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RESPONSE OF ROSELLE PLANTS TO VARIOUS LEVELS OF WATER AND NUTRIENTS GROWN IN SANDY SOILS

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ABSTRACT

Field experiments were conducted during 2020 and 2021 seasons at Aly Mobarak Experimental Farm, Horticulture Research Station" in El-Bustan area, Nubaria, El-Beheira Governorate to study the effect of various irrigation levels and NPK fertilizer rates using drip irrigation system on the vegetative growth, yield and quality of roselle plant (*Hibiscus sabdariffa* L.) grown in sandy soil. The experiment comprised of four drip irrigation levels (I1=60%, I2=80%, and I3=100% of crop evapotranspiration (ETc), in addition to control treatment (I4=120% ETc) which represented the growers practice in the area and four NPK fertilizer rates (F1=70%, F2=80%, F3=90% and F4=100% of the growers practice in the studied area) in a split plot design with three replications. The results revealed that both irrigation and NPK levels significantly affected growth parameters, yield and anthocyanin content of roselle plant. The highest values of dry yield of sepals were obtained with the highest irrigation treatment (120% ETc) which showed non-significant differences with the lower irrigation level (100% ETc) combined with the full NPK fertilizer rate (100%). Maximum mean values of anthocyanin content were obtained with I1F3 treatment. Therefore, it could be concluded for maximizing dry sepal yield and quality of roselle plants as well as water use efficiency applying the irrigation treatment at 100% ETc combined with the highest NPK dose (I3F4) through fertigation at El-Bostan area.

Key words: drip irrigaton, inorganic fertilizers, fertigation, roselle

INTRODUCTION

Roselle (*Hibiscus sabdariffa* L., Malvaceae family) is an annual tropical and subtropical herbaceous plant. It is widely cultivated in Egypt for the dried sepals (calyx). It is cultivated mainly in Upper Egypt (Aswan Governorate). The dried calyces are used in drinks, jams, jellies and a natural food colorant due to the presence of anthocyanins (Ismail *et al*., 2008). Roselle calyx is medicinally used as anti-hyperlipidemic, anti-hypertensive, anti-inflammatory and antimicrobial agent (Huan *et al*., 2015; Faraji *et al*., 1999; Al-Hashimi, 2012). The biological activities of roselle are mainly attributed to the main constituents in the calyces such as polysaccharides, organic acids and flavonoids mainly anthocyanins (Mahadevan *et al*., 2009).

Roselle plants can grow well in low quality land and are moderately drought tolerant (FAO, 2018). In arid and semi-arid regions where water and nutrients are limited, the adoption of crop management practices such as planting drought-tolerant crops could be a suitable strategy of mitigating agricultural drought. Drip irrigation system is mainly used in these regions for efficient use of water. In this system water is directly added to the root zone of the plant. Adding water soluble fertilizers in irrigation water through irrigation system is defined as fertigation. Fertigation enables quick delivery of nutrients to plant roots thus increasing fertilizer use efficiency and nutrient availability, which saves about 20-40% of fertilizers without affecting growth and yield of crops (Abdel-Motagally *et al*., 2015; Ibrahim *et al*., 2016). Water and nutrient availability for plants vary with climatic conditions and soil type. Most of the previous studies on water and fertilizer rates of roselle were recommended for clay soils (Rashed and Moursi, 2016; El-Dissoky *et al*., 2020). Therefore, the aim of this study was to investigate the response of roselle plants to different levels of irrigation and NPK fertilizers through drip irrigation system to determine the optimum water and nutrient levels in order to maximize roselle yield and quality in newly reclaimed land.

MATERIAL AND METHODS

1. Experimental site, Plant material and Experimental design

Field experiments were carried out at "Aly Mobarak Experimental Farm, Horticulture Research Station" in El-Bustan area, Nubaria, El-Beheira Governorate, Egypt (latitude 33°30' 1.4"N, longitude 30°19' 10.9"E and altitude 21 m above sea level) during 2020 and 2021 seasons to study the effect of four irrigation levels and four NPK fertigation doses on vegetative growth, dry sepal yield and anthocyanin content of roselle plants.

Seeds of Roselle (*Hibiscus sabdariffa* L.) dark red variety were obtained from Medicinal and Aromatic Plants Research Department, Horticulture Research Institute, ARC, Egypt. The seeds were sown directly in the experimental area on April 20th and April 25th in the first and second seasons, respectively. After 3 weeks, the seedlings were thinned to one plant/hole.

The experimental design was a split-plot in a randomized complete block design with three replicates. Four drip irrigation levels (I_1=60% crop evapotranspiration (ET_c); I_2=80% ET_c; I_3=100% ET_c; and I_4=120% ET_c as a control treatment which represented the growers practice in the area, were assigned to the main plots and four fertigation rates (F_1= 70% NPK; F_2=80% NPK; F3= 90% NPK and F4= 100% NPK of the full dose used by the growers in the studied area) were assigned to the sub-plots. Calcium super phosphate (15% P_2O_5) was added during land preparation at a rate of 200 kg/feddan. The full dose of nitrogen, phosphorus and potassium fertilizers were added at a rate of 200 kg/fed as ammonium sulphate (20.5% N), 25 L/fed as phosphoric acid (85% H_3PO_4) and 150 kg/fed. as potassium sulfate (48% K_2O) through fertigation and were given to the plants starting from the 3rd week after sowing. Irrigation water was applied using surface drip lateral lines connected to the sub-main line. Each lateral line is equipped with built-in emitters of a 4 l/h discharge. Small portions of soluble water fertilizers were injected each alternate day through a tank connected to the drip irrigation system.

Soil and irrigation water analysis

Chemical (Chapman and Pratt, 1961) and physical properties of the soil were determined before cultivation (Table 1). The saturation point % (SP), field capacity % (FC), wilting point % (WP) and bulk density t m^{-3} (BD) of the soil were determined according to (Israelson and Hansen 1962). The irrigation water analysis is shown in Table (2) according to (Rainwater and Thatcher 1960).

2. **Meteorological data**

The mean minimum and maximum monthly temperature, relative humidity (RH), wind speed, sunshine, reference evapotranspiration and mean crop coefficient values were calculated. Data were obtained from the Central Laboratory for Agricultural Climate, Agricultural Research Center, Egypt during 2020 and 2021 growing seasons and are presented in Table (3).

3. **Measurements**

3.1. Water Relations

Water consumptive use (ET_c)

Water consumptive use (ET_c) was determined by using the direct methods of monitoring soil water content after and before irrigation. The amount of water within the active root zone was determined by a portable soil moisture meter and the moisture tester sensor was calibrated by using gravimetric method described by Gardner (1965).

Reference evapotranspiration (ET_o)

Reference evapotranspiration (ET_o) mm/day was determined by using Modified Penman equation according to the agro-climatic data of El-Bostan area according to the following equations:

ET_o = C [W. Rn (1-w) -F (u) (ea -Ed)] …..mm/day

Where:-

ET_o = the rate of evapotranspiration from an excessive surface of active growing green covers of certain high range from 8 to 15 cm that completely shade the ground and did not face shortage in water (mm/day).

W=temperature-related weighting factor, which depending on temperature and altitude.

Rn = net radiation in equivalent evaporation in mm/day.
F (u) = wind related function.
ea-Ed = difference between the saturation of air vapour pressure (bar).
C = adjustment factor to compensate the effect of day and night weather conditions.

Crop coefficient (K_c)

Daily crop coefficient values (K_c) was estimated by using the equation as follows:-

$$K_c = ET_c/ET_o$$

Where:-

K_c = Crop coefficient value
ET_c = daily crop evapotranspiration…………mm/day
ET_o = daily reference evapotranspiration……..mm/day

3.2. Vegetative growth characters and yield components

Plant samples from the middle of the rows of each sub-plot at harvest were randomly chosen for assessing growth and yield characters as follows: Plant height (cm), number of branches/plant, number of capsules/plant, fresh weight of capsules/plant (g), fresh weight of sepals/plant, dry weight of sepals/plant and yield of dry sepals/ feddan(kg).

3.3. Anthocyanin content (mg g^{-1} fresh sepals)

Total anthocyanin content in fresh sepals was determined as described by Connor *et al.*, 2002.

***4.* Statistical analysis**

Data were analyzed using analysis of variance (ANOVA). Average values from the different treatments were compared by least significant difference (L.S.D.) test at a 0.05 probability level (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Vegetative growth and yield parameters

Roselle plants were significantly influenced by irrigation levels and NPK fertilizer rates and their interaction. All studied parameters were significantly decreased with decreasing irrigation water amounts. The highest mean values for plant height (237.89 cm, 246.94 cm), number of shoots (26.41, 31.19), fresh (1879.83 g, 1997.18 g) and dry weights (428.51g, 445.98 g) per plant in the first and second seasons, respectively were obtained with irrigation treatment at 120% ETc. Whereas irrigation at 60% ETc resulted in the least mean values of vegetative growth during both seasons (Table 4).

The highest mean values for number of capsules/plant (206.58, 218.59) and the fresh weight of capsules/plant (776.83 g, 557.39 g) in the first and second seasons, respectively were obtained with the irrigation treatment at 120% ETc (Table 5).

Maximum mean values of fresh weight of sepals (778.58 g, 800.90 g)/ plant, dry weight of sepals (115.20 g, 134.07g)/ plant and dry yield of sepals (921.66, 1072.54 kg/fed) were obtained with the highest irrigation level (I4) in the first and second seasons, respectively (Table 6). It was noticed that although the yields of dry sepals from the irrigation treatment (I4) was higher than I3, they were statistically similar.

On the other hand, irrigation level at 60% ETc and 80% ETc yielded the lowest values as compared to the irrigation level at 120% ETc. The yield decreased by 74.58% and 60.60%, respectively in the first growing season and by 74.91% and 61.27%, respectively in the second growing season.

The results obtained in this study indicate that roselle plants were stressed under the lowest irrigation amount (I1) due to insufficient soil moisture for plant growth. Minimum values of plant growth parameters might be due to the fact that, drought induces disorders in all biochemical and morphological attributes in plants. Water stress reduces water content of leaves; decrease photosynthesis due to decrease in leaf area and decrease stomatal conductance due to closure of stomata (Parkash and Singh, 2020). Similar findings were reported by Abbas and Ali, (2011) and Khalil and Yousef, (2014) on roselle plants. Furthermore, different fertigation levels significantly affected vegetative growth and yield parameters of roselle plants. Generally, increasing fertigation levels was associated with increased plant growth characters and yield. Maximum fresh weight of sepals/plant (758.72 g) and dry weight of sepals/plant (11.86 g) as well as dry yield of sepals/feddan (894.89 kg) were obtained with the highest NPK rate (100%) during the first season (Table 6). The second growing season followed the same trend. The results also revealed that, the interaction between the irrigation treatments and NPK fertigation rates on growth and yield parameters were significant. The highest values were obtained in plants received the highest irrigation treatment (I4) and fertigated with the highest NPK rate (F4), which was statistically similar to I3F4 treatment. The yield of dry sepals decreased only by 7.84% in I3F4 treatment as compared to I4F4 treatment, indicating that this treatment could be adopted by the farmers in case of insufficient irrigation water amounts in a semi-arid region.

These results are in accordance with those reported by Abdel-Motagally *et al*., (2015), Ibrahim *et al*., (2016) and Mehriya *et al*., (2020) on safflower, maize and cumin plants, who indicated that the highest yield attributes were achieved with the highest NPK dose using drip fertigation system. The promoting effects of both drip irrigation and fertigation in this study could be due to the proper timing, amounts of fertilizers applied through the drip irrigation system. With drip irrigation system, fertigation enables precise nutrient application, reduces nutrient leaching and thus promote plant growth and development (Cetin, 2019).

The promoting effect of the highest fertigation level (NPK 100%) could be due to the fact that adequate nitrogen rates improve the uptake of other nutrients, particularly P and K. Adequate amounts of N, P and K enhance photosynthetic rate, plant growth and yield. Sufficient amounts of potassium enhance the total dry mass accumulation under low moisture conditions. An adequate amount of K helps osmotic adjustment, which maintains higher turgor pressure, relative water content, thus improving the ability of plants to tolerate drought stress (Hasanuzzaaman *et al*, 2018).

Anthocyanin content (mg/g)

The results presented in Fig.1 revealed that the anthocyanin content was influenced by different irrigation and fertigation levels. The highest mean values of anthocyanin content (18.39, 17.82 mg/g) in the first and second seasons, respectively was obtained when plants were irrigated with 60% of evapotranspiration (ETc). Furthermore, anthocyanin content was enhanced with the higher NPK rates. The highest mean values were obtained at the higher rate of NPK (90%) and NPK (100%). However, the differences were non-significant between treatments in both seasons. The results also revealed that, the interaction between irrigation treatments and NPK fertigation rates on anthocyanin content were significant. The highest values were obtained in plants received irrigation treatment (I1) and fertigated with NPK rate (90%). Similar results were reported by Abbas and Ali (2011) and Khalil and Yousef (2014). Anthocyanins are considered as a significant determinant for the quality of roselle calyces. Anthocyanin accumulation in plants is one of the strategies of adaptation to environmental stresses such as water stress. Anthocyanin protect plants through scavenging free radicals, known as reactive oxygen species (Xu and Rothstein, 2018) which explains their higher concentration in the lowest irrigation treatment (I1) compared to other treatments. Moreover, adequate fertilization positively influences the quality by regulating anthocyanin levels.

CONCLUSION

This study concluded that, irrigation at 100% crop evapotranspiration combined with the highest rate of NPK fertilizer (100%) using drip irrigation system were suitable for roselle plants for maximizing crop yield productivity and quality. Therefore, an adequate supply of water and use of nutrients at high efficiencies can potentially result in optimizing roselle yields while limiting most water losses in a semi-arid region at El-Bustan area in South Tahrir district.

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Table 1. Chemical and physical properties of the soil at the experimental site.

Physical properties			
Soil layer depth (cm)	00-20	20-40	40-60
Texture	Sandy	Sandy	Sandy
Course sand (%)	48.66	55.71	37.76
Fine sand (%)	48.83	40.58	58.43
Silt+ clay (%)	2.51	3.71	3.81
Field Capacity, (%)	13.0	13.3	10.1
Wilting Point, (%)	4.6	4.5	4.4
Available water, (%)	8.3	8.1	8.0
Bulk density (t m^{-3})	1.69	1.68	1.67
Chemical properties			
$EC_{1:5}$ (dS m^{-1})	0.45	0.53	1.00
pH (1:2.5)	8.60	8.70	9.32
Total $CaCO_3$ (%)	7.00	2.34	4.66

Table 2. Chemical properties of the irrigation water at the experimental site

pH	Ecw		Soluble anions (meq/l)			Soluble cations (meq/l)			
	ppm	dS/m	CO_3^{--}	HCO_3^{--}	Cl^-	Ca^{++}	Mg^{++}	Na^+	K^+
7.78	1664	2.6	-	5.20	17.20	4.00	3.60	18.01	0.32

Table 3. Meteorological data at the experimental site (the average of two seasons 2020 and 2021)

Month		April	May	June	July	August	September	October
Temperature °C	Max	27.00	34.29	35.50	36.63	36.74	33.7	31.8
	Min	12.73	17.27	21.44	22.67	22.73	19.3	18.2
RH_AVG %		49.23	38.85	49.49	49.47	51.49	50.3	53.5
Wind speed (m/sec)		3.24	3.22	3.34	3.20	2.92	2.56	3.7
Radiation MJ/m^2		25.14	27.29	29.0	29.14	27.17	27.00	26.2
Et_o mm day^{-1}		5.87	7.65	7.91	8.06	7.53	7.1	5.87
Crop coefficient		0.37	0.70	0.94	1.025	0.91	0.82	0.76
Seasonal amount of water	3870 m^3/feddan at 120% crop evapotranspiration							

Table 4. Effect of irrigation levels and NPK fertilizer rates on vegetative growth of roselle plants during 2020 and 2021 seasons

NPK fertilizer levels (F)	First season (2020)					Second season (2021)				
	Plant height (cm)									
	Irrigation levels (I)									
	I1	I2	I3	I4	Mean	I1	I2	I3	I4	Mean
F1	165.47	192.28	211.92	220.42	197.52	168.78	196.13	216.16	224.83	201.47
F2	196.53	222.41	233.29	241.32	223.39	202.43	229.08	240.29	248.56	230.09
F3	220.99	232.93	236.02	243.47	233.35	229.83	242.25	245.46	253.21	242.69
F4	235.80	243.15	245.93	246.37	242.81	247.59	255.31	258.23	261.15	255.57
Mean	204.69	222.69	231.79	237.89		212.16	230.69	240.03	246.94	
LSD (0.05) I F I X F	4.71 3.60 12.46					3.44 2.89 6.03				
	Number of shoots									
	I1	I2	I3	I4	Mean	I1	I2	I3	I4	Mean
F1	15.66	18.33	19.00	20.33	18.33	17.23	20.16	20.90	22.36	20.16
F2	16.66	21.66	23.00	24.00	21.33	19.99	25.99	27.60	28.80	25.60
F3	22.00	27.33	29.66	32.66	27.91	26.40	32.80	35.59	39.19	33.50
F4	24.66	26.66	28.00	28.66	26.99	29.59	31.99	33.60	34.39	32.39
Mean	19.74	23.49	24.91	26.41		23.30	27.74	29.42	31.19	
LSD (0.05) I F I X F	2.60 1.37 4.76					2.11 1.23 3.55				
	Fresh weight (g/plant)									
	I1	I2	I3	I4	Mean	I1	I2	I3	I4	Mean
F1	824.33	851	914	1104.66	923.49	989.20	1021.20	1096.80	1325.59	1108.20
F2	1341.33	1461.66	1578.33	1707.33	1522.16	1408.40	1534.74	1657.25	1792.70	1598.27
F3	1894.66	2113	2327.33	2187.33	2130.58	1970.45	2197.52	2420.42	2274.82	2215.80
F4	2211.33	2276.33	2579	2520	2396.66	2299.78	2367.38	2682.16	2595.60	2486.23
Mean	1567.91	1675.49	1849.665	1879.83		1666.96	1780.21	1964.16	1997.18	
LSD (0.05) I F I X F	29.37 26.32 91.18					34.16 28.54 88.63				
	Dry weight (g/plant)									
	I1	I2	I3	I4	Mean	I1	I2	I3	I4	Mean
F1	219.42	284.52	322.06	355.32	295.33	226.00	293.06	331.72	365.98	304.19
F2	241.84	320.94	424.41	435.79	355.74	251.51	333.78	441.39	453.22	369.97
F3	286.23	395.90	462.47	435.36	394.99	297.68	411.74	480.97	452.77	410.79
F4	330.99	437.08	483.03	487.57	434.66	347.54	458.93	507.18	511.95	456.40
Mean	269.62	359.61	422.99	428.51		280.68	374.38	440.31	445.98	
LSD (0.05) I F I X F	11.60 14.36 49.72					18.43 12.06 32.29				

Table 5. Effect of irrigation levels and NPK fertilizer rates on number of capsules/plant and fresh weight of capsules/plant during 2020 and 2021 seasons

NPK fertilizer levels (F)	First season (2020)					Second season (2021)				
	Irrigation levels (I)									
	Number of Capsules/plant									
	I1	I2	I3	I4	Mean	I1	I2	I3	I4	Mean
F1	42.67	56.67	123.00	145.00	91.83	45.23	60.07	130.38	153.70	97.35
F2	64.33	72.00	171.33	175.33	120.75	68.83	77.04	183.32	189.36	129.64
F3	82.00	98.33	223.33	246.67	162.58	86.10	103.25	234.50	259.00	170.71
F4	111.67	134.33	254.67	259.33	190.00	117.25	141.05	267.40	272.30	199.50
Mean	75.16	90.33	193.08	206.58		79.35	95.35	203.90	218.59	
LSD (0.05) I F I X F	4.75 4.40 15.23					5.43 3.15 12.52				
	Fresh weight of capsules/plant (g)									
	I1	I2	I3	I4	Mean	I1	I2	I3	I4	Mean
F1	300.15	385.84	300.15	385.84	300.15	385.84	300.15	385.84	300.15	385.84
F2	416.05	58 1.02	416.05	58 1.02	416.05	58 1.02	416.05	58 1.02	416.05	58 1.02
F3	643.20	846.12	643.20	846.12	643.20	846.12	643.20	846.12	643.20	846.12
F4	870.17	1294.33	870.17	1294.33	870.17	1294.33	870.17	1294.33	870.17	1294.33
Mean	557.39	776.83	557.39	776.83	557.39	776.83	557.39	776.83	557.39	776.83
LSD (0.05) I F I X F	33.42 21.12 73.16					41.77 45.21 87.05				

Table 6. Effect of irrigation levels and NPK fertilizer rates on fresh weight of sepals/plant, dry weight of sepals/plant and dry yield of sepals/feddan during 2020 and 2021 seasons

	First season (2020)					Second season (2021)				
	Irrigation levels (I)									
NPK fertilizer rates (F)	Fresh weight of sepals/plant (g)									
	I1	I2	I3	I4	Mean	I1	I2	I3	I4	Mean
F1	88.95	154.52	377.85	412.03	258.34	90.73	157.61	385.41	420.27	263.50
F2	152.99	208.99	540.17	660.97	390.78	157.58	215.26	556.38	680.80	402.50
F3	228.88	346.29	817.48	959.29	587.98	238.04	360.14	850.18	988.07	609.11
F4	407.32	512.49	1033.04	1082.02	758.72	427.69	538.11	1084.69	1114.48	791.24
Mean	219.53	305.57	692.14	778.58		228.51	317.78	719.16	800.90	
LSD (0.05)										
I			12.65					15.38		
F			10.87					11.69		
I X F			37.65					22.57		
	Dry weight of sepals/plant (g)									
	I1	I2	I3	I4	Mean	I1	I2	I3	I4	Mean
F1	12.89	23.39	62.13	62.28	40.17	14.18	25.73	68.34	74.74	45.75
F2	25.20	29.68	103.80	106.74	66.35	30.24	35.62	124.56	128.09	79.63
F3	31.65	49.93	114.22	124.49	80.07	37.98	59.92	137.06	149.39	96.09
F4	47.36	78.56	154.20	167.32	111.86	52.10	86.42	169.62	184.05	123.05
Mean	29.27	45.39	108.59	115.20		33.62	51.92	124.90	134.07	
LSD (0.05)										
I			6.38					8.11		
F			4.23					3.53		
I X F			14.64					12.78		
	Dry yield of sepals/fed. (Kg)									
	I1	I2	I3	I4	Mean	I1	I2	I3	I4	Mean
F1	103.14	187.12	497.09	498.24	321.39	113.44	205.84	546.72	597.92	365.98
F2	201.65	237.44	830.45	853.92	530.86	241.92	284.96	996.48	1024.72	637.02
F3	253.22	399.44	913.76	995.92	640.58	303.84	479.36	1096.48	1195.12	768.7
F4	378.88	628.53	1233.60	1338.58	894.89	416.8	691.36	1356.96	1472.4	984.38
Mean	234.22	363.13	868.72	921.66		269	415.38	999.16	1072.54	
LSD (0.05)										
I			50.43					64.71		
F			33.77					45.19		
I X F			116.00					127.84		

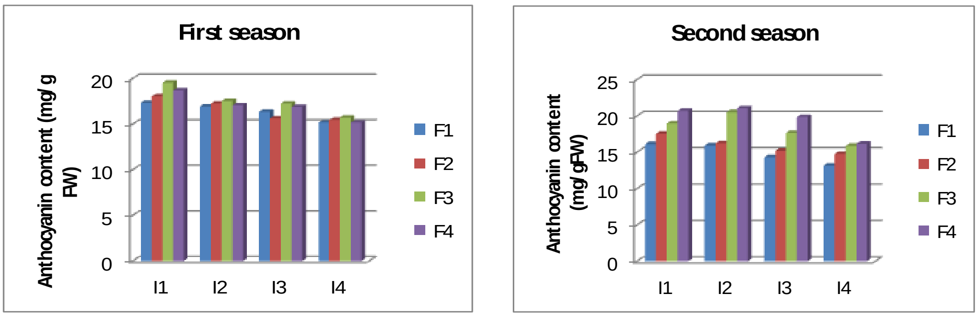

Fig 1. Effect of irrigation levels and NPK fertilizer rates on anthocyanin content (mg/g FW of sepals) during 2020 and 2021 seasons.

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الملخص العربي

إستجابة نباتات الكركديه المنزرعة بالأراضي الرملية لمستويات مختلفة من الري والتسميد

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تم أجراء تجارب حقلية في محطة بحوث البساتين بمنطقة جنوب التحرير، محافظة البحيرة خلال موسمين متتالين 2020، 2021 وذلك لدراسة تأثير مستويات مختلفة من التسميد المعدني والري على النمو والمحصول وجودة نباتات الكركديه المنزرعة في أرض رملية. اشتملت التجربة على 4 مستويات من الري بالتنقيط 60%، 80%، 100% من بخر نتح المحصول. بالإضافة إلى معاملة الكنترول والتي تتمثل في الري التقليدي بحيز الدراسة (120% من بخر نتح المحصول) و أربعة مستويات من التسميد المعدني NPK (70، 80، 90، 100% من ممارسة المزارع بحيز الدراسة). أظهرت النتائج تأثير مستويات الري والتسميد على النمو والمحصول ومحتوى الأنثوسيانين في نبات الكركديه. أدى الري عند 120% من بخر النتح مع التسميد المعدني (100%) إلى الحصول على أعلى قيم لمحصول السبلات الجاف وعدم وجود فروق معنوية بين هذه المعاملة والمعاملة عند 100% بخر نتح مع التسميد المعدني (100%). وأدت المعاملة I3F4 إلى أعلى قيم لمحتوى الأنثوسيانين في السبلات. وبالتالي يمكن التوصية بالري عند بخرنتح 100% والتسميد المعدني الكامل (100%) من خلال الري بالتنقيط وذلك لتعظيم إنتاجية المحصول وجودة نباتات الكركديه وزيادة كفاءة استخدام المياه تحت ظروف الأراضي الجافة.