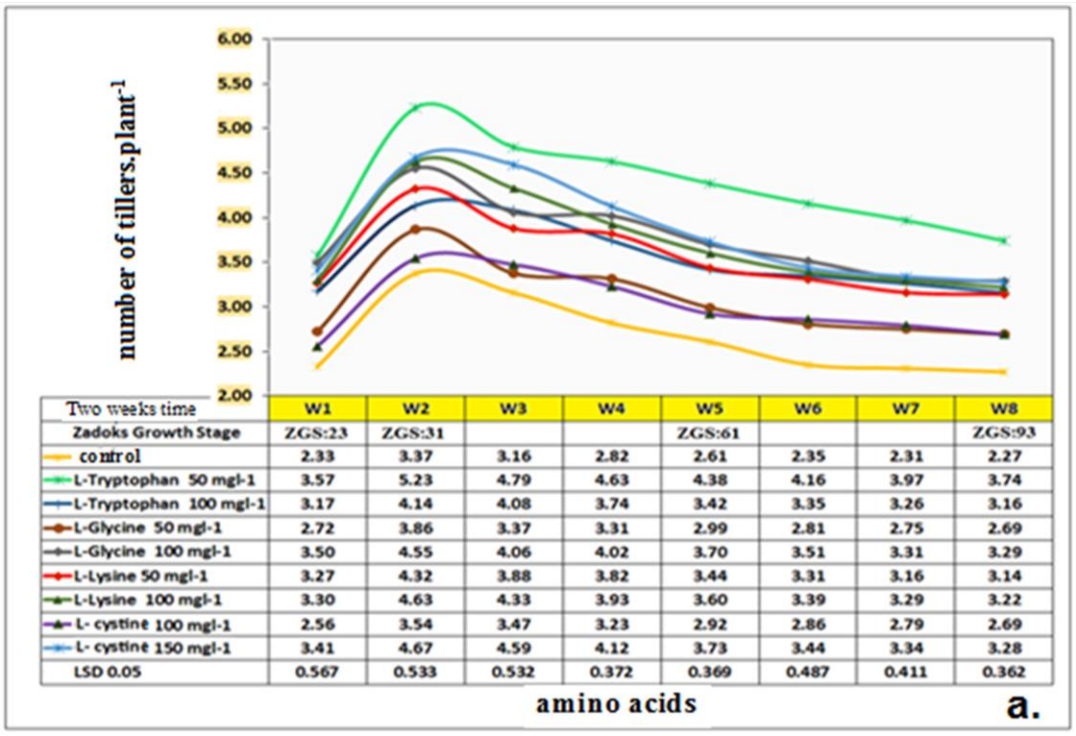
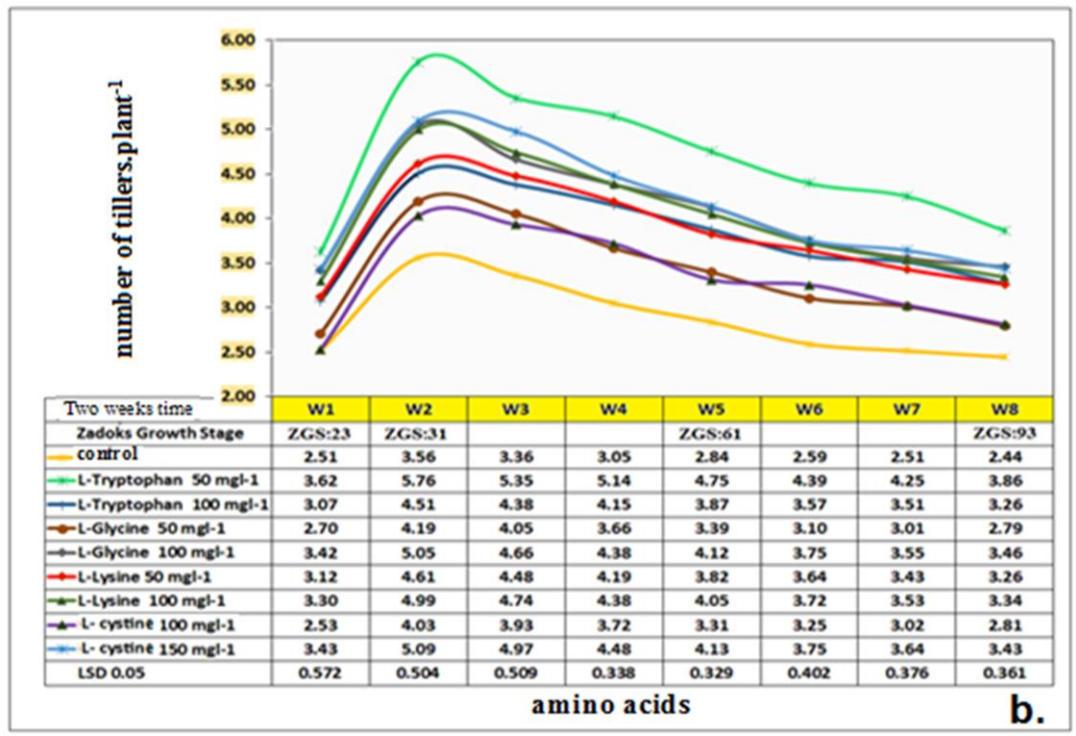


Figure 3. the average number of tillers. $plant^{-1}$ affected by amino acids (the effect of the grand average of the interaction between the average of varieties and the average of eight time durations) in the two seasons 2016-2017 and 2017-2018.



Two weeks time	W1	W2	W3	W4	W5	W6	W7	W8
Zadoks Growth Stage	ZGS:23	ZGS:31			ZGS:61			ZGS:93
control	2.33	3.37	3.16	2.82	2.61	2.35	2.31	2.27
L-Tryptophan 50 mgl-1	3.57	5.23	4.79	4.63	4.38	4.16	3.97	3.74
L-Tryptophan 100 mgl-1	3.17	4.14	4.08	3.74	3.42	3.35	3.26	3.16
L-Glycine 50 mgl-1	2.72	3.86	3.37	3.31	2.99	2.81	2.75	2.69
L-Glycine 100 mgl-1	3.50	4.55	4.06	4.02	3.70	3.51	3.31	3.29
L-Lysine 50 mgl-1	3.27	4.32	3.88	3.82	3.44	3.31	3.16	3.14
L-Lysine 100 mgl-1	3.30	4.63	4.33	3.93	3.60	3.39	3.29	3.22
L- cystine 100 mgl-1	2.56	3.54	3.47	3.23	2.92	2.86	2.79	2.69
L- cystine 150 mgl-1	3.41	4.67	4.59	4.12	3.73	3.44	3.34	3.28
LSD 0.05	0.567	0.533	0.532	0.372	0.369	0.487	0.411	0.362

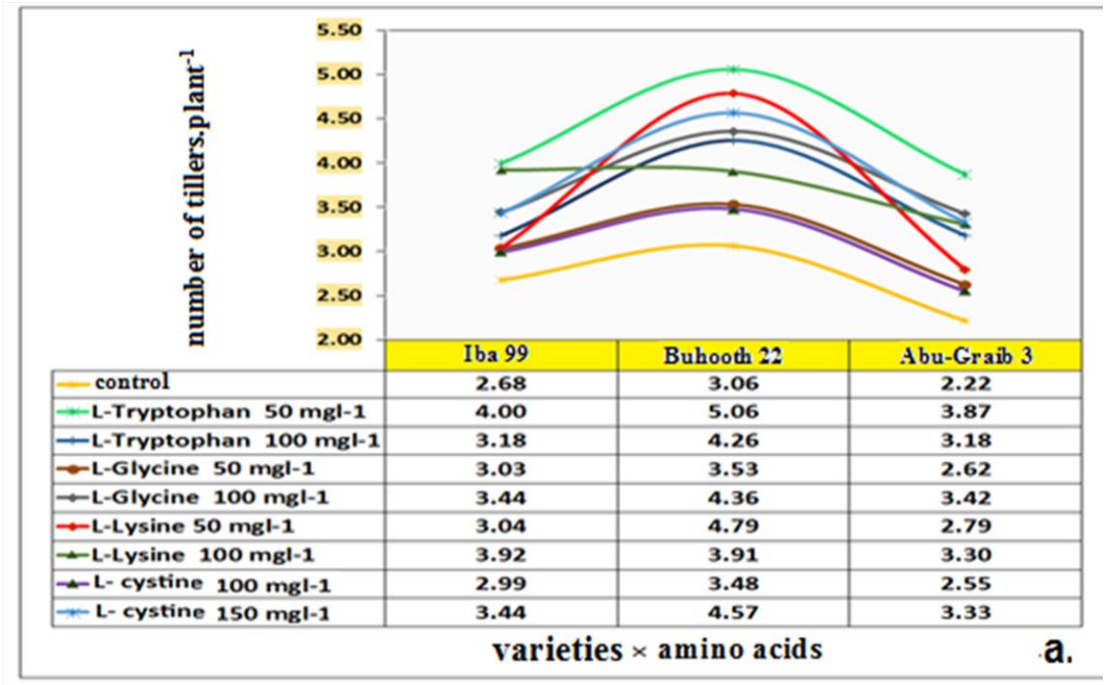
amino acids a.



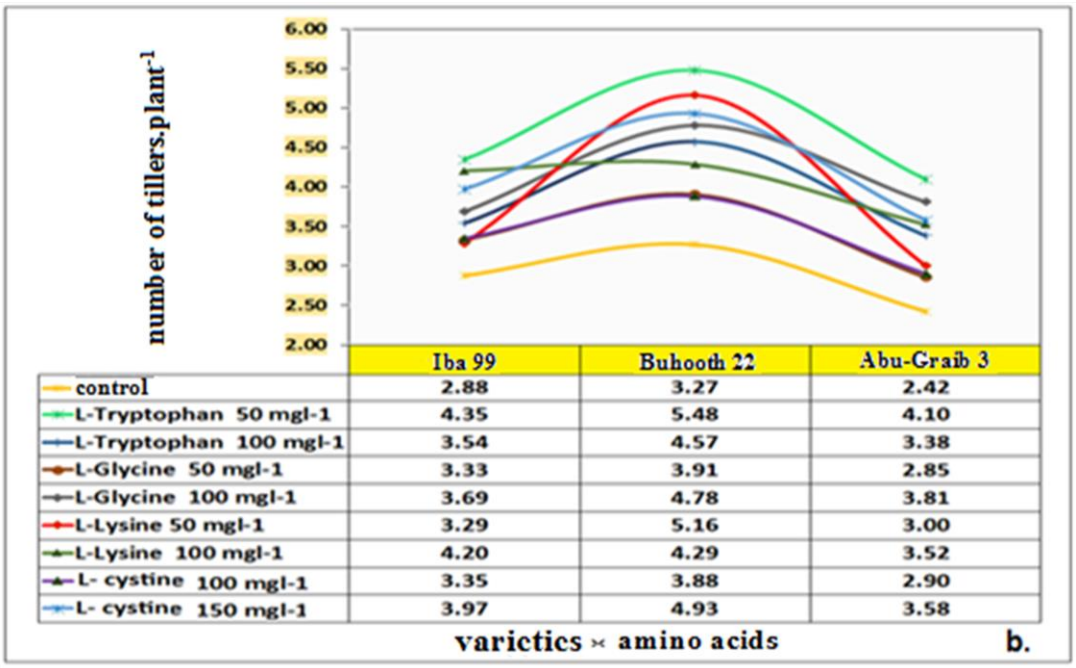
Two weeks time	W1	W2	W3	W4	W5	W6	W7	W8
Zadoks Growth Stage	ZGS:23	ZGS:31			ZGS:61			ZGS:93
control	2.51	3.56	3.36	3.05	2.84	2.59	2.51	2.44
L-Tryptophan 50 mgl-1	3.62	5.76	5.35	5.14	4.75	4.39	4.25	3.86
L-Tryptophan 100 mgl-1	3.07	4.51	4.38	4.15	3.87	3.57	3.51	3.26
L-Glycine 50 mgl-1	2.70	4.19	4.05	3.66	3.39	3.10	3.01	2.79
L-Glycine 100 mgl-1	3.42	5.05	4.66	4.38	4.12	3.75	3.55	3.46
L-Lysine 50 mgl-1	3.12	4.61	4.48	4.19	3.82	3.64	3.43	3.26
L-Lysine 100 mgl-1	3.30	4.99	4.74	4.38	4.05	3.72	3.53	3.34
L- cystine 100 mgl-1	2.53	4.03	3.93	3.72	3.31	3.25	3.02	2.81
L- cystine 150 mgl-1	3.43	5.09	4.97	4.48	4.13	3.75	3.64	3.43
LSD 0.05	0.572	0.504	0.509	0.338	0.329	0.402	0.376	0.361

amino acids b.

Figure 4. the average number of tillers. plant^{-1} for two weeks affected by the amino acids and the treatment control (affected by the three varieties) in the two seasons a. 2016-2017 and b. 2017-2018.



	Iba 99	Buhooth 22	Abu-Graib 3
control	2.68	3.06	2.22
L-Tryptophan 50 mgl-1	4.00	5.06	3.87
L-Tryptophan 100 mgl-1	3.18	4.26	3.18
L-Glycine 50 mgl-1	3.03	3.53	2.62
L-Glycine 100 mgl-1	3.44	4.36	3.42
L-Lysine 50 mgl-1	3.04	4.79	2.79
L-Lysine 100 mgl-1	3.92	3.91	3.30
L- cystine 100 mgl-1	2.99	3.48	2.55
L- cystine 150 mgl-1	3.44	4.57	3.33



	Iba 99	Buhooth 22	Abu-Graib 3
control	2.88	3.27	2.42
L-Tryptophan 50 mgl-1	4.35	5.48	4.10
L-Tryptophan 100 mgl-1	3.54	4.57	3.38
L-Glycine 50 mgl-1	3.33	3.91	2.85
L-Glycine 100 mgl-1	3.69	4.78	3.81
L-Lysine 50 mgl-1	3.29	5.16	3.00
L-Lysine 100 mgl-1	4.20	4.29	3.52
L- cystine 100 mgl-1	3.35	3.88	2.90
L- cystine 150 mgl-1	3.97	4.93	3.58

Figure 5. the average number of tillers. plant^{-1} of the interaction between the varieties and amino acids (under the effect of eight time durations W1-W8) in the two seasons 2016-2017 and 2017-2018.

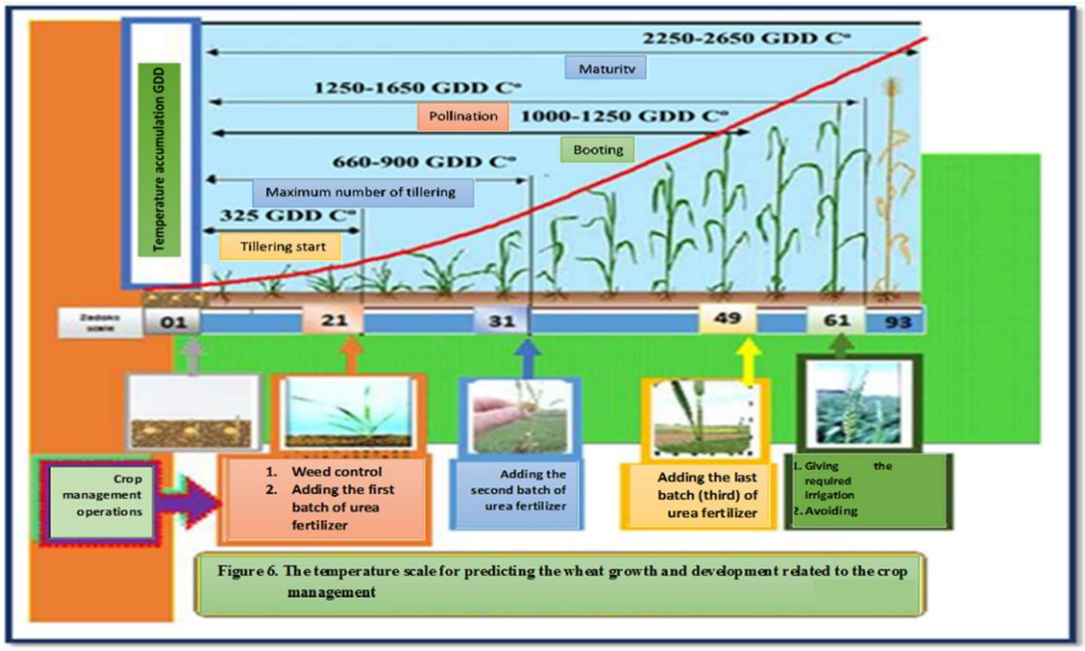
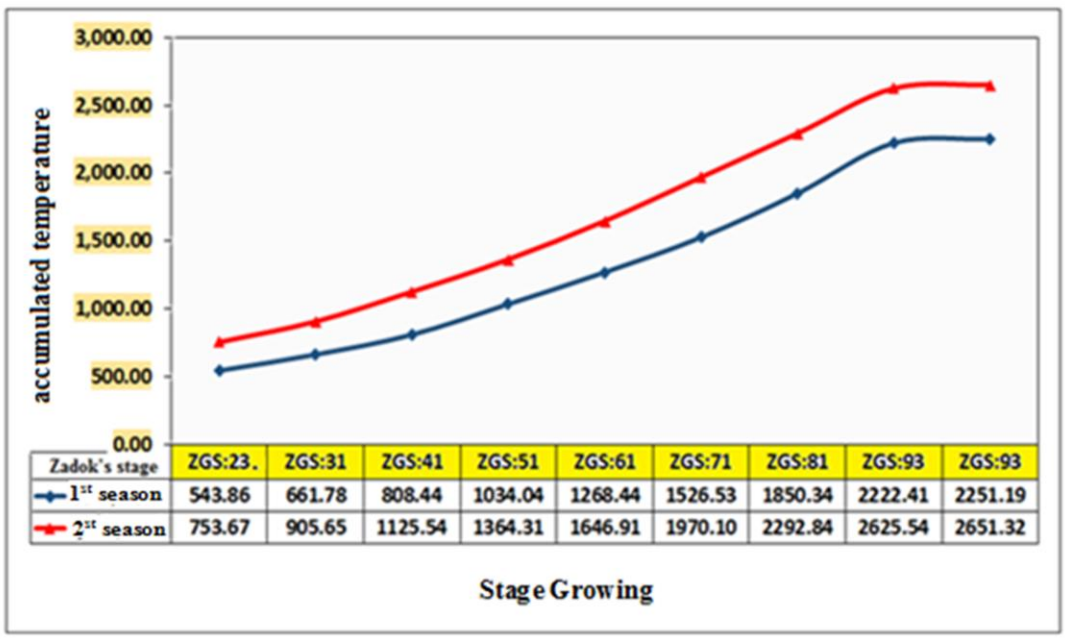


Figure 6. The temperature scale for predicting the wheat growth and development related the crop management.



Zadok's stage	ZGS:23.	ZGS:31	ZGS:41	ZGS:51	ZGS:61	ZGS:71	ZGS:81	ZGS:93	ZGS:93
1st season	543.86	661.78	808.44	1034.04	1268.44	1526.53	1850.34	2222.41	2251.19
2st season	753.67	905.65	1125.54	1364.31	1646.91	1970.10	2292.84	2625.54	2651.32

Figure7. accumulated temperature of the first season 2016 -2017 and the second season 2017-2018.

Grain yield (Mg. ha^{-1}): The grain yield is considered as a result of multiple factors correlated to the yield such as the number of spikes per the unit of area, number of grains per spike, and 1000- grains weight. It is determined mainly by the agriculture operation that helps the source to supply nutrients for the sink (the grain) to store the nutrients (Atia and Jaddoa, 1999). Some of them related to the genetic factors in addition to the environmental factors affecting plant growth. Data results in table 2 demonstrate a significant difference affected by the varieties and by spraying the amino acids as well as the interaction between the two factors. Buhooth 22 was superior producing the highest grain yield averaged 5.39 and 5.15 Mg. ha^{-1} in the two seasons respectively, however, it did not differ significantly from Iba 22 in the two seasons. It is worth mentioning that Buhooth 22 exceed Abu-Graib 3, which gave the lowest grain yield averaged 4.49 and 4. 32 Mg. ha^{-1}, by 20.04 and 19.21 % in the two seasons respectively. The same table also reveals no significant difference between Iba 99 and Abu-Graib 3 in this trait. The Buhooth 22 superiority in the grain yield may be due to the superiority in the number of tellers (figure2 a, b). This is in line with the results of Kadom (2015) who referred to the superiority Buhooth 22 producing the highest averages of grain yield reached 5.46 and 5.14 Mg.ha^{-1} in two seasons respectively which did not differ significantly from Iba 99 Concerning the yield response for spraying amino acids, results in Table 2 refer that the treatment of spraying 50 mg.L^{-1} L-Tryptophan was significantly superior that gave the highest yield averaged 5.77 and 5.33 Mg.ha^{-1} in the two seasons respectively, that surpassed the control treatment which gave 3.75 and 3.91Mg.ha^{-1} by 47.57 and 42.13%. The same table results show that superior treatment of spraying 50 mg.L^{-1} L-Tryptophan did not differ significantly from spraying 50 mg. l^{-1} L-Lysine and 150 mg. L^{-1} L-Cystine in the first season nor from spraying 50 mg.L^{-1} L-Glycine and 50 as well as 100 mg.L^{-1} L-Lysine in the second season. Results in Table 2 illustrate no significant difference in the grain yield resulted from spraying different concentrations of the same amino acids in the two seasons except for L- Tryptophan. It is also noticed that increasing the amino acid concentration decreased the grain yield in the two seasons except for the amino acid L-Cystin indicating that the relationship was negative between the amino acid concentrations including, L-Tryptophan, L-Glycine, and L-Lysine and the grain yield in the two seasons and was positive between the concentration of L-Cystine and the grain yield. The grain yield decreased in the two seasons when increasing the concentration of the amino acids, L-Tryptophan, L-Glycine, and L-Lysine by 17.50 and 13.13 %, 1.82 and 1.23 %, and 7.98 and 0.39% respectively, while the grain yield decreased when the concentration of L- Cystin increased to 150 mg.L^{-1} by 7.50 and 7.43% in the two seasons respectively. The reason behind the grain yield increase resulted from spraying L- Tryptophan may be due to increasing the number of tillers (Table 2) as well as to its participating in increasing the levels of IAA, GA3, and Cytokines that contribute to enhancing the plant growth. This is consistent with the results obtained by EL-Bassiouny (2005) who reported that spraying 50 mg. L^{-1} Tryptophan achieved the highest grain yield as well as with the results of Nilesh et al (2012) who illustrated that spraying high doses of L-Cystin gave higher grain yield in contrary to the low doses that did not show any significant difference compared to the control treatment. It is in line with the results of Aldesuquy et al. (2012) who mentioned that spraying glycine betaine affected positively the yield and its components. However, the positive effect of the amino acids may be conditioned by the fact that some amino acids with mineral compounds form compounds difficult to dissolve especially with exist of microelements, as foliar spray facilitates the absorption of nutrients and utilizing them in protein synthesis that helps to increase chlorophyll concentration leading to the highest level of photosynthesis which, in turn increasing the dry matter stored in the sink and consequently increasing the grain yield Amino acids also stimulate some enzymes responsible for synthesizing proteins and carbohydrates as well as the dry matter which related to the yield increase. Concerning the interaction, the yield was increased positively when the concentration of the amino acids, L-Glycine, L- Lysine, and L-Cystin, sprayed on Iba 99 was increased in the two seasons, to the contrary of Buhooth 22, while the grain yield of Abu-Graib 3 increased resulted from the increase in the concentration of L- Cystin in both seasons and of L-Glycine the second season only. Table 3 also shows a decrease in the grain yield accompanied to increasing the concentration of L- Tryptophan sprayed on the three varieties (Iba 99, Buhooth 22, and Abu-Graib3) in the two seasons.

Table 2: effect of the varieties and amino acids on the grain yield (Mg. ha^{-1}) in the two seasons 2016-2017 and 2017-2018.

Cultivars / Amino acids	Season 2016-2017			
	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	1.10			0.62
Mean	5.05	5.39	4.49	
LSD	0.587			
Cultivars / Amino acids	Season 2017-2018			
	Ibaa 99	Buhooth 22	Abu-Graib3	Mean
Control	3.74	4.06	3.46	3.75
L-Tryptophan 50 mgl^{-1}	5.59	5.98	4.44	5.33
L-Tryptophan 100 mgl^{-1}	5.13	4.59	4.16	4.63
L-Glycine 50 mgl^{-1}	4.01	5.89	4.63	4.84
L-Glycine 100 mgl^{-1}	4.94	4.69	4.72	4.78
L-Lysine 50 mgl^{-1}	5.25	5.52	4.44	5.07
L-Lysine 100 mgl^{-1}	5.51	5.26	4.40	5.05
L- Cystine 100 mgl^{-1}	4.40	5.64	3.69	4.57
L- Cystine 150 mgl^{-1}	5.02	4.76	4.96	4.91
LSD	0.96			0.51
Mean	4.84	5.15	4.32	
LSD	0.58			

Conclusions

The highest number plant^{-1} of branches of the plant was achieved and for all varieties and in both seasons when the stage of elongation of the main stem, i.e. ZGS stage: 31 (the presence of one mature node on the main stem), after this stage the decrease in the number of productive branches began, and the three varieties (fathers) entered 99 and researches 22 and Abu Ghraib 3) the stage of starting branching simultaneously according to the different parameters of the study when it possessed a thermal aggregation amounted to 325-350 (Growing Degree Days) (GDD) but it differed in its possession of the number of branches Plant^{-1}, and the three varieties needed the same to reach the maximum the number plant^{-1} branches heat accumulation amounted to 660-900 (GDD) and this represents one-third of the total heat accumulation, which amounted to 2250-2650 (GDD) during the full growing season and for both seasons respectively. Therefore, accumulated temperatures can be considered a useful measure to predict the start of crop growth or The end of its growth and this is of great importance in understanding the needs of the crop and the elements of its successful management.

- The amino acid L-Tryptophan was the most effective substance in all the studied characteristics when used at a concentration of 50 mg L^{-1}.

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