Effect of Cultivars and Spraying Phenylalanine on Growth and Yield of Black Barley in Babil Governorate

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Abstract

A field experiment was carried out during the winter agricultural season for the y 2022-2023, in Babil Governorate, Al-Qasim Green University - College of Agriculture - Fields affiliated with the Field Crops Department, to study the response of three cultivars of black barley "Zanbaka", "Mosul 1" and "Black Local" and amino acid Spraying, Phenylalanine at concentrations of 0, 50, and 100 mg L^{-1} in some growth and yield characteristics of black barley plants. The combinations of treatments were distributed in a factorial experiment according to a randomized complete block design (RCBD) with three replications. The data was collected and analyzed according to the analysis of variance table, and the means were tested according to the least significant difference test at the level of Probability 0.05.

The results showed a significant superiority of the "Zanbaka" cultivar in the characteristics of the height of the main stem (85.65 cm) and the number of grains per spike(30.96 grain), and a significant superiority of the "Mosul 1" cultivar in most of the vegetative characteristics, yield components. Similar superiority was also recorded in the treatment of spraying Phenylalanine at a concentration of 50 mg L^{-1}, while it was significantly superior in the treatment of spraying at a concentration of 100 mg L^{-1} at the height of the main stem only, and a conductive overlap treatment of Mosul 1×50 mg L-¹ Phe. was achieved. significantly superior to leaf area, total chlorophyll pigment index, percentage of dry weight, number of spike per square meter, weight of 1000 grains, total grain yield, and biological yield, it gave the highest averages of 16.51 cm², 43.54 SPAD, 13.11%, 359.00 spikes, 45.44 g, 4.71 tons ha-¹, and 11.19 tons ha-¹, respectively. While the treatment Zanbaka × 100 mg L-¹ Phe. was significantly superior. in plant height, while the Zanbaka x 50 mg L-¹ Phe treatment outperformed. in the number of grains per spike amounted to 32.96 grams.

Key word: *Cultivars, Spraying Phenylalanine, Growth, Yield, Black Barley*

Introduction

Barley *Hordeum vulgare* L. is one of the important strategic crops that plays a major role in national and global food security for humans and animals alike. Barley has a high nutritional value because it contains a good percentage of protein, amino acids, carbohydrates, and various nutrients [1], Black barley cultivars are known for their dark-colored grains, ranging from brown to black, depending on the cultivar, environment, and the interaction between them. This coloration is attributed to the grains' content of anthocyanin pigments, which are among the most important antioxidant compounds that work to suppress free radicals that are generated in the biological system. Black barley is a medicinal crop that acts as antioxidants that prevent carcinogenesis [2], enhances blood circulation, delays tissue aging, and reduces cholesterol and blood sugar levels [3]. It positively affects the function of the pituitary gland and prevents the breakdown of platelets [4], and a relationship

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has been observed between regular consumption of whole grain black barley products and reducing the risk of chronic non-communicable diseases such as cardiovascular disease, obesity, diabetes, and certain types of cancer [5,6], Resch in this field has focused on the health effects of whole grain components, especially biologically active molecules such as phenols that act as scavengers of oxygen, free radicals, and hydrogen donors [7]. Anthocyanins are classified as a group of multiple phenols (flavonoids) that are soluble in water and are responsible for red, violet and blue colors in fruits, vegetables and grains [8], These pigments have demonstrated in the laboratory antioxidant potential that has led to a decrease in the risk of chronic diseases [9]. Amino acids are the basic building blocks of protein and enzymes and are therefore the functional biological basis for the processes of food metabolism, ionic transport, detoxification by heavy metals, and increased metabolism. Gene expression and the balance between oxidation and reduction processes, which makes it affect the physiological and biological activity of plant growth and development [10,11], as well as improving the plant's tolerance to the abiotic stresses it is exposed to [12].

The amino acid phenylalanine is one of the essential cyclic amino acids important for plant growth, as it was the basic unit for building protein and the initiator of many compounds involved in plant metabolism, which play an important role in its growth, reproduction, and response to environmental conditions, especially in building lignin in vascular plants, which represents the basic component of cell walls. In plants, Phenylalanine also plays an important role in the biosynthesis of the compound Salicylic Acid, which is necessary to stimulate biological resistance in many plants to biotic and abiotic stresses [13]. The aim of this study was the possibility of rationing the application of nitrogen fertilizer to some black barley varieties by spraying concentrations of the amino acid phenylalanine and its effect on some growth characteristics, yield and its components.

Materials and Methods

A field experiment was conducted in the winter agricultural season 2022-2023 in Babil Governorate, Al-Qasim Green University - College of Agriculture - Fields affiliated with the Field Crops Department, and ten random samples were taken from the field soil at different depths (0-30 cm) to determine the physical and chemical properties of the soil. Ten random samples of irrigation water (field well water) were analyzed Table (1).

Table 1: Physical and chemical properties of soil and irrigation water

Material	**Reaction Degree (pH)**	**Electrical conductivity EC (DSLM)**	**availability -made items (mg kg-1)**			**Organic matter OM%**	**Soil separations %**			**Soil texture**
			Nitrogen	Phosphorus	Potassium		Clay	Silt	Sand	
Soil	7.09	5.65	33.4	8.6	236.1	2.02	2.03	50.20	47.76	Sandy mixture
water	7.18	1.54	22.7	9.3	1.17					

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Soil service operations were carried out by plowing, smoothing and leveling, then phosphate fertilizer and potassium fertilizer were added according to the recommendation of 85 kg ha^{-1} [14], mixed with the soil. Planting was done on lines and the quantity of seeds was 100 kg ha^{-1} [15]. The irrigation process was carried out immediately after planting, and irrigation continued as needed during the growing season. The experiment included studying the effect of two factors. The combinations of treatments were distributed in a factorial experiment according to a randomized complete block design (RCBD) with three replications. first factor was three cultivars of black barley: (Zanbaka, Mosul 1, and Black Local). Which was prepared by the Ministry of Agriculture - Department of Agricultural Resch / Mosul, and the second factor is spraying the amino acid Phenylalanine ($C_9H_{11}NO_2$) at three concentrations: spraying distilled water only and 50 and 100 mg L^{-1}, implementing three sprays, the first at the tillers stage, the second at the booting stage, and the third at the maturity stage.

Vegetative growth characteristics were measured when the plants flowered at 100%, including the height of the main stem (cm), which was done using a metal tape, starting from the surface of the soil until the end of the spike (without the stem), and the area of the flag leaf (cm^2) according to the equation approved by [16]. the index of total chlorophyll pigments (SPAD) and the percentage of dry matter (%), and the characteristics of the crop and its components were measured by calculating the number of spike (m^2). The number of s was calculated by taking a random sample from the midlines of each treatment using a square-shaped wooden frame with an area of one square meter. The number of grains per spike. The average number of grains per was calculated for a random sample of ten spikes taken from the midline plants for each experimental unit, the weight of 1000 grains (g) and the total grain yield (ton ha^{-1}). The weight of grain yield per square meter was ratiod to ton ha^{-1} to indicate the total yield and dry matter yield (ton ha^{-1}), in which the plants taken randomly were weighed in their entirety using the square of the wooden frame (grain + straw) and then attributed to ton ha^{-1}.

Results and Discussion

Vegetative growth indicators :

Table (2) showed the presence of significant differences for black barley plant cultivars and spraying with the amino acid Phenylalanine, and the interactions between them in vegetative growth indicators, which included plant height, flag leaf area, total chlorophyll, and percentage of dry weight. The highest mean apped for the "Zanbaka" cultivar, while the lowest were for The "Mosul 1" cultivar had the highest average stem height of 85.65 and 80.50 cm, respectively, while the "Mosul 1" cultivar was significantly superior, giving the highest mean in leaf area of 14.76 cm^2, total chlorophyll pigment index of 42.70, and dry matter percentage of 12.89%. The characteristic of leaf area, which was considered one of the most important vegetative characteristics and in which the Mosul 1 cultivar excels, is the characteristic that has a direct relationship to the characteristics of the yield components, which vary according to the genotype of each cultivar [17], and this may result in variation between varieties according to the level of gene expression that it determines the rates of cell division and expansion of the intercellular meristem located at the bases of the leaves,

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which works to increase the leaf area, especially the flag leaf [18].

Table (2) showed there was a significant superiority of spraying with the amino acid phenylalanine at a concentration of 100 mg L^{-1} in the height of the main stem of black barley plants, which reached 88.14 cm. While the spraying treatment with phenylalanine at a concentration of 50 mg L^{-1} was significantly superior in the characteristics of leaf area, total chlorophyll, and percentage of the dry weight reached 15.62 cm^2, 41.74 SPAD, and 12.90%, respectively, compared to the spraying treatment with distilled water only, which recorded the lowest means. The high discrepancy in the relative increase between the two characteristics of flag leaf area and the chlorophyll pigment index, despite the significant superiority of the spray concentration itself, may explain the possibility of a common influence on leaf area. Knowledge of the role of Phenylalanine in increasing the production of Coumaric Acid, which maintains the efficiency and quantity of auxin IAA [19]. The production of the second auxin growth compound, Phenylacetic Acid (PAA), as Phenylalanine was transformed into Phenyl pyruvate and then into PAA. This biochemical activity results from an enzyme made by the TAAL gene, whose effect varies according to the interaction between the genetic makeup and the environment [20]. The significant superiority in the total chlorophyll pigments index may be explained by the role of phenylalanine in increasing the production of secondary metabolic compounds that include phenols, flavonoids, tannins, and anthocyanins, all of which and their various compounds have an antioxidant effect that works to protect the plant's pigment system, especially chlorophyll pigments, from oxidation or decomposition [21]. The limited effect of the amino acid Phenylalanine in increasing these pigments may be due to the fact that it competes with or participates in the accumulation of nitrogen fertilizer inside the chloroplasts in the form of the acids Glutamate and Glycine. Its concentration does not exceed a certain limit according to the genetic potential of the plant to produce chlorophyll pigments, which also was not exceed a certain concentration range [22], these results were consistent in their general framework with the findings of [23,24].

Therefore, the double interaction treatment of the Zanbaka cultivar ×100 mg L^{-1} Phe was significantly superior in terms of stem height. gave an mean of 91.08 cm, while the double interaction treatment Mosul 1 × 50 mg L^{-1} Phe. recorded the highest mean for flag leaf area and chlorophyll pigment index. The total and percentage of dry weight achieved 16.51 cm^2, 43.54 SPAD and 13.11%, respectively.

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Table 2: Effect of cultivar and spraying phenylalanine on growth parameters of black barley				
Treatments	**Plant Hight (cm)**	**Flage Leave Area (cm^2)**	**Total Chlorophyll (SPAD)**	**Dry Weight (%)**
Zanbaka	**85.65**	**13.41**	**37.94**	**12.57**
Mosul 1	**80.5**	**14.76**	**42.70**	**12.89**
Local Black	**83.89**	**13.33**	**41.58**	**12.78**
LSD $_{(0.05)}$	**0.94**	**0.26**	**0.07**	**0.24**
Phe^{0}	**78.27**	**11.40**	**39.53**	**12.57**
Phe ^{50}	**83.64**	**15.62**	**41.74**	**12.90**
Phe ^{100}	**88.14**	**14.48**	**40.95**	**12.76**
LSD $_{(0.05)}$	**0.94**	**0.26**	**0.07**	**0.24**
Zanbaka × Phe^{0}	**80.31**	**11.70**	**36.99**	**12.42**
Zanbaka × Phe ^{50}	**85.56**	**14.64**	**38.78**	**12.69**
Zanbaka × Phe ^{100}	**91.08**	**13.88**	**38.03**	**12.59**
Mosul 1 × Phe^{0}	**74.61**	**11.85**	**41.84**	**12.64**
Mosul 1 × Phe ^{50}	**81.58**	**16.51**	**43.54**	**13.11**
Mosul 1 × Phe ^{100}	**85.32**	**15.91**	**42.74**	**12.91**
Local Black × Phe^{0}	**79.89**	**10.64**	**39.76**	**12.66**
Local Black × Phe ^{50}	**83.78**	**15.71**	**42.89**	**12.89**
Local Black × Phe ^{100}	**88.01**	**13.64**	**42.08**	**12.78**
LSD $_{(0.05)}$	**1.63**	**0.44**	**0.12**	**0.41**

Yield components indicators

It is clear from the results of Table (3) that there were significant differences for the two experimental factors and the interaction between them in the characteristics of the yield and its components. Mosul 1 cultivar was significantly superior in terms of the number of spikes per square meter, the weight of 1000 grains, the total grain yield, and the biological yield, which amounted to 293.80 spike, 41.55 grams, and 3.44. tons ha-¹ and 8.27 tons ha-¹, respectively. Zanbaka cultivar was significantly superior in terms of the number of grains per spike, reaching 30.69 grain spike^{-1}, The reason for the superiority of the Mosul1 cultivar in increasing the number of spike is due to the difference between the cultivars in their ability to produce shoots resulting from the difference in the hormonal balance in the crown area, which determines the number of shoots that grow in each plant, and this result agreed with what was found [25]. The reason for the superiority in 1000 grain weight may be attributed to the variety's ability to produce dry matter that supports the natural growth and development of shoots into fertile spike , or to the decrease in the number of grains per spike , which reduces competition between the grains of a single in storing dry matter, which in turn leads to an

increase in weight. This result agreed with the findings of [26,27]. As for the reason for the superiority of the Mosul 1 cultivar in the total grain yield, this characteristic is the result of the accumulation of characteristics of the components of the yield, especially the number of spike per square meter and the weight of 1000 grains [28,29] This resulted in a significant superiority in biological yield resulting from the cultivars superiority in high growth rates in the most important indicators of vegetative growth, which was the area of the flag leaf and its content of total chlorophyll pigments, which achieves the best interception of sunlight and the highest efficiency in converting light energy into dry matter [30,31]. While it was noted that the Zanbaka cultivar was significantly superior in the number of grains per spike, and this may be due to genetic differences between the cultivars or to the fact that this trait is considered a genetically determined quantitative trait [31].

The same table indicates that there are significant differences for spraying Phenylalanine, and it was significantly superior to spraying with a concentration of 50 mg L-¹ in the number of spikes , number of grains per spike , weight of 1000 grains, total grain yield, and biological yield, and achieved the highest means of 334.60 spikes m², 30.85, 42.04 grams, 4.32, and 10.46 tons. ha-¹, respectively, compared to the spraying treatment with distilled water only, which achieved the lowest means for the mentioned characteristics. It is also evident from the results of Table (3) that the Mosul 1×50 mg L^{-1} Phe. conductive interference treatment was superior in the above traits, and the highest averages were 359.00 spike m^2, 45.44 grams, 4.71 tons ha-¹, and 11.19 tons ha-¹, respectively, while the interaction treatment, Zanbaka x 50 mg L^{-1} Phe, was significantly superior as the number of grains per spike reached 32.96 grain $spike^{-1}$.

Table 3: Effect of cultivar and spraying phenylalanine on yield parameters of black barley

Treatments	No.Spikes per m^2	Grains No. (per $spike^{-1}$)	Weight of 1000 grain (g)	Grains Yield (t ha^{-1})	Biological Yield (t ha^{-1})
Zanbaka	**268.30**	**30.69**	**38.19**	**3.17**	**8.05**
Mosul 1	**293.80**	**27.62**	**41.55**	**3.44**	**8.27**
Local Black	**289.20**	**29.59**	**38.53**	**3.26**	**8.09**
LSD $_{(0.05)}$	**5.47**	**0.22**	**0.5**	**0.02**	**0.05**
Phe^{0}	**236.30**	**27.65**	**36.82**	**2.30**	**5.89**
Phe ^{50}	**334.60**	**30.85**	**42.04**	**4.32**	**10.46**
Phe ^{100}	**280.40**	**29.41**	**39.40**	**3.24**	**8.07**
LSD $_{(0.05)}$	**5.47**	**0.22**	**0.5**	**0.02**	**0.05**
Zanbaka × Phe^{0}	**232.00**	**28.27**	**35.07**	**2.21**	**5.81**
Zanbaka × Phe ^{50}	**301.90**	**32.96**	**41.04**	**4.10**	**10.05**
Zanbaka × Phe ^{100}	**271.10**	**30.86**	**38.45**	**3.21**	**8.30**
Mosul 1 × Phe^{0}	**233.10**	**26.28**	**37.91**	**2.28**	**5.67**
Mosul 1 × Phe ^{50}	**359.00**	**28.84**	**45.44**	**4.71**	**11.19**
Mosul 1 × Phe ^{100}	**289.20**	**27.73**	**41.31**	**3.32**	**7.96**
Local Black × Phe^{0}	**243.70**	**28.40**	**37.49**	**2.43**	**6.21**
Local Black × Phe ^{50}	**342.90**	**30.74**	**39.65**	**4.16**	**10.13**
Local Black × Phe ^{100}	**281.00**	**29.63**	**38.45**	**3.19**	**7.94**
LSD $_{(0.05)}$	**9.48**	**0.38**	**0.87**	**0.03**	**0.08**

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