Effect of deficit irrigation on some growth parameters, yield and water productivity of broad bean crop

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ABSTRACT

This experiment was conducted to evaluate the effect of the deficit irrigation on some growth parameters, crop productivity and crop water productivity of broad bean crop (Nubaria 1) during winter seasons of (2018/2019) and (2019/2020) in Faculty of Agriculture farm (Latitude of 30⁰ 25\ 10.9N and longitude of 30⁰ 32\ 34.2 E, mean altitude 32 meters above sea level), Al-Azhar University, El-Sadat City, Monufyia Governorate, Egypt. The experiment was a randomized complete block design The irrigation system was used under drip irrigation system. The plant growth periods are divided into three stages: vegetative growth stage (S_1), flowering stage (S_2) and seed filling stage (S_3). The irrigation treatments are 100% of ET_{crop} (DI_1) in all growth periods as a control, 85% of ET_{crop} (DI_2) in one of the growth periods, then complete the remaining growth periods by 100% of ET_{crop} and 70% of ET_{crop} (DI_3) in one of the growth period, then complete the remaining growth periods by 100% of ET_{crop}. The water requirements of broad bean crop were calculated from data of Central Laboratory for Agricultural Climate using CROPWAT 8.0 program. The results showed that the highest values of growth parameters (plant length, leaves number and dry weight) and yield of broad bean were obtained after irrigated by 100% of ET_{crop} followed by treatments which were irrigated with 85% of ET_{crop} at flowering stage without significant difference between them when compared to other treatments. The water productivity of 70% of ET_{crop} treatments is higher than the other treatments, although the yield of these treatments is the lowest compared to 100% and 85%.

Keywords: deficit irrigation, broad bean, CROPWAT 8.0, water productivity.

INTRODUCTION

The scarcity of water is a menace to food production for many people in arid and semiarid areas. Rationalization of irrigation water has become a unique and necessary way to save the water used in the sandy soil of Egypt. Water is the main limiting factor for increasing the cultivated area and agricultural production. The main purpose of utilization of deficit irrigation (DI) is to increase water use efficiency (WUE) by decreasing the quantity of water applied with irrigation or by decreasing the number of irrigation events (Kirda, 2002).

The good addition of deficit irrigation needs complete observation of the crop response to deficit irrigation (English, 1990). Khan et al. (2007) reported that faba bean crop grown under non stress conditions recorded higher shoot dry matter as compared to crop grown under irrigation stress Circumstances. Hirich et al. (2012) reported that yield production recorded higher grain yield of faba bean with half of the required water supply as compared to crop plants with full irrigation during vegetative growth stages.

Ramazan et al. (2014) reported that there are strategies for an efficiency irrigation water using deficit irrigation system in the places having water deficit under good management for deficit water, which results in a substantial water saving with no height impact on the quality and the amounts of the harvested crop. Crop productivity can be increased by the application of suitable amount of water wither saline or not under specific condition (Ebtisam et al., 2015). Water is considered as one of the most important environmental factors that reduces crop productivity more than any other factor (Saxena et al., 2017; Nkoana et al., 2019; Kiymaz et al., 2019; Jahantigh et al., 2019 and Miladinov et al., 2020). Belachew et al. (2019) recorded significant effect of water deficit on the yield components in faba bean.

Broad bean (*Vicia faba* L.) has become a popular crop due to its high yield and high protein content that makes it attractive to consumers It is reputed to be more sensitive to drought than other grain legumes (Abdellatif et al., 2012). The water deficit is an irrigation requirement that can apply through variances application ways.

So, the aim of this investigation, under study, is to evaluate the impact of different deficit irrigation treatments on some growth parameters, crop productivity and crop water productivity of broad bean crop.

MATERIAL AND METHOD

The experiment was conducted in Faculty of Agriculture farm, Al-Azhar University, El-Sadat City, Monufyia Governorate, Egypt (Latitude of 30^0 25\ 10.9N and longitude of 30^0 32\ 34.2 E, with mean altitude 32 meters above sea level) during winter seasons 2018/2019 and 2019/2020 It is conducted to study the effect of deficit irrigation treatments on broad bean crop (*Vicia faba* L. Nubaria 1) under conditions of drip irrigation system in experimental field. The experiment was a randomized complete block design (RCBD) in a split plot arrangement with three replicates. Broad bean was sown at 12th of November, where the plant growth periods are divided into three stages: vegetative growth stage (S_1), flowering stage (S_2), seed filling stage (S_3). The irrigation treatments were100% of ET_{crop} (I_1) in all growth stages (S_1), (S_2) and (S_3). As well as a control, 85% of ET_{crop} (DI_2) in stages (S_1), (S_2) and (S_3), then complete the remaining growth stages (61-100 and 101-135 day) by 100% of ET_{crop} . Regarding 70% of ET_{crop} in (DI_3) in one of the growth periods, then complete the remaining growth periods by 100% of ET_{crop}, as shown in Table1. Every plot has an independent water valve to control the amount of water irrigation applied during each period of these stages (S_1, S_2, S_3). All treatments have received the same quantity of water without deficit during the initial 20 days after sowing This irrigation supply, during this stage, was necessary for crop to start its growth and to be able later to resist apply deficit irrigation. Ordinary calcium superphosphate at rate of 200 kg fed^{-1} (12.5% P_2O_5) was added at soil preparation Broad bean seeds was mixed with Rhizobium and Azotobacter at rate 400gm fed^{-1} (inoculated) before sown, potassium sulfate at rate of 50 kg fed^{-1} (48% K_2O) was divided in two doses, after thinning (after 12 days from sown) and after 15 days of thinning, and ammonium sulfate at rate of 100kg fed^{-1} (20.5% N) was added after 10 days from sown. ET_{crop} of broad bean crop is calculated from climate data of Central Laboratory for Agricultural Climate and using CROPWAT.8 program (FAO, 1992). The investigated parameters of the plant include: plant height (cm), number of leaves, dry weight (gm), crop productivity (kg fed^{-1}) and crop water productivity (k gm^{-3}).

Soil and irrigation water of the experiment location were physically and chemically analyzed according to Black et al. (1982), Klute (1986), and Saxton and Rawls (2006) as shown in Tables 2, 3, and 4. The climate data were taken from central laboratory for Agricultural Climate of the experimental location as shown in Table 5.

The recorded data were analyzed statistically using statistical package for the social sciences (SPSS, 2014). The least significant difference (LSD) at $p \leq 0.05$ was calculated according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Calculation of the water requirements of broad bean crop

There are many methods for the water requirements calculation of any crop; one of these methods is using climate data from weather stations such as Central Laboratory for Agricultural Climate in Egypt. These data include: name of location, latitude, longitude, altitude, average temperatures, relative humidity, precipitation, solar radiation, wind speed and evapotranspiration (ETo). These data are used in Cropwat 8.0 program with help of Climwat program, Cropwat 8.0 program which is used in determination water requirements, where the program was designed by the Land and Water Development Department in USA of Food Agricultural Organization (FAO, 1992). We obtain from it the actual ET_{crop} for each crop according to each region. Also, by using these data on the above mentioned in the program, we obtained ET_{crop} of broad bean crop (Nubaria 1) and it was 1875 m^3 fed^{-1}, which represents 100% of ET_{crop}. Accordingly, it calculated the treatments of DI 85 and 70% of ET_{crop} and it corresponds to the following quantities of water 1594 and 1313 m^3 fed^{-1} respectively.

Effect of deficit irrigation treatments on some growth parameters of broad bean crop

Plant height (cm)

The effect of deficit irrigation on the plant height of broad bean crop for the two winter seasons (2018/2019 and 2019/2020) were presented in Table 6. The results revealed the affected of plant height for water stress at different periods of plant growth. Data show that the mean highest values of plant height were 32.00, 45.00 and 92.00 cm for three stages in the first season. They were obtained after irrigation with 100% of ET_{crop} (DI_1), followed by DI_2 S_3 whereas the values were 31.50 ,44.40 and 78.20 cm for growth stages. The other treatments took the following order: DI_2 S_2> DI_2 S_3>DI_3S_2> DI_3 S_3> DI_2S_1> DI_3S_1. moreover, the results showed that the same trend was observed in the second season, whereas the highest effect of deficit irrigation was in the plots irrigated by 70% of ET_{crop} at vegetative growth stage (DI_3S_1), whereas the total height of plant was 57.23 cm. The statistical analyses of data showed that no significant differences at ($P \leq 0.05$) between 85% of ET_{crop} treatments and 100% of ET_{crop} treatments, while there are significant variances at ($P \leq 0.05$) between 100% of ET_{crop} treatments and 70% of ET_{crop} treatments. These results were in harmony with El-Noemani et al. (2009) who stated that soil water apply is directly Appropriate with plant rise growth. Also, Ahmed and Mohammed (2014) stated that the affirmative impact for irrigation on plant rise may be attributed to the impact of irrigation on hearten for a long of cell, cell division and consequently growing meristemic growth. On the other hand, the lessening of plant high in less soil wet stress may be related to the closure of stomata to keep soil wet evaporation. This leads to the decrease of uptake of dioxide carbon and nutritious substance. So, photosynthesis and other biochemical effective are stopped, which will finally impact plant growth (Vaux and Pruitt, 1983).

Leaves number

The results indicated that the leaves number influenced by deficit irrigation treatments, as a general trend. The leaves number decreased as amount of irrigation water decreased. Data presented in Table 7. reveal that the heights values of leaves number were 31.00, 52.00 and 88.00 leaves for three stages under first season were obtained after irrigation with 100% of ET_{crop} (DI_1), followed by DI_2 S_2, whereas the values were 30.60, 47.00 and 77.40 leaves for different growth stages. The other treatments took the following order: DI_2 S_3> DI_3 S_2> DI_3 S_3> DI_2 S_1> DI_3 S_1. Also, the results showed that the same trend was observed in the second season, whereas, the highest effect of DI was in the plots irrigated by 70% of ET_{crop} at vegetative growth stage (DI_3 S_1), whereas the total of leaves number was 43.00 leaves. The statistical analyses of data showed that there were no significant differences between 85% of ET_{crop} treatments and 100% of ET_{crop} treatments, while there were significant differences between 100% of ET_{crop} treatments and 70% of ET_{crop} treatments in number of leaves. These results conform to those results mentioned by Ahmed and Mohammed (2014).

Dry weight (gm)

Table 8. Showed that the dry weight of full broad bean plant (shoots and roots) was affected by deficit irrigation treatments. The mean highest values of broad bean dry weight for the first season were 75.00, 114.00 and 190.70 gm for three stages that were obtained after irrigation with 100% of ET_{crop} (DI_1), followed by DI_2 S_2 whereas the values were 73.50, 106.80 and 179.55 gm for growth stages. The other treatments took the following order: DI_2 S_3> DI_2 S_2> DI_3S_3> DI_2 S_1> DI_3S_1. The same trend was observed in the second season, whereas the highest values of dry weight was in the plots irrigated by 100% of ET_{crop}, whereas the total dry weight of plant was 192.00 gm and the lowest value was in the plots which were irrigated by 70% ET_{crop} at the vegetative growth stage. The statistical analyses of data showed that no significant differences between 85% of ET_{crop} treatments and 100% of ET_{crop} treatments, while there were significant differences between 100% of ET_{crop} treatments and 70% of ET_{crop} treatments. These increase in dray matter in 100 % and 85% treatments may be attributed to suitable available soil moisture in the root zone that caused an increase in the number and size of meristemic cells, that consequently increases plant height and number of tillers. In this concern, El Tahir and Yagoub (2011) stated that the significantly was reduced of yield under longer intervals of irrigation because of the lowest number of tillers. $plant^{-1}$, number of $spikes.m^{-2}$, account of spikelets /spike, account of grains/spike, the weight of 1000 grains of wheat plant. They added that the depletion of soil moisture was increased by lowering the amount of irrigation cumulative from origin to harvest, straw and grain yield was reduced. These results conform to those results mentioned by Zhang et al. (2005), who stated that in the arid region, the formation of spring wheat yield mainly depended on the amount of water supply.

Crop productivity (kg fed^{-1})

The influence of deficit irrigation treatments on final crop productivity of broad bean is shown in Table 9. The maximum broad bean crop productivity was obtained in plots after irrigation by 100% of ET_{crop} (2250 kg fed^{-1}) followed by plots (DI_2 S_2) which was irrigated by 100% of ET_{crop} in vegetative and seed filling stages, and 85% ET_{crop} in flowering stage (2120 kg fed^{-1}) without significant difference between both treatments,while, the other treatments take the following order: DI_2 S_3 > DI_2 S_1 >DI_3S_2 > DI_3 S_3 > DI_3 S_1. The LSD values from statistical analysis showed that the difference in crop productivity is significant (at 0.05) between these treatments and control treatment (100%). The same trend of these results was observed in the second season. These results may be attributed to the increasing of plant length and leaves number, which encourages the improvement of the photosynthesis process. Also, soil moisture increasing lad to an increase in nutrients availability for plant absorption and consequently crop productivity increased. These results are in agreement with those of Sadras and Calvino (2001), who found that the increment in yield with more in frequency and irrigation water quantity. Also, Bashir and Mohamed (2014) stated that the largest yield was obtained with full irrigation followed by deficit irrigation after 90 days from planting.

Water productivity (WP) or water use efficiency (WUE).

Crop water productivity (CWP) or water use efficiency (WUE) is an important parameter for good irrigation management especially in arid and semi-arid areas. Molden (2003) defined it as the rate of the bloc of marketable crop (Ya) to the volume of water which was consumed during season by the crop (ETa) with standard dimensions of (kg. m^{-3}), according to the following equation: $WP = \frac{Ya}{ETa}$

The data in Table 10. show that for the full irrigation 100% of ET_{crop}, the cubic meter of irrigation water produced 1.20 kg. The values of water productivity at 85% of ET_{crop} treatments ranged between 1.32 and 1.33 kg m^{-3} for different stages periods, while the values of 70% of ET_{crop} treatments ranges among 1.40 and 1.42 kg m^{-3}. The same trend was observed in the second season. The variances in water use efficiency between treatments were very small taking into consideration that the low crop is a determinant factor. The results revealed that there were no significant differences ($P \leq 0.05$) between 100% of ET_{crop} and 85% of ET_{crop} treatments in water productivity. The results are in agreement with those of Enchalew et al. (2016) who found that the rise crop water productivity of onion crop from treatment received at 70% of ETc and better bulb diameter which was observed from treatment received at 100% of ETc. additionally, Mohamed (1994) concluded that the productivity was the highest of grain yield in wheat, when irrigation at 60% available soil moisture depletion, where water use efficiency at 85% available soil moisture depletion was the highest. Karim et al. (1997) stated that at 35%, available soil moisture depletion produced the highest crop (4.71-ton ha^{-1}) with the addition of 120 kg N, where irrigation at 65% of available soil moisture depletion produced an acceptable crop (4.13 ton ha^{-1}) with total high of WUE (196.5 kg ha /cm) with addition of 80 kg N.

CONCLUSIONS

The water is the main determinant factor for increasing the cultivated area and agricultural production, especially in arid and semi-arid areas.

The results of this study can be concluded as follows:

The highest values of growth parameters and yield of broad bean were obtained after being irrigated by 100% of ET_{crop}, followed by treatments which were irrigated with 85% of ET_{crop} at flowering stage without significant difference between them compared to the other treatments.

The water productivity of 70% of ET_{crop} treatments is higher than the other treatments, although the yield of these treatments is the lowest compared to the 100% and 85%.

So, economically it is recommended that the best choice of treatments for broad bean irrigation was at 85% of ET_{crop} treatment during flowering stage (DI_2S_2). Where the resulting yield reduction may be small compared with the benefits gained by diverting the saved water to irrigate other crops.

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Table 1: Illustration scheme of experimental design.

Irrigation through growth stages per day	Deficit irrigation treatments						
	100 % (D1$_1$)	85 % (DI$_2$)			70 % (DI$_3$)		
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7
	Control	S_1	S_2	S_3	S_1	S_2	S_3
1-20	100	100	100	100	100	100	100
21- 60	100	85	100	100	70	100	100
61-100	100	100	85	100	100	70	100
101-135	100	100	100	85	100	100	70

Table 2: Chemical properties of used irrigation water.

pH	EC dSm^{-1}	Cations mmol$_c$ L^{-1}				Anions mmol$_c$ L^{-1}				SAR	RSC mmol$_c$ L^{-1}
		Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	SO_4^{-2}		
7.85	0.63	2.50	1.50	2.07	0.22	----	3.50	2.10	0.69	1.46	0.50

Table 3: Chemical properties of the experiment soil.

Soil depths (cm)	Ph (soil suspension) (1: 2.5)	EC(dS m^{-1})	Soluble ions							
			Cations mmol$_c$ kg^{-1}				Anions mmol$_c$ kg^{-1}			
			Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{-2}
0-30	7.90	1.35	6.85	4.00	2.21	0.41	--	2.00	3.70	7.77
30-60	7.92	1.34	8.50	4.00	0.70	0.14	--	1.00	3.90	8.44
60-90	7.60	0.40	1.95	1.10	0.77	0.18	--	1.00	1.00	2.00
90-120	7.80	0.39	1.00	0.60	2.14	0.14	--	0.20	2.20	1.48

Table 4: Some soil physical properties of experiment soil.

Soil depths (cm)	Particle size distribution (%)				TC	B.D (Mg.m^{-3})	RD (Mg.m^{3})	T.P (%)	MWD (mm)	Soil moisture constants		
	C.S	F.S	Silt	Clay						W.C (%)	F.C (%)	A.W (%)
0-30	49.40	35.00	10.30	5.30	LS	1.46	2.42	39.66	0.70	6.70	16.60	9.90
30-60	53.20	33.0	9.30	4.50	LS	1.43	2.71	47.23	0.89	6.50	15.80	9.30
60-90	54.00	34.30	7.40	4.30	LS	1.57	2.40	34.58	0.88	6.80	16.30	9.50
90-120	57.50	31.70	6.50	4.30	LS	1.58	2.56	43.75	0.91	6.30	16.40	10.10

Where: C.S = cores sand, F.S = fine sand, F.C = field capacity, WC = wilting coefficient, AW = available water, TC = textural class, B.D = soil bulk density, RD= real density particles, T.P = total porosity, LS= loamy sand, S= sand MWD= mean wight diameter.

Table 5: Monthly weather data at study area during winter 2018/2019 and 2019/2020 growing seasons.

Month	2018/2019							2019/2020						
	Max.temp .C^0	Min.temp .C^0	R.H (%)	Wind speed(m/sec)	SR(MJ/m^2/day)	Rain fall(mm)	ETo mm/day	Max.temp .C^0	Min.temp .C^0	R.H. (%)	Wind speed(m/sec)	Rain fall(mm)	SR(MJ/m^2/day)	ETo mm/day
Nov.	26.4	12.8	81	0.6	511.24	1.2	2.3	27	14.6	80	0.5	0.0	417.6	1.6
Dec.	23.4	8.6	88	0.9	409.55	4.4	1.5	21	10	85	0.7	4.0	393.04	1.3
Jan.	23.7	5.6	84	0.9	276.69	0.0	1.3	19.5	2.4	83.2	0.7	0.0	389.16	1.4
Feb.	20.7	10.5	88.1	0.6	348.68	1.0	1.7	18.8	6.4	82.2	1.1	0.0	520.71	2.2
Mar.	21.2	10.5	81.4	0.8	517.53	2.2	2.7	21.2	10.7	77.9	1.3	0.0	647.79	3.3
Apr.	40.7	8.4	80.9	0.8	655.73	0.0	3.7	23	8.4	66.7	1.2	0.2	718.62	4.1
May	41.7	16.7	75	1.1	975.25	0.5	6.1	41.7	18.8	75.5	1.0	0.0	915.9	5.4

Table 6: Effect of deficit irrigation treatments on broad bean plant height (cm).

Irrigation treatments	100% (DI_1)	85% (DI_2)			70% (DI_3)		
	Frist season						
DI applied period Time of sampling	Control	S_1	S_2	S_3	S_1	S_2	S_3
60 day	32.00	23.30	31.00	31.50	16.30	31.40	31.30
100 day	45.00	33.60	39.50	44.40	27.10	36.50	44.40
145 day	92.00	71.30	81.30	78.20	55.30	77.40	74.30
LSD at 0.05		NS	NS	NS	*	NS	NS
			32.53				
	Second season						
60 day	34.00	22.90	30.00	30.60	17.60	30.40	30.50
100 day	46.00	32.50	41.50	45.30	26.90	38.50	45.00
145day	94.00	72.50	83.00	79.60	57.23	79.50	75.50
LSD at 0.05		NS	NS	NS	*	NS	NS
			33.32				

* Significant at P Value = 0.05 level, N.S = not significant, S_1 = Vegetative growth stage, s_2= Flowering stage, s_3=Seed filling stage

Table 7: Effect of deficit irrigation treatments on leaves number of broad bean plant.

Irrigation treatment	100 % (DI_1)	85% (DI_2)			70% (DI_3)		
	Frist season						
DI applied period Time of sampling	Control	S_1	S_2	S_3	S_1	S_2	S_3
(60 days)	31.00	23.66	30.60	30.50	18.00	30.40	30.30
(100 days)	52.00	41.00	47.00	50.50	30.66	46.60	50.00
(145 days)	88.00	58.33	77.40	74.30	41.33	73.00	70.60
LSD at 0.05		NS	NS	NS	*	NS	NS
				31.96			
	Second season						
(60 days)	32.00	24.33	31.00	31.20	18.33	30.60	30.20
(100 days)	54.00	41.33	49.70	52.00	29.00	48.30	53.00
(145 days)	90.00	60.33	79.50	76.30	43.00	75.00	72.50
LSD at 0.05		NS	NS	NS	*	NS	NS
				32.55			

* Significant at P Value = 0.05 level, N.S = not significant, S_1 = Vegetative growth stage, s_2= Flowering stage, s_3=Seed filling stage

Table 8: Effect of deficit irrigation treatments on dry weight (gm) of broad bean crop.

Irrigation treatments	100% (DI_1)	85% (DI_2)			70% (DI_3)		
	Frist season						
DI applied period Time of sampling	Control	S_1	S_2	S_3	S_1	S_2	S_3
(60days)	75.00	63.66	73.50	74.00	54.00	73.70	73.00
(100 days)	114.00	75.66	106.80	112.60	66.57	103.00	112.50
(145days)	190.70	170.50	179.55	175.30	147.50	175.00	171.00
LSD at 0.05		NS	NS	NS	*	NS	NS
				38.10			
	Second season						
(60 days)	75.45	62.18	73.80	74.50	53.12	74.70	74.40
(100 days)	114.50	71.53	108.00	113.50	65.00	105.55	113.70
(145days)	192.00	165.23	181.40	177.40	147.14	177.00	173.30
LSD at 0.05		NS	NS	NS	*	NS	NS
				38.91			

* Significant at P Value = 0.05 level, N.S = not significant, S_1 = Vegetative growth stage, s_2= Flowering stage, s_3=Seed filling stage

Table 9: Effect of deficit irrigation treatments on broad bean crop productivity kg fed^{-1}.

Irrigation treatments	100% (DI1)	85% (DI2)			70% (DI3)		
	Frist season						
DI applied period	Control	S1	S2	S3	S1	S2	S3
crop productivity	2250.00	2105.30	2120.00	2116.00	1840.00	1860.60	1855.30
		*	NS	*	*	*	*
LSD at 0.05	132.60						
	Second season						
crop productivity	2252.50	2108.50	2126.00	2122.50	1844.50	1868.50	1857.60
		*	NS	NS	*	*	*
LSD at 0.05	133.71						

* Significant at P Value = 0.05 level, N.S = not significant, S_1 = Vegetative growth stage, s_2= Flowering stage, s_3=Seed filling stag

Table10: Effect of deficit irrigation treatments on broad bean crop water productivity kg m^{-3}.

Irrigation treatments	100 % (DI1)	85 % (DI2)			70 % (DI3)		
	Frist season						
DI applied period	Control	S1	S2	S3	S1	S2	S3
CWP	1.20	1.32	1.33	1.32	1.40	1.42	1.41
		NS	NS	NS	*	*	*
LSD at 0.05	0.18						
	Second season						
CWP	1.20	1.32	1.33	1.33	1.40	1.42	1.41
		NS	NS	NS	*	*	*
LSD at 0.05	0.19						

* Significant at P Value = 0.05 level, N.S = not significant, S_1 = Vegetative growth stage, s_2= Flowering stage, s_3=Seed filling stage

تأثير الرى الناقص على بعض قياسات المحصول وإنتاجية المياه لمحصول الفول

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الملخص العربي

أجريت تجربة حقلية لتقييم تأثير الرى الناقص على بعض مقاييس النمو، إنتاجية وكفاءة استخدام المياه لمحصول الفول البلدي (نوبارية١) خلال موسمي الشتاء (٢٠١٨/٢٠١٩م) و (٢٠١٩/٢٠٢٠م) بمزرعة كلية الزراعة - جامعة الأزهر - مركز السادات - محافظة المنوفية - مصر. صممت التجربة في قطاعات تامة العشوائية، تحت نظام الري بالتنقيط وكانت فترة حياة النبات مقسمة إلى ثلاث مراحل: مرحلة النمو الخضرى (S_1)، مرحلة النمو الزهرى(S_2) ومرحلة امتلاء الحبوب (S_3). وكانت معاملات الرى: ١٠٠ % من الاستهلاك المائى للمحصول فى كل فترات النمو (كنترول)، ٨٥٪ من الاستهلاك المائي للمحصول في أحد فترات النمو المذكورة سابقاً ثم استكمال باقى فترات النمو بـ ١٠٠٪ من الاستهلاك المائي و٧٠٪ من الاستهلاك المائى للمحصول فى أحد فترات النمو المذكورة سابقاً ثم استكمال باقي فترات النمو بـ ١٠٠٪ من الاستهلاك المائى. جرى حساب الاحتياجات المائية من بيانات المعمل المركزي للمناخ الزراعي باستخدام برنامج الـ Cropwat 8.0. أظهرت النتائج أن أعلى القيم لمقاييس النمو هي: عدد الأوراق، ارتفاع النبات (سم)، الوزن الجاف للنبات (جم/ نبات)، إنتاجية المحصول (كجم/الفدان) وإنتاجية المياه (كجم/م٣)كانت فى المعاملة ١٠٠٪ تلتها معاملة ٨٥٪ في مرحلة التزهير مع عدم وجود فروق معنوية بينهما مقارنة بالمعاملات الأخرى. إنتاجية المياه للمعاملة ٧٠٪ من الاستهلاك المائى للمحصول أعلى من المعاملات الاخرى بالرغم من ان المحصول لهذه المعاملات كان منخفضاً مقارنة مع ١٠٠٪ و٨٥٪، ومن الناحية الاقتصادية تعتبر أفضل معاملة لري الفول البلدى هى معاملة ٨٥ % في مرحلة التزهير لذلك توصي الدراسة بأنه يمكن تطبيق نظام الرى الناقص على محصول الفول عند معاملة ٨٥٪من الاستهلاك المائي المحصولي وأفضل مرحلة لتطبيق الرى الناقص تكون عند مرحلة التزهير.

الكلمات الاسترشادية: الرى الناقص، الفول البلدي، برنامج حساب الاحتياجات المائية، انتاجية الماء.