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Effect of Foliar Spraying for Some Amino Acids on The Water Requirements of snap beans (*phaseolus vulgaris* l.) Plants

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Abstract

Snap bean *(Phaseolus vulgaris* L.*)* is one of the most important economic market crops in the Egypt**.** Also, the water is one of the major resources that limit agricultural developments especially in the arid lands so the shortage of irrigation water is the most important factor constraining agricultural production in Egypt. **So,** the field experiments were carried out during successive autumn seasons of 2019 and 2020 in EL-Kassasien Horticulture Research Station Ismailia Governorate to investigate the effect of water requirements rates (720, 960 and 1200 m^3 / fed) combined with different concentrations of amino acids (100 mg/l, 150 mg/l and 200 mg/l) on vegetative growth, chemical composition of plant foliage as well as green pods yield and its quality of snap bean **(***Phaseolus vulgaris* L. cv. Poulista) grown under sandy soil condition using drip irrigation system. Results showed that all vegetative growth characteristics (plant hight, leaves area, number of leaves as well as branches and fresh as well as dry weights of snap bean plants), chemical compision characteristics (N%, P%, K% and total carbohydrates contents), pods quality (average pod length, diameter and weight of snap beans pods) and pods yield as well as WUE were significantly increased with increasing rate of applied irrigation water in both seasons. In addition increasing amount of applied irrigation water from 720 to 1200 m^3/fed. exhibited the highest values of most studied parameters of snap beans plants in both seasons of study. Results show also clearly that studied paremeters were significantly increased gradully with increasing concentration of applied amino acids from 100 up to 200 mg/l. In this respect, the highest values of studied parmters were represented in plants which were sprayd by highest concentration of amino acids (200 mg/L.) and were irrigated by highest level of irrigation water (1200 m^3/F) followed by the plants which were sprayed by middle concentration of amino acids (150 mg/L.) and were irrigated with the same level of irrigation water during both seasons. Meanwhile the lowest values were obtained the snape bean plants which were irrigated by 720 m^3/F of irrigation water and were sprayed with 100 mg/L. of amino acids.

Keywords: amino acids, water requirements, snap beans

Introduction

Snap bean *(Phaseolus vulgaris* L.*)* is one of the most important economic market crops in the world. In Egypt snap bean is one of the most important vegetable crops have cultivated for local consumption and export as an out of vegetable season to European countries especially during the period from December to May. In 2018, the Egyptian cultivation of green snap bean plants was 65671 fed. which produced 284299 tons of green pods with an average of 4,327 tons / fed. (**FAO, 2019**).

Water is one of the major resources that limit agricultural developments especially in the arid lands so the shortage of irrigation water is the most important factor constraining agricultural production in Egypt. Snap bean like many other crops is sensitive to water stress at all growth stages, it is more sensitive to drought at flowering, green pods and grain development stage (**Thaloot *et al.*, 2006**). The responses of plants to stresses depend on many factors, such as phonological stage and the time and strength of stresses **(Torres *et al.*, 2006** and **Jaleel *et al.*, 2008).** Drought stress is one of the major causes for crop production losses world-wide, reducing average yield with 50% and over **(Wang *et al.*, 2003).** Where, deficit irrigation had an opposite influences on many aspects of plants physiology, water balance, nutrient, absorption and consequently photosynthetic capacity so that, plant growth **(Abd El-Ati, 2000; Amer *et al.*, 2002a; Ismail, 2004; El-Noemani *et al.*, 2010; Abd El-Aal *et al.*, 2011; Hegab *et al.*, 2014** and **Marzouk *et al.*, 2016)** and production are severely decreased **(Buan, 2002; Ismail, 2004; Khonok *et al.*, 2012; Byan, 2014; Silva *et al.*, 2016** and **Morais *et al.*, 2017).**

Amino acids as biostimulants substances that promote plant growth, improve nutrient availability, and enhance plant quality (**Rouphael and Colla, 2018** and **Rouphael *et al.*, 2018**) and are not only getting popular for mitigating injuries caused by abiotic stresses [**Kowalczyk *et al.*** 2008] but also serve as hormone precursors (**Rouphael and Colla, 2018**; **Zhao, 2010** and **Calvo *et al.*, 2014**); regulators of nitrogen uptake (**Miller *et al.*, 2007**), and antioxidant metabolism **(Calvo, 2014; Halpern, 2015 and Ertani *et al.*, 2013**). Additionally, application of amino acids was also found to increase K+ in plants both in the presence of salt stress and without salt application **(Calvo, 2014; Halpern *et al.*, 2015 and Ertani, 2013).** Amino acids is a well known biostimulant which has positive effects on plant growth, yield and significantly mitigates the injuries caused by abiotic stresses **(Kowalczyk and Zielony 2008)**. **Saeed *et al.,* (2005)** on soybean found that treatments of amino acids significantly improved growth parameters of shoots and fresh weight as well as pod yield.

Accordingly, this study was conducted to investigate the effect of water requirements rate and foliar application with some amion acids concentration as well as their interaction between them on vegetative growth, plant chemical constituents, yield and its components of green pods as well as quality of green pods and water use efficiency of snap bean under sandy soil condition.

Materials and Methods

Two field experiments were carried out during successive autumn seasons of 2019 and 2020 in EL-Kassasien Horticulture Research Station Ismailia Governorate to investigate the effect of water requirements rates combined with different concentrations of amino acids (Arginine+Proline+Glutamic acid) on vegetative growth, chemical composition of plant foliage as well as green pods yield and its quality of snap bean **(***Phaseolus vulgaris* L. cv. Poulista) grown under sandy soil condition using drip irrigation system.

The experiment included 9 treatments, which were combination between three water requirements rates (720 m^3, 960 m^3 and 1200 m^3) and three concentrations of amino acids (100 mg/l, 150 mg/l and 200 mg/l) as follows:

A split plot designed with three replicates was adopted. Irrigation quantities treatments were located randomly in the main plots while concentrations of amino acids were applied in the subplots.

Drip irrigation system was used (4 L/h for dripper) with 40 cm interval on the lateral line and spaced 20 cm along the irrigation tube (16 mm).

Each subplot area was 21 m^2. It consisted of 1.5m width and 14 m in length and it contained three drippers' lines. Two dripper lines between each subplot area were used as interval between irrigation treatments (Belt).

All experimental units received equal amounts of water during germination (50 m^3/fed). The irrigation treatments started at 10 days after emergence and were added three days intervals in the morning along plant life. The water was added using water counter. The amounts of water added at different treatments were calculated, expressed in terms of time based on the rate of water flow through the drippers (4L/hr.) at one bar to give such amounts of water presented in Table 3.

Foliar spray treatments were applied three times during the growing period of snap bean plants at 21, 35 and 50 days after sowing. The recommended agricultural practices for commercial snap bean production, i.e., irrigation; fertilization and weed as well as pests control were followed according to Ministry of Agriculture recommendations.

Table 3. The amount of water, the irrigation number and amount of water supply every irrigation.

Total water quantity (m^3/fed.)	**Irrigation number**	**Water supply / irrigation (m^3/ fed.)**
720 m^3/fed.	**24**	**30.00**
960 m^3/fed.	**24**	**40.00**
1200 m^3/fed.	**24**	**50.00**

Three plants from each plot were taken random from each plot at 60 days after sowing to evaluate the following vegetative characters (**Plant height, Number of branches per plant, Number of leaves per plant and Fresh weight per plant.**

Leaf area was determined according to the following formula of **Wallace and Munger (1965**).

$$\frac{leaves\ dry\ weight\ (g.)x\ disk\ area\ (cm2)}{disk\ dry\ weight\ (g.)} = cm2$$

LA*=*.

Sample of leaves were taken from each plot and oven dried at 70 ^{0}C till constant weight. The dry matter of leaves was finely ground and wet digested with sulfuric acid and perchloric acid (v/v) (3:1). Nitrogen (%) was determined colorimetrically according to the method described by **Kock and Mc-Meekin (1924)**. Phosphorus (%) was determined colorimetrically according to the method mentioned by **Murphy and Riley (1962)**. Potassium (%) was determined using the flame-photometer according to **Brown and Lilliland (1946)**.

Green pods were harvested at proper maturity stage in each harvest and the following data were recorded.

Total yield, as kg/plot, and then calculated as kg/fed.

Water use efficiency expressed as water economy, was calculated using the following equation of **Begg and Turner (1976)**.

Water use efficiency (kg/m^3)

$$= \frac{\text{Total yield (kg/fed.)}}{\text{Total amount of applied water } (m^3/\text{fed.})}$$

Representative sample of 20 pods from each experimental plot was taken and average pod length, diameter and fresh weight as well as TSS were recorded.

A representive sample of 20 green pods was taken and oven dried at $70c^0$ till constant weight and the dry matter was used to determine the chemical constituents of pods as follows.

a. Total protein (%): It was calculated by multiplying total nitrogen x 6.25

b. Total sugars, it was determined in the dry matter samples according to **Herbert *et al.* (1971)**.

c. Fibres %, it was determined as g/100 g dry weight according to **A.O.A.C. (1990)**.

Data were subjected to the statistical analysis by the method of Duncan's multiple range tests as reported by **Gomez and Gomez (1984)**. All statistical analysis was performed with SAS computer software.

Results and discussion

4.1 Vegetative growth characteristics of snape beans plants.

A. Effect of water requirements rate.

Concerning the effect of irrigation water rates on vegetative growth paremters of snap beans, results in Table 5 show that there were significant differences among the irrigation water treatments on all vegetative growth characteristics of snap beans plants during 2019 and 2020 autumn seasons. In this regard, it is obvious from such data that plant hight, leaves area, number of leaves as well as branches and fresh as well as dry weights of snap bean plants were significantly increased with increasing rate of applied irrigation water in both seasons of study. In addition increasing amount of applied irrigation water from 720 to 1200 m^3/fed. exhibited the highest values of plant hight, leaves area, number of leaves as well as branches and fresh and dry weights of snap beans plants parameters in both seasons of study. Such increments in plant growth aspects due to increasing the level of irrigation water may be attributes to the role of water in accelerating the physiological processes and increasing the solubility and up-take of macro-nutrients which constituse and incorporates in the formation of protoplasmic matrial necessary for cells formation and consequantly increasing the plant growh. The reduction in plant growth under conditions of low level (720 m^3 / feddan) as compared with the higher levels (1200 m^3) may be due to that water stress causes losses in tissue water which reduce turger pressure in the cell, there by inhibition enlargement and division of cells as concluded by **(Hsiao and Acevedo 1974)**. Also, the decrease in enlargement and division of cells decrease leaf area and hence the effectiveness of photosynthetic surface **(Jain and Misra 1970**. These results are in accordance with those reported by each of **Marzouk *et al.* (2016), Baath *et al.* (2020), Papazoglou *et al*. (2020)**, **Silva *et al.* (2020)**, **El-Gawad *et al.* (2021)**, **Ibrahim *et al.* (2021)** and **Moraes *et al.* (2022)** who showed that increase water quantity led to a significant increase of plant growth (plant height, leaves number and leaves area /plant as well as fresh and dry weight).

C. Effect of amion acids concentration.

As shown in Table 5, the different concentration of studied amino acids significantly affected all vegetative growth characteristics in both seasons except leaves number in second season which did not reach the level of significance. Where, these parmters were increased gradully with increasing concentration of applied amino acids from 100 up to 200 mg/l. The highest concentration (200 mg/L.) recorded the highest values and no significant differences were found between the lowest (100 mg/L.) and the moderate (150 mg/L.) concentrations of applied amino acids. Such inhancment effect of the used amino acids (Argnine + proline + glutamic acids) on all measured growth parmeters ar attributed to the main role which play and necessary for inhancement plant metabolism phytoprotection and maintain planthealth and consequantly increase plant growth. Obtained results are in agreement with those reported **Ismail and Helmy (2018)**, **Ibrahim *et al.* (2019), Talib *et al.* (2021)** and **Zaky *et al.* (2021)** on differant crops they showed that vegetative growth paremters affected by proline treatment.

Table 5. Effect of water requirements rate, amion acids concentration and the interaction between them on some vegetative growth characteristics of snape beans plants during 2019 and 2020 autumn seasons.

Characteristics Treatments		First season						Second season					
Water rates (m^3/Fed.)	**Amion acids (mg/L)**	**Plant hight (cm)**	**Leaves area (cm^2/plant)**	**Branches No.**	**Leaves No.**	**Fresh weight (g/plant)**	**Dry weight (g/plant)**	**Plant hight (cm)**	**Leaves area (cm2/plant)**	**Branches No.**	**Leaves No.**	**Fresh weight (g/plant)**	**Dry weight (g/plant)**
720		29.5C	213.4C	6.0C	7.8C	31.7C	5.3C	29.3C	201.5C	5.3C	6.1C	32.1C	5.3C
960		42.2B	332.1B	8.0B	11.1B	46.2B	8.1B	41.6B	323.5B	7.6B	11.0B	45.9B	7.8B
1200		53.2A	370.2A	14.2A	22.4A	55.1A	11.3A	50.7A	359.4A	11.7A	17.1A	53.6A	9.9A
	100	40.2B	300.9C	8.8C	13.0C	43.3C	7.9C	40.2B	292.4B	8.0B	11.5A	43.4B	7.6B
	150	40.4AB	306.0B	9.4B	13.9B	44.4B	8.3B	40.4AB	293.8B	8.1B	11.5A	43.7B	7.7B
	200	41.0A	308.9A	10.0A	14.5A	45.2A	8.5A	41.0A	298.3A	8.5A	11.2A	44.5A	7.8A
720	100	28.6d	210.2c	5.4d	7.3d	30.0e	5.1d	28.9c	200.5c	5.1c	6.1c	31.4c	5.3c
	150	29.8d	213.7c	6.2d	8.0d	32.3d	5.3d	29.0c	200.5c	5.1c	6.0c	31.8c	5.3c
	200	30.1d	216.2c	6.2d	8.0d	32.7d	5.4d	30.0c	203.6c	5.7c	6.1c	33.1c	5.5c
960	100	41.6c	327.8b	7.7c	10.8c	45.9c	7.9c	41.3b	319.8b	7.6b	10.9b	45.6b	7.7b
	150	42.2c	332.8b	8.0c	11.1c	46.1c	8.2c	41.6b	323.0b	7.6b	10.9b	45.8b	7.8b
	200	42.8c	335.9b	8.3c	11.6c	46.6c	8.2c	42.0b	327.8b	7.8b	11.2b	46.2b	8.0b
1200	100	52.1b	364.7a	13.3b	20.9b	53.9b	10.8b	50.3a	356.9a	11.4a	17.4a	53.2a	9.8a
	150	53.1ab	371.6a	14.0ab	22.4ab	54.8ab	11.3ab	50.7a	358.0a	11.6a	17.7a	53.5a	9.9a
	200	54.3a	374.4a	15.3a	23.9a	56.5a	11.9a	51.0a	363.4a	12.1a	16.3a	54.2a	10.1a

Amino acids mean Argnine + proline + glutamic acids at 100, 150 and 200 mg/L. at each amino acid.

E. Effect of water requirements rate X amion acids concentration.

Data presented in Table 7 clearly indicate that plant hight, leaves area, number of leaves as well as branches and fresh as well as dry weights of snap bean plants were significantly affected by amion acids concentration as foliar application with rates of irrigation water in both seasons. In this respect, the highest values were represented in plants which were foliar sprayd by highest concentration of amino acids (200 mg/L. of each amino acid used) and were irrigated by highest level of irrigation water (1200 m^3/F) followed by the plants which were sprayed by middle concentration of amino acids (150 mg/L. of each amino acid used) and were irrigated with the same level of irrigation water during both seasons of study. Meanwhile the lowest values were obtained from the snape bean plants which were irrigated by 720 m^3/F of irrigation water and foliar sprayed with 100 mg/L. of amino acids (Argnine + proline + glutamic).

As a consequence, vegetative growth characters decreased as deficit level increased. Increasing deficit level up to 720m^3/F. decreasedthe quantity of water absorption by plant roots so that decreasing the quantity of essential nutrients (N P K) absorped by plant roots. Also, water stress (by deficit of irrigation) had an opposite influence on many aspects of plants physiology, especially photosynthetic capacity. So that, if the drought stress is prolonged, plant growth and production are severely decreased, plants dehydrate and finally will die. Whereas, the combination treatment of spraying plants by highest concentration of amino acids (200 mg/l.) resulted in the highest values of vegetative growth charactres under each level of irrigation quantity. In general, increasing the deficit irrigation reduced the vegetative growth in both seasons. Meanwhile the effects of applied treatments either individual or with their interactions reversed these results where the treatments increased the parameters of vegetative growth.

4.2 Chemical composition of snape bean plants.

A. Effect of water requirements rate.

With regards the effect of water requirements rate, results in Table 10 reveal that irrigation with various levels of irrigation water affected significantly and increased on N%, P%, K% and total carbohydrates contents as well as loss total chlorophyll for plant foliage in both seasons of study. Where, increasing amount of applied irrigation water from 720 to 1200 m^3/fed. exhibited the highest values of N%, P%, K% and total carbohydrates contents and the lowest values for total chlorphyll reading for plant foliage in both seasons of study. Such enhancing effect of irrigation on determined N, P, K elments and total carbohydrates may be due to the increase of nutrient soliability which become available for absorrpation by plants and total carbohydrats assimilation through photo synthetic process which in turn translocate and accumulate in plant leaves. Obtained results are matched with those reported on tomato, by **El-Gawad *et al.* (2021)** who reported that the uptake of nitrogen and phosphorus was significantly reduced by increasing water stress in the plants. On other hand, **Ibrahim (2005)** showed that increasing the irrigation level decreased the total nitrogen and phosphorus concentration of plant foliage.

C. Effect of amion acids concentration.

The different concentration of studied amino acids significantly affected all the determined chemical composition of snape beans plants in both seasons, as shown in Table 10. Where, N%, P%, K% and total carbohydrates contents were increased gradully with increasing the concentration of applied amino acids from 100 up to 200 mg/l on the other hand, total chlorophyll reading which decreased gradully with increasing the increasing the concentration of applied amino acids from 100 up to 200 mg/l for each used amino acid (Argnine + proline + glutamic acids)

Table 10. Effect of water requirements rate, amion acids concentration and the interaction between them on some chemical characteristics of snape beans plants during 2019 and 2020 autumn seasons**.**

Characteristics / Treatments		First season					Second season				
Water rates (m^3/Fed.)	**Amion acids concentration (mg/L)**	**Total chlorophyll (Reading)**	**N (%)**	**P (%)**	**K (%)**	**Total CARB. (%)**	**Total chlorophyll (Reading)**	**N (%)**	**P (%)**	**K (%)**	**Total CARB. (%)**
720		**0.782A**	**2.02C**	**0.32C**	**1.76C**	**9.56C**	**0.782A**	**2.09C**	**0.35C**	**1.85C**	**10.89C**
960		**0.705B**	**2.30B**	**0.42B**	**2.08B**	**11.73B**	**0.703B**	**2.39B**	**0.45B**	**2.16B**	**13.03B**
1200		**0.622C**	**2.47A**	**0.50A**	**2.14A**	**14.30A**	**0.624C**	**2.63A**	**0.55A**	**2.35A**	**16.35A**
	100	**0.710A**	**2.13C**	**0.35C**	**1.85C**	**11.00C**	**0.707A**	**2.24C**	**0.39C**	**1.98C**	**12.62C**
	150	**0.702B**	**2.26B**	**0.42B**	**2.01B**	**11.66B**	**0.703B**	**2.36B**	**0.45B**	**2.12B**	**13.35B**
	200	**0.697B**	**2.39A**	**0.47A**	**2.12A**	**12.93A**	**0.698C**	**2.51A**	**0.50A**	**2.26A**	**14.31A**
	100	**0.788a**	**1.89f**	**0.26g**	**1.56g**	**8.88f**	**0.788a**	**1.99g**	**0.29f**	**1.68g**	**10.26e**
720	**150**	**0.781a**	**2.02ef**	**0.32f**	**1.81f**	**9.33f**	**0.782ab**	**2.08fg**	**0.35e**	**1.89f**	**10.82e**
	200	**0.777a**	**2.14de**	**0.38e**	**1.90ef**	**10.47e**	**0.777b**	**2.21ef**	**0.40d**	**1.98ef**	**11.60de**
	100	**0.716b**	**2.19cd**	**0.35ef**	**1.96de**	**10.85de**	**0.705c**	**2.28de**	**0.39d**	**2.05de**	**12.21c**
960	**150**	**0.702c**	**2.30bc**	**0.42d**	**2.10bc**	**11.60d**	**0.702c**	**2.39cd**	**0.46c**	**2.16cd**	**12.92cd**
	200	**0.698c**	**2.40b**	**0.47bc**	**2.19ab**	**12.74c**	**0.700c**	**2.49bc**	**0.49c**	**2.26bc**	**13.96c**
	100	**0.627d**	**2.31bc**	**0.44**	**2.04cd**	**13.25bc**	**0.628d**	**2.46c**	**0.49c**	**2.20bc**	**15.40b**
1200	**150**	**0.623d**	**2.46b**	**0.50b**	**2.12bc**	**14.06b**	**0.625d**	**2.61b**	**0.54b**	**2.31b**	**16.30ab**
	200	**0.617d**	**2.63a**	**0.56a**	**2.26a**	**15.60a**	**0.618d**	**2.83a**	**0.60a**	**2.53a**	**17.36a**

Amino acids mean Argnine + proline + glutamic acids at 100, 150 and 200 mg/L. at each amino acid.

E. Effect of water requirements rate X amion acids concentration.

Data presented in Table 12 clearly indicated that total chlorophyll reading, N%, P%, K% and total carbohydrates contents for snap bean foliage were significantly affected by amion acids as foliar application with rates of irrigation water interaction treatments in both seasons. In this respect, the highest values were represented in plants which were sprayd by the highest concentration of amino acids (200 mg/L.) and were irrigated by the highest level of irrigation water (1200 m^3/Fed.) followed by the plants which were sprayed by middle concentration of amino acids (150 mg/L.) and were irrigated with the same level of irrigation water during both seasons. Meanwhile the lowest values were represented in the snape bean plants which were irrigated by 720 m^3/Fed. of irrigation water and were sprayed with 100 mg/L. of amino acids (Argnine + proline + glutamic acids).

4.3 Quality of snape beans pods.

4.3.1 Physical quality of snape beans pods.

A. Effect of water requirements rate.

With regard to the effect of irrigation water quantity, results in Table 15 show significant differences among the irrigation water treatments on all physical quality characteristics of snap pods during 2019 and 2020 autumn seasons. In this regard, it is obvious from such data the average pod length, diameter and weight of snap beans pods were significantly increased with increasing rate of applied irrigation water in both seasons. In addition increasing amount of applied irrigation water from 720 to 1200 m^3/fed. exhibited the highest values of average pod length, diameter and weight of snap beans pods in both seasons of study. Obtained results are in harmony with those of **Morais *et al.* (2017), El-Gawad *et al.* (2021)** and **Ibrahim *et al.* (2021)** who showed that the pod length have a linear increase according to the increase of irrigation.

C. Effect of amion acids concentration.

Regarding to the effect of foliar application with some amino acids, the same data in Table 15 show that the different concentration of studied amino acids (Argnine + proline + glutamic acids) significantly affected all physical quality characteristics of snap pods in both seasons exceptpod length and diameter only in second season which did not reach to the level of significance. Where, these parmters were increased gradully with increasing concentration of applied amino acids from 100 up to 200 mg/l from each amino acid used. The highest concentration (200 mg/L.) recorded the highest values and no significant differences were found between the lowest (100 mg/L.) and the moderate (150 mg/L.) concentrations of applied amino acids. Such improvement in physical green pod traits as aresult of using some amino acids treatments may be due to the increase in menral elements content (Table 5) and consequantly on physical quality of produced green pods.

Table 15. Effect of water requirements rate, amion acids concentration and the interaction between them on some physical quality of snape beans pods during 2019 and 2020 autumn seasons**.**

Treatments	**Characteristics**	**First season**			**Second season**		
Water rates (m^3/Fed.)	**Amion acids concentration (mg/L)**	**Pod length**	**Pod diameter**	**Pod weight**	**Pod length**	**Pod diameter**	**Pod weight**
720		**7.6C**	**0.51C**	**4.04C**	**7.6C**	**0.51C**	**4.03C**
960		**11.6B**	**0.69B**	**6.14B**	**11.6B**	**0.67B**	**6.13B**
1200		**13.9A**	**0.77A**	**7.31A**	**13.5A**	**0.76A**	**7.28A**
	100	**10.8B**	**0.64B**	**5.73B**	**10.8A**	**0.64A**	**5.73B**
	150	**10.9B**	**0.66AB**	**5.80B**	**10.9A**	**0.64A**	**5.79B**
	200	**11.3A**	**0.67A**	**5.96A**	**10.9A**	**0.65A**	**5.92A**
720	**100**	**7.4d**	**0.51d**	**3.98d**	**7.4c**	**0.51c**	**3.98d**
	150	**7.6d**	**0.51d**	**4.03d**	**7.6c**	**0.49c**	**4.03d**
	200	**7.7d**	**0.53d**	**4.10d**	**7.7c**	**0.52c**	**4.09d**
960	**100**	**11.3c**	**0.66c**	**5.96c**	**11.4b**	**0.66b**	**6.01c**
	150	**11.6bc**	**0.70b**	**6.14bc**	**11.5b**	**0.67b**	**6.07bc**
	200	**11.9b**	**0.71b**	**6.32b**	**11.9b**	**0.68b**	**6.30b**
1200	**100**	**13.7a**	**0.77a**	**7.24a**	**13.7a**	**0.76a**	**7.21a**
	150	**13.7a**	**0.77a**	**7.23a**	**13.8a**	**0.77a**	**7.28a**
	200	**14.2a**	**0.77a**	**7.47a**	**13.1a**	**0.77a**	**7.36a**

Amino acids mean Argnine + proline + glutamic acids at 100, 150 and 200 mg/L. at each amino acid.

E. Effect of water requirements rate X amion acids concentration.

Data presented in Table 17 clearly indicate that average length, diameter and weight of snap beans pods were significantly affected by amion acids as foliar application with rates of irrigation water in both seasons. In this respect, the highest values were represented in plants which were sprayd by the highest concentration of amino acids (200 mg/L.of each amino acid used) and were irrigated by the highest level of irrigation water (1200 m^3/Fed.) followed by the plants which were sprayed by the same concentration of amino acids and were irrigated with the middle level of irrigation water (960 m^3/Fed.) during both seasons. Meanwhile the lowest values were obtained with the snape bean plants which were irrigated by 720 m^3/Fed. of irrigation water and were sprayed with 100 mg/L. of amino acids (Argnine + proline + glutamic acids). Such results are similar in the two seasons of growth.

4.3.2 Chemical quality of snape beans pods.

A. Effect of water requirements rate.

Results in Table 20 show significant differences among the irrigation water treatments on all chemical quality characteristics of snap pods during 2019 and 2020 autumn seasons. In this regard, it is obvious from such data the loss total fibers and highest total protien of snap beans pods were significantly with increasing rate of applied irrigation water in both seasons. In addition increasing amount of applied irrigation water from 720 to 1200 m^3/fed. exhibited the lowest and the highest values for the total fibers and total protien of snap beans pods in both seasons of study.

C. Effect of amion acids concentration.

Results in Table 20 show that the different concentration of studied amino acids significantly affected all chemical quality characteristics of snap pods in both seasons. Where, the total protien increased gradully with increasing concentration of applied amino acids from 100 up to 200 mg/l. and the oppeside trend was observed on the total fibers. In this concept, similar results were reported by **El-Saadony *et al*. (2017), Mahmood *et al*. (2017)** and **Zaky *et al.* (2021)**.

Table 20. Effect of water requirements rate, organic manure amount and amion acids concentration on some chemical quality of snape beans pods during 2019 and 2020 autumn seasons.

Characteristics / Treatments		First season			Second season		
Water rates (m^3/Fed.)	**Amion acids (mg/L.)**	**Fibers**	**Protien**	**TSS**	**Fibers**	**Protien**	**TSS**
720		10.12A	12.28C	8.78A	10.23A	13.12C	8.78A
960		9.60B	13.79B	7.59B	9.68B	15.52B	7.59B
1200		8.87C	16.44A	7.06C	8.96C	17.81A	7.06C
	100	9.80C	13.15C	7.89A	9.86C	14.47C	7.93A
	150	9.54B	14.22B	7.83AB	9.64B	15.35B	7.81A
	200	9.25A	15.14A	7.70B	9.36A	16.63A	7.69B
		Fibers	**Protien**	**TSS**	**Fibers**	**Protien**	**TSS**
	100	10.34a	11.33g	8.89a	10.49a	12.21f	8.89a
720	150	10.13b	12.32f	8.78a	10.22b	12.92f	8.78a
	200	9.90c	13.19de	8.67a	9.98c	14.23e	8.67a
	100	9.83c	12.74ef	7.67b	9.89cd	14.46e	7.78b
960	150	9.63d	13.77d	7.67b	9.74d	15.41d	7.56bc
	200	9.33e	14.87c	7.44bc	9.40e	16.70c	7.44c
	100	9.23e	15.38c	7.11cd	9.22f	16.75c	7.11d
	150	8.87f	16.57b	7.06d	8.97g	17.72b	7.11d
1200	200	8.51g	17.38a	7.00d	8.70h	18.95a	6.94d

Amino acids mean Argnine + proline + glutamic acids at 100, 150 and 200 mg/L. at each amino acid.

E. Effect of water requirements rate X amion acids concentration.

Data presented in Table 22 clearly indicate that total protien and the total fibers of snap beans pods were significantly affected by amion acids as foliar application with rates of irrigation water in both seasons. In this respect, the highest values of total protien were represented in plants which were sprayd by highest concentration of amino acids (200 mg/L.) and were irrigated by highest level of irrigation water (1200 m^3/F) followed by the plants which were sprayed by the same concentration of amino acids and were irrigated with the middle level of irrigation water during both seasons and the oppesid trend were observed in case of total fibers.

4.4 Total yield and WUE.

A. Effect of water requirements rate.

Results in Table 25 reveal that irrigation with various levels of irrigation water affected significantly increased on total yield of pods and WUE in both seasons. Where, increasing amount of applied irrigation water from 720 to 1200 m^3/fed. exhibited the highest values of total yield of pods and WUE in both seasons. It could be suggest that increasing the quantity of water applied to the soil increases the soil moisture content, that makes the nutritional elements more available to the plant, and this in turn might favoured the plant growth characters (Table, 5) and most of the physiological processes (Table, 10), that directly affect the yield and its components. In addition, higher water quantity applied to plants led to keep higher water content in the plant tissues, and this turn produced the higher number of pods than those under water stress. These results are in accordance with those reported by each of **El-Gawad *et al.* (2021)**, **Ibrahim *et al.* (2021), Yavuz (2021)** and **Moraes *et al.* (2022).**

C. Effect of amion acids concentration.

The different concentration of studied amino acids significantly affected total yield of pods and WUE for snape beans plants in both seasons. Where, total yield of pods and WUE for snape beans plants were increased gradully with increasing concentration of applied amino acids from 100 up to 200 mg/l. . Obtained results are in harmony with those of **Ismail and Helmy (2018)**, **Ibrahim *et al.* (2019), Talib *et al.* (2021)** and **Zaky *et al.* (2021)** who showed that the studied treatments had a significant impact on total yield.

Table 25. Effect of water requirements rate, organic manure amount and amion acids concentration on total yield and WUE of snap beans plants during 2019 and 2020 autumn seasons.

Treatments / Characteristics		First season		Second season	
Organic manure (m^3/Fed.)	**Amion acids (mg/L.)**	**Yield (kg/F.)**	**WUE**	**Yield (kg/F.)**	**WUE**
720		**913C**	**1.27C**	**764C**	**1.06C**
960		**2271B**	**2.37B**	**1895B**	**1.97B**
1200		**5535A**	**4.61A**	**4600A**	**3.83A**
	100	**2870C**	**2.72C**	**2392C**	**2.26C**
	150	**2909B**	**2.75B**	**2413B**	**2.28B**
	200	**2941A**	**2.78A**	**2454A**	**2.32A**
10	**100**	**906d**	**1.26d**	**755d**	**1.05d**
	150	**906d**	**1.26d**	**761d**	**1.06d**
	200	**928d**	**1.29d**	**775d**	**1.08d**
20	**100**	**2251c**	**2.35c**	**1877c**	**1.95c**
	150	**2273c**	**2.37c**	**1894c**	**1.97c**
	200	**2289c**	**2.38c**	**1915c**	**1.99c**
30	**100**	**5453b**	**4.54b**	**4544b**	**3.79b**
	150	**5547a**	**4.62a**	**4583b**	**3.82b**
	200	**5605a**	**4.67a**	**4671a**	**3.89a**

Amino acids mean Argnine + proline + glutamic acids at 100, 150 and 200 mg/L. at each amino acid.

E. Effect of water requirements rate X amion acids concentration.

Data presented in Table 27 clearly indicate that total yield of pods and WUE for snape beans plants were significantly affected by amion acids as foliar application with rates of irrigation water in both seasons. In this respect, the highest values were represented in plants which were sprayd by highest concentration of amino acids (200 mg/L.) and were irrigated by highest level of irrigation water (1200 m^3/F) followed by the plants which were sprayed by middle concentration of amino acids (150 mg/L.) and were irrigated with the same level of irrigation water during both seasons. Meanwhile the lowest values were represented in the snape bean plants which were irrigated by 720 m^3/F of irrigation water and were sprayed with 100 mg/L. of amino acids.

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تأثير الرش الورقي لبعض الأحماض الأمينية على الاحتياجات المائية لنباتات الفاصوليا (*Phaseolus Vulgaris* L)

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تعتبر الفاصوليا أحد أهم محاصيل السوق الاقتصادية في مصر. كما أن المياه هي أحد الموارد الرئيسية التي تحد من التنمية الزراعية خاصة في الأراضي القاحلة ، لذا فإن نقص مياه الري هو أهم عامل يعوق الإنتاج الزراعي في مصر. لذلك أجريت هذه الدراسة خلال مواسم الخريف المتتالية لعامي 2019 و 2020 بمحطة بحوث القصاصين بمحافظة الإسماعيلية لدراسة تأثير معدلات الاحتياجات المائية (720 ، 960 ، 1200 م 3 / فدان) مع تراكيز مختلفة من الأحماض الأمينية. (100 مجم / لتر ، 150 مجم / لتر و 200 مجم / لتر) على النمو الخضري ، التركيب الكيميائي لأوراق النبات وكذلك محصول القرون الخضراء وجودة قرون الفاصوليا صنف بوليستا النامية المنزرع فى الارض الرمليه وباستخدام نظام الري بالتنقيط. أظهرت النتائج أن تحسنت جميع صفات النمو الخضري (ارتفاع النبات ، المساحة الكلية للأوراق ، عدد الأوراق وكذلك الأفرع والوزن الطازج والجاف لنبات الفاصوليا) ، صفات المحتوى الكيميائي للأوراق (النتروجين والفوسفور والبوتاسيوم و الكربوهيدرات الكلية)) ، وجودة القرون (متوسط طول القرون وقطرها ووزنها) والمحصول الكلى للقرون وكفاءة استخدام المياه مع زيادة معدل مياه الري في كلا الموسمين. بالإضافة إلى زيادة كمية مياه الري من 720 إلى 1200 م 3 / فدان. أظهرت أعلى قيم لمعظم الصفات المدروسة لنباتات الفاصوليا في موسمي الدراسة. كما أوضحت النتائج أن الصفات المدروسة زادت معنوياً تدريجياً مع زيادة تركيز الأحماض الأمينية المستخدمه من 100 حتى 200 ملجم / لتر. في هذا الصدد ، تم تمثيل أعلى قيم للصفات المدروسة في النباتات التي تم رشها بأعلى تركيز من الأحماض الأمينية (200 مجم / لتر) وتم ريها بأعلى مستوى من مياه الري (1200 م 3 / الفدان) تليها النباتات التي تم رشها بتركيز متوسط من الأحماض الأمينية (150 مجم / لتر) وتم ريها بنفس مستوى مياه الري خلال الموسمين. في حين تم الحصول على أقل القيم لنباتات الفاصوليا التي تروى بمقدار 720 م 3 / فدان من مياه الري وتم رشها بـ 100 ملجم / لتر. من الأحماض الأمينية.