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Effect of Organic Fertilizer Rates on the Water Requirements of Snap Beans (*Phaseolus vulgaris* L.) plants

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Abstract

A field experiment was 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 amounts of organic manure (10, 20, 30 m^3) 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. A split plot designed with three replicates was adopted. Irrigation quantities treatments were placed in the main plots and amounts of organic manure treatments were located randomly in the subplots. Results showed that all vegetative growth characteristics, chemical compision characteristics, pods quality 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 with increasing amount of applied organic manure from 10 to 30 m^3/fed. in both seasons of study. The highest values were obtained with adding highst amounts of organic manure (30 m^3/Fed.) then irrigate plants by highest rate of water (1200 m^3/Fed.) and vice versa.

Key words: Snap beans, *Phaseolus vulgaris*, Water Requirements, Organic fertilizer and organic manure.

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.*, 2002; 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).**

In soils with reduced organic matter content, organic fertilizers are soil-conditioning agents, which improve crop conditions, increasing water retention and availability of macro and micronutrients absorbable by the roots **(Galvão *et al.*, 2008; Costa *et al.*, 2013)**. The use of organic fertilizers in agricultural crops have already been investigated in many studies, with relevant results for quality and yield, for either organic and conventional farming **(Araújo *et al.*, 2001; Vidal *et al.*, 2007; Oliveira *et al.*, 2010; Silva *et al.*, 2012)**.

Accordingly, this study was conducted to investigate the effect of water requirements rate and organic manure amount 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 in sandy soil condition.

Materials and Methods

A field experiments was 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 amounts of organic manure 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 drip irrigation system in sandy soil condition. The soil mechanical and chemical properties are shown in Table 1 according to **Chapman and Pratt (1982)**.

Table 1. Physical and chemical properties of the experimental soil as average of two seasons.

Physical properties		**Chemical properties**	
Sand (%)	89	Organic matter (%)	0.3
Silt (%)	5.9	Available K (ppm)	55.3
Clay	4.6	Available P (ppm)	4.1
Field capacity	8.2	Available N (%)	3.7
Wilting point	2.5	Calcium carbonate (%)	0.28
Texture	**Sandy**	pH	8.1

The seeds of cv. Poulista were obtained from Hort. Res. Inst., Agric. Res. Center, Egypt and sown on Sept 20th and 30th in the first and second season, respectively (2019 and 2020) on one side of ridge (two seeds/hill) at 7 cm spacing. The experiment included 9 treatments, which were combination among three water requirements rates (720, 960 and 1200 m^3 / fed) with three amounts of organic manure (10, 20, 30 m^3). A split plot designed with three replicates was adopted. Irrigation quantities treatments were placed in the main plots and amounts of organic manure treatments were located randomly 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.

All experimental units received equal amounts of water during germination (50 m^3/fed). Three irrigation levels i.e. 1200, 960 and 720 m^3 / fed., were applied and started at 10 days after emergence. Total water requirement of the snap bean crop in the Ismailia region was obtained from the Central Laboratory for Agricultural Climate (C.L.A.C) Ministry of Agriculture and Land Reclamation. The amounts of added water 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 2. The different amounts of organic manure were added at once during preparing of the soil. The physical and chemical properties of the experimental organic manure are shown in Table 3.

Table 2. The total amount of water, irrigation number and amount of water supply every irrigation during the growing season.

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**

Table 3. Physical and chemical properties of the experimental manure during the two seasons.

Item/sander	**Moisture content (%)**	**Bulk density (%)**	**pH (1:2.5)**	**EC (1:2.5) (dS/m)**	**Total nitrogen (%)**	**Total phosphor (%)**	**Total potassium (%)**	**Organic matter (%)**	**Organic carbon (%)**
2019	**7.1**	**254**	**6.2**	**3.1**	**2.3**	**1.14**	**2.23**	**41.2**	**23.9**
2020	**7.6**	**280**	**6.2**	**3.4**	**2.8**	**1.31**	**2.44**	**42**	**24.59**

Three plants from each plot were taken random from each plot at 60 days after sowing to evaluate the following vegetative characters such as plant height, number of branches per plant, number of leaves per plant and fresh as well as dry weight per plant**.**

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

LA=.Leaves dry weight (g) x disk area (cm^2)/ disk dry weight (g.)= cm^2

Chlorophyll reading of the fifth mature leaf from top of the plant was measured using Minolta chlorophyll meter SPAD -502. 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)**. Total carbohydrate was determined colorimetrically using the method described by **Dubois *et al*. (1956)**.

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) = Total yield (kg/fed.) / Total amount of applied water (m^3/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 total protein (%) and total fibres % (**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

Vegetative growth characteristics of snape beans plants.

Concerning the effect of irrigation water rates on vegetative growth paremters of snap beans, results in Table 4 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 and branches as well as fresh and 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 and branches as well as fresh and dry weights of snap beans plants 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).

Regarding the effect of organic manure amounts on vegetative growth traits, such data in Table 4 show significant differences among the organic manure amounts on plant hight, leaves area, number of leaves and branches as well as fresh and dry weights during 2019 and 2020 autumn seasons. Results show clearly that current paremeters were significantly increased with increasing amount of applied organic manure from 10 to 30 m^3/fed. in both seasons of study. In this respect, the improving effect for organic fertilzer on plant growth may be due to its highest content of nutrient elements and organic matter (Table 3) which may be improved both soil fertility and physical soil characteristics, In addition, organic manure considered slow release organic fertilizer lasting long period in the soil and positively affect on plant growth. Obtained results are in agreement with those reported by **Feleafel and Mirdad (2014), Angeli *et al.* (2016)** and **Hanoon *et al.* (2020)** who showed that the organic fertilization and nitrogen fertilization exceeded plant height, fresh and dry weight compared with control treatment.

Regarding the effect interaction of water requirements X organic manure, data in Table 5 show significant increase in plant hight, leaves area, number of leaves and branches as well as fresh and dry weights of snap bean plants during both seasons. The highest values were obtained with adding highst amounts of organic manure (30 m^3/Fed.) and irrigate plants by highest rate of water (1200 m^3/Fed) and vice versa. From a forementioned results it can be concluded that, increasing deficit irrigation level up to 720 m^3/Fed. of irrigation water reduced the plant hight, leaves area, number of leaves and branches per plant as well as fresh and dry weights of snap bean plants as comparing with 1200 m^3/Fed. Meanwhile adding the highest amount of organic manure (30 m^3/fed.) increased the plant hight (cm), leaves area per plant, number of leaves and branches per plant as well as fresh and dry weights per plant of snap bean plants at highest level of irrigation water (1200 m^3/fed.), compared to plants which received the lowest amount of organic manure and irrigated by the same irrigation level in 2019 and 2020 autumn seasons.

Table 4: Effect of water requirements rate, organic manure amount 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.)	Organic manure (m^3/Fed.)	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
	10	39.1C	292.9C	8.1C	11.9C	42.5C	7.4C	39.0C	288.1C	7.7C	10.48B	42.4C	7.2C
	20	41.9B	307.8B	9.4B	13.7B	44.1B	8.3B	40.8B	294.1B	8.1B	11.52A	44.0B	7.8B
	30	43.8A	315.1A	10.7A	15.7A	46.4A	9.0A	41.8A	302.3A	8.8A	12.2A	45.2A	8.1A
Water requirements X organic manure													
720	10	26.0j	201.3i	5.0h	6.4g	29.1g	4.6i	26.3d	196.7i	4.8f	6.0d	29.4f	4.8g
	20	30.1i	215.3h	6.0g	8.0f	31.4f	5.4h	30.2c	202.2h	5.3ef	6.1d	31.4f	5.6f
	30	32.3h	223.4g	6.9f	8.9f	34.5e	5.9g	31.3c	205.7g	5.8e	6.1d	34.5d	5.7f
960	10	40.8g	318.9f	7.4ef	10.4e	45.1d	7.3f	40.8b	313.9f	7.1d	10.4c	45.1c	7.1e
	20	42.2f	335.0e	8.0de	10.9de	46.2cd	8.2e	41.7b	321.3e	7.7cd	11.1c	46.2cd	8.0d
	30	43.6e	342.6d	8.6d	12.1d	47.2c	8.7d	42.4b	335.3d	8.1c	11.4c	46.5c	8.5c
1200	10	50.7d	358.3c	11.8c	18.8c	53.2b	10.3c	49.9a	353.7c	11.2b	15.0b	52.7b	9.6b
	20	53.4b	373.0b	14.1b	22.3b	54.6b	11.3b	50.6a	358.7b	11.3b	17.3a	54.6b	9.9b
	30	55.4a	379.3a	16.8a	26.1a	57.4a	12.4a	51.6a	366.0a	12.6a	19.1a	54.7a	10.3a

From a forementioned results, it can be concluded that increasing deficit irrigation level was of adeleterious effect on vegetative growth characteristics expressed as plant hight, leaves numbers as well as fresh and dry weights of shoots. So that highest level of irrigation water (1200m^3/Fed.) showed the higher significant positive effects on all vegetative growth parameters. As a consequence, vegetative growth characters decreased as deficit level increased. Increasing deficit level up to 720m^3/Fed. decreased the quantity of water absorption by plant roots so that decreasing the quantity of essential nutrients (N P K) absorbed 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 (**Lisar *et al*., 2012**). Restricted water supply is a major problem that may affect plant growth then fruit yield and quality. This assumption is emphasised by more reduction in plant growth under the high deficit irrigation level (720 m^3/Fed.) and can interpret the obtained results.

Adding organic manure improved vegetative growth characters *i.e* plant hight, leaves numbers, fresh and dry weights of shoots under the non-deficit irrigation level (1200m^3/F.) and medium level (960 m^3/F.) of irrigation water. Wherease, fertilzing snap bean plants by highest amounts of organic manure (30 m^3/Fed.) increased the plant hight, leaves numbers, fresh weight and dry weight of shoots by compared with the lowest amount of organic manure (10 m^3/Fed.) under the non-deficit irrigation level (1200m^3/Fed.).

Chemical composition of snape bean plants

With regards the effect of water requirements, results in Table 6 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 photosynthetic process which in turn translocate and accumulate in plant leaves. Obtained results are matched with those reported 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.

Concerning the effect of applied organic manure amount (10, 20 and 30 m^3/fed) on chemical composition of snape bean foliage, the results presented also in Table 6 reveal that there were significant effects on total chlorophyll reading, N%, P%, K% and total carbohydrates contents for plant foliage in both seasons of study. Results show clearly that the determined chemical composition of snape bean plant foliage were significantly increased with increasing the amount of applied organic manure from 10 to 30 m^3/fed. except total chlorophyll reading which decreased with increasing the amount of applied organic manure in both seasons of study. Obtained results are in agreement with those reported by **Feleafal and Mirdad (2014)** and **Jasim *et al.* (2018)** who reported that organic fertilization significantly increased N, P and K% in snap bean foliage.

Regarding the effect of interaction treatments between water requirements X organic manure, data in Table 6 show significant increase on N%, P%, K% and total carbohydrates contents for snap bean plant foliage during both seasons. The highest values were obtained with adding the highst amounts of organic manure (30 m^3/Fed.) and irrigated plants by the highest rate of water (1200 m^3/Fed) and vice versa. On the other hand the highest values of total chlorophyll reading were obtained when adding the lowest rate of irrigation water (720 m^3/Fed.) and the lowest amount of organic manure (10 m^3 / Fed.).

Table 6. Effect of water requirements rate, organic manure amount 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.)	**Organic manure (m^3/Fed.)**	**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
	10	0.714A	2.10C	0.38C	1.89C	10.77C	0.715A	2.22C	0.41C	1.99C	12.54B
	20	0.702B	2.28B	0.41B	2.00B	11.90B	0.703B	2.38B	0.45B	2.13B	13.33B
	30	0.693B	2.40A	0.44A	2.10A	12.92A	0.691C	2.51A	0.48A	2.24A	14.41A
Water requirements X Organic manure											
720	10	0.795a	1.85e	0.28f	1.60f	8.51g	0.796a	1.94e	0.31h	1.67g	10.27d
	20	0.712c	2.05d	0.32ef	1.77e	9.75f	0.712d	2.08d	0.35gh	1.87f	10.91cd
	30	0.636d	2.16d	0.36de	1.90d	10.42ef	0.637g	2.25c	0.38fg	2.00ef	11.50cd
960	10	0.781b	2.14d	0.38cd	2.01cd	10.84e	0.781b	2.26c	0.42ef	2.07de	12.25c
	20	0.702c	2.31c	0.42bc	2.08bc	11.71d	0.702e	2.41b	0.45de	2.16cd	12.61c
	30	0.622	2.44b	0.44b	2.16ab	12.64c	0.625h	2.50b	0.48cd	2.24bc	14.24b
1200	10	0.769b	2.30c	0.47ab	2.07bc	12.95c	0.770c	2.46b	0.51bc	2.22bc	15.09b
	20	0.701c	2.49ab	0.50a	2.14ac	14.25b	0.693f	2.66a	0.54ab	2.35bc	16.47a
	30	0.608f	2.61a	0.53a	2.22a	15.70a	0.610i	2.78a	0.58a	2.46	17.50a

Quality of snape beans pods

Physical properties of snape beans pods

With regard to the effect of irrigation water quantity, results in Table 7 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.

Table 7. Effect of water requirements rate, organic manure amount and the interaction between them on some physical quality of snape beans pods during 2019 and 2020 autumn seasons.

Characteristics Treatments		First season			Second season		
Water rates (m^3/Fed.)	**Organic manure (m^3/Fed.)**	**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
	10	10.5C	0.62C	5.55C	10.5B	0.62C	5.55C
	20	11.1B	0.66B	5.86B	11.0A	0.65B	5.85B
	30	11.5A	0.69A	6.08A	11.1A	0.67A	6.05A
Water requirements X Organic manure							
720	10	7.2h	0.48g	3.85h	7.2d	0.48g	3.85h
	20	7.6g	0.51f	4.06g	7.6d	0.50g	4.06g
	30	7.8g	0.56e	4.19g	7.8d	0.54f	4.19g
960	10	10.9f	0.63d	5.78f	10.8c	0.63e	5.73f
	20	11.7e	0.70c	6.20e	11.7b	0.67d	6.18e
	30	12.1d	0.73b	6.44d	12.3b	0.70c	6.48d
1200	10	13.3c	0.76a	7.02c	13.4a	0.75b	7.07c
	20	13.9b	0.77a	7.33b	13.8a	0.77ab	7.30b
	30	14.4a	0.78a	7.60a	13.3a	0.78a	7.48a

Concerning the effect of organic manure amount on physical quality of snape bean green pods, data in Table 7 show significant differences among the organic manure amounts on average length, diameter and weight of snap beans pods during 2019 and 2020 autumn seasons. Results show clearly that current paremeters were significantly increased with increasing amount of applied organic manure from 10 to 30 m^3/fed. in both seasons of study.The possitive effect of using organic manure on physical green pods quality may be attributed to the enhancing effect of such treatment on vegetative growth parmeters (Table 4) which affect consequantly physical quality of produced green pods. These results are in accordance with those reported by each of **Santos *et al.* (2001) Soliman *et al.* (1991**) and **Wen *et al.* (1997)** showed that the pod fresh weight, pod width, pod thickness of common bean were significantly affected by the application of organic manure.

Regarding the effect interaction treatments between water requirements X organic manure, data in Table 7 show significant increase on average length, diameter and weight of snap beans pods during both seasons. The highest values were obtained with adding highst amounts of organic manure (30 m^3/Fed.) and irrigate plants by highest rate of water (1200 m^3/Fed.) and vice versa. Obtained results are true during the two seasons of growth.

Chemical charecteristics of snape beans pods

Results in Table 8 show significant differences among the irrigation water treatments on all chemical 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, respectively in both seasons of study.

Data in Table 8 show significant differences among the organic manure amounts on the total fibers and total protien of snap beans pods during 2019 and 2020 autumn seasons. Results show clearly that total protien was significantly increased with increasing amount of applied organic manure from 10 to 30 m^3/fed. in both seasons of study and the oppesid trend was observed in case of on the total fibers. In this concept, similar results were reported by **Santos *et al.* (2001), Ismail (2004), Mousumi *et al.* (2015)** and **Angeli *et al.* (2016)**.

Table 8. Effect of water requirements rate, organic manure amount and the interaction between them on some chemical quality of snape beans pods during 2019 and 2020 autumn seasons.

Treatments: Water rates (m^3/Fed.)	Organic manure (m^3/Fed.)	First season: Fibers	First season: Protien	First season: TSS	Second season: Fibers	Second season: Protien	Second season: 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**
	10	**9.68A**	**13.41C**	**8.04A**	**9.79A**	**14.75C**	**8.04A**
	20	**9.53B**	**14.21B**	**7.85A**	**9.63B**	**15.40B**	**7.85A**
	30	**9.37C**	**14.89A**	**7.54B**	**9.44C**	**16.30A**	**7.54B**
Water requirements X Organic manure							
720	**10**	**10.29a**	**11.66g**	**9.17a**	**10.43a**	**12.69e**	**9.17a**
	20	**10.09ab**	**12.39fg**	**8.72b**	**10.17b**	**13.09e**	**8.72b**
	30	**10.00b**	**12.78f**	**8.44c**	**10.08b**	**13.58e**	**8.44c**
960	**10**	**9.73c**	**13.13ef**	**7.78d**	**9.81c**	**14.64d**	**7.78d**
	20	**9.66c**	**13.84de**	**7.67d**	**9.72cd**	**15.42d**	**7.67d**
	30	**9.39d**	**14.41d**	**7.33e**	**9.50d**	**16.51c**	**7.33e**
1200	**10**	**9.04e**	**15.43c**	**7.17e**	**9.14e**	**16.92bc**	**7.17e**
	20	**8.85ef**	**16.41b**	**7.17e**	**9.01e**	**17.70b**	**7.17e**
	30	**8.73f**	**17.49a**	**6.83f**	**8.74f**	**18.80a**	**6.83f**

Regarding the effect interaction of water requirements X organic manure, data in Table 8 show significant increase and decrease on the total protien and the total fibers of snap beans pods, respectively during both seasons.

Total yield and WUE

Results in Table 9 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, 4) and most of the physiological processes (Table, 5), 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).**

Results in Table 9 reveal that there were significant effects on total yield of pods and WUE in both seasons. Results show clearly that the total yield of pods and WUE were significantly increased with increasing amount of applied organic manure from 10 to 30 m^3/fed. in both seasons of study. The superiority of organic manure in improving yield might be attributed to the favourable and beneficial effects of organic manure in increasing snap bean plant growth as well as the dry weight / plant as mentioned in Table 4, which in turn increase total yield / feddan. Obtained results are in agreement with those reported by **Barbosa *et al.* (2017)**, **Toledo *et al.* (2017)** and **Hanoon *et al.* (2020)** who The application of cattle manure fertilizer improved the yield.

Regarding the effect interaction of water requirements X organic manure, the same data in Table 9 show significant increase on total yield of pods and WUE for snape beans plants during both seasons. The highest values were obtained with adding highst amounts of organic manure (30 m^3/F.) then irrigate plants by highest rate of water (1200 m^3/F) and vice versa.

Table 9. Effect of water requirements, organic manure and the interaction between them on total yield and WUE of snap beans plants during 2019 and 2020 autumn seasons.

Characteristics Treatments		First season		Second season	
Water rates (m^3/Fed.)	Organic manure (m^3/Fed.)	Yield (kg/Fed.)	WUE (kg/m^3)	Yield (kg/Fed.)	WUE (kg/m^3)
720		913C	1.27C	764C	1.06C
960		2271B	2.37B	1895B	1.97B
1200		5535A	4.61A	4600A	3.83A
	10	2834C	2.68C	2362C	2.23C
	20	2905B	2.75B	2410B	2.28B
	30	2981A	2.82A	2487A	2.35A
Water requirements X Organic manure					
720	10	891f	1.24g	743f	1.03g
	20	909f	1.26fg	763f	1.06fg
	30	940f	1.31f	785f	1.09f
960	10	2231e	2.32e	1860e	1.94e
	20	2259e	2.35e	1882e	1.96e
	30	2324d	2.42d	1943d	2.02d
1200	10	5380c	4.48c	4483c	3.74c
	20	5547b	4.62b	4583b	3.82b
	30	5679a	4.73a	4732a	3.94a

Conclusion

it could be concluded that adding the highest amount of organic manure (30 m^3/fed.) and irrigating plants by highest rate of irrigation water (1200 m^3/F) where this treatment obtained the better vegetative growth, the highest green pod yield per plant and green pod yield per fed. as well as the better pod quality and WUE under such experiment condition.

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تأثير معدلات السماد العضوي على *الاحتياجات* المائية لنباتات الفاصوليا (*Phaseolus vulgaris* L)

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أجريت هذه الدراسة خلال موسمى الخريف لعامى 2019 و 2020 بمحطة بحوث القصاصين بمحافظة الإسماعيلية لدراسة تأثير معدلات الاحتياجات المائية (720 ، 960 ، 1200 م 3 / فدان) مع كميات مختلفة من السماد العضوي. (10 ، 20 ، 30 م 3) على النمو الخضري ، التركيب الكيميائي لأوراق النبات وكذلك محصول القرون الخضراء وجودة قرون الفاصوليا صنف بوليستا المنزرع فى الارض الرمليه وباستخدام نظام الري بالتنقيط . فقد تحسنت جميع صفات النمو الخضري ، صفات المحتوى الكيميائي ، جودة القرون والمحصول الكلى للقرون وكفاءة استخدام المياه مع زيادة معدل مياه الري في كلا الموسمين. كما أن زيادة كمية مياه الري من 720 إلى 1200 م 3 / فدان أظهرت أعلى القيم لمعظم الصفات المدروسة لنباتات الفاصوليا في كلا موسمي الدراسة. كما أوضحت النتائج أن الصفات المدروسة زادت معنوياً بزيادة كمية السماد العضوي المستخدم من 10 إلى 30 م 3 / فدان في كلا موسمي الدراسة وتم الحصول على أعلى القيم بإضافة أعلى كمية من السماد العضوي (30 م 3 / الفدان) ثم ري النباتات بأعلى معدل ماء (1200 م 3 / الفدان) والعكس صحيح.