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IMPROVING WATER USE EFFICIENCY OF RICE TO COPE WITH CLIMATE CHANGE AND WATER SCARCITY IN NORTH SINAI

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ABSTRACT

A field experiment was conducted using modern irrigation system such as trickle irrigation system for irrigation a new variety of drought resistant rice (Oraby3) under Balouza (latitude 31° 3\ N and Longitude 32° 36\ E), condition in North Sinai through two seasons,(i.e,2017 and 2018). This study includes three irrigation water requirements which represent three deficits, (i.e., ETC 20%, 40% and 50%) as a depletion of free available water as a major treatment. Three distances between drip lines, (i.e., 20, 30 and 40cm) were designed as sub-main treatment. Three replicates were taken in split plot design as a statistical program (statistic software version 9 (Analytical Software, 2008)). The objective of this work is trying to implement some of water deficits in computing water consumptive use of drought resistant rice (Oraby 3, *Oryza sativa L* and maximizing water use efficiency to save more water quantities under climate change circumstances in the experimental area of Balouza. Results revealed that actual evapotranspiration could be reduced 3.75 % when applying 20% of irrigation water deficit comparing with 50%. Also yield increased 31.62%, 35.55% and 33.63% for grain, straw and biological yield, respectively. The Same trend was noticed with the space between the dripper lines, water consumption increase by increasing the spaces between laterals by 4.73% for 40 cm compared with 20 cm. The results indicated that, the highest seasonal ETa value was recorded at D_3C_3, (i.e., 795.21mm), treatment while the lowest ETa was recorded with D_1C_1, (i.e., 751.67mm) treatment. The results indicated an increase in WUE with a decrease in both the depletion rate and the distance between the emitter lines. The highest coefficients in terms of WUE was the D_1C_1, (i.e., 0.906) treatment, the WUE values achieved by D_1C_1reached to 1kg grains/1m^3consumed water which is triple that of traditional rice which 300 gm/1m^3. From the results obtained, it is might spread the cultivation of drought rice in the desert lands. About 59% of the consumed water can be saved in relation to the traditional rice varieties. The saved water can be used to cultivate drought rice for the sake of an increase in production which estimated with 3715 kg/fed. Accordingly, the area cultivated with rice and production can be doubled .So the food gap resulting from the increase in population can be closed. The highest investment ratio of 1.84,1.92 and 3.77for each of cereal,

straw and biological crops respectively recorded withD_1C_3 .Therefor, it is recommended to plant drought rice with treatment D_1C_3 under Balouza conditions.

INTRODUCTION

Water scarcity, caused by the rapidly increasing world population accompanying increases in water use for social and economic development, threatens sustainable world crop production that consumes most of the global water resources, the global water consumption for irrigation has been steadily growing over the last 50 years and today it makes 70% of all water consumption **(Tian et al., 2017).** The great challenge of the agricultural sector is to produce more food from less water, which can be achieved by increasing Crop Water Productivity (CWP) **(Zwart and Bastiaanssen 2004).** Rice provides livelihood for about two-thirds of the world population. Conventionally, rice is being grown under continuous standing water in all phenological stages except maturity. This method of cultivation of rice utilizes more than 30 to 45% of the world's fresh water resources **(Humphreys et al., 2005).** To meet the rising food demand from an ever-increasing population, rice production has to increase by 40% by the end of 2030 (**FAO, 2009**). The conventional method of rice production is challenging in today's scenario due to water scarcity. The greatest consumer of irrigation water per unit area is rice. Rice (paddy) is the second most important commodity worldwide, and rice cropping fields significantly contribute to climate change since they are a considerable source of methane **(Parthasarathi et. al., 2018).** Statistics indicate that the water consumption of rice accounts for approximately 54% of the total water consumption (**He et al., 2014).** Rice crop is one of the strategic grain crop that Egyptians depend on for their food. However, the traditional Egyptian varieties are high water consuming and this does not suit the condition of water scarcity in Egypt and need adding new cultivated areas of land to meet increasing population growth. . Water shortage in Egypt and the need to rationalize it so that we can add new agriculture areas , it is the largest areas that consume large part of the water have become a need to face growing and saving water for future generations to add new areas of agriculture land. We should be develop new rice variety of low consumption and more accordance with environmental factors. Soil moisture plays an important role in the water, carbon and energy cycles. The amount of moisture in soil is an important variable to understand the coupling of the surface and the atmosphere. The sustainability of agricultural production depends on conservation and appropriate use and management of scarce water resources especially in arid and semi-arid areas where irrigation is required for the production of food and cash crops **Douh and Boujelben, 2011.** Water resource management and water availability are among the most important political, social and economic issues of 21st century in Egypt (**Medany et al., 1997).**Climate change may affect food systems in several ways ranging from direct effects on crop production (e.g. changes in rainfall leading to drought or flooding, or warmer or cooler temperatures leading to changes in the length of growing season **Gregory et al., (2005).** By the end of the 21st century, the Arab region will face an increase of 2 to 5.5ºC in the surface temperature. This increase will be coupled with a expected decrease in precipitation up to 20%. These projected changes will lead to shorter winters and dryer summers, hotter summers, more frequent heat wave occurrence, and more variability and extreme weather events occurrence **(IPCC, 2007).** Drip irrigation is an irrigation method that saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters. It is done through narrow tubes that deliver water directly to the base of the plant. **El-Meseery (2003)** found that drip irrigation for maize in sandy soil saved about 20 to 25% of the water used by applying 80 and 75% of the Etc, respectively, and no significant difference in crop yield was observed in comparison to crop yield at application of 100% of Etc. Drip irrigation improved the aerobic rice yield and water savings by 29 and 50%, respectively **Parthasarathi *et al.*(2018).**Water use efficiency (WUE), measured as the biomass produced per unit transpiration , describes the relationship between water use and crop production .In water- limiting condition, it would be important to produce a high amount of biomass , which contributes to crop yield using a low or limited amount of water . WUE can be achieved through integrated farm resources management. On-farm irrigation water management techniques such as deficit irrigation if coupled with better cropping patterns together with appropriate cultural practices, crop water productivities suggest that agricultural production can be maintained to its current level by using 20 to 40% less water if new water management practices are adopted **(Dehghanisanij et al., 2006).** The WUE or water productivity is the same term for expression about the number of produced yield units for each irrigation water unit (m3). The main pathways for enhancing WUE in irrigated agriculture on-farm are to increase the output per unit of water via aspects of engineering and agronomic management **(Howell, 2006).** From here, the idea of research was the growing rice crop (Araby3) as anew drought – generated class under sand soil conditions, drip irrigation system and deficit irrigation 20,40 and 50% of free water available, under three distance of drip lines ,(i.e, 20,30 and40 cm), in order to rationalize and raise the efficiency of water use and maximize the production of land and water units.

MATERIAL AND METHODS

The main objective of the present work was to study integrated system for maximizing the productivity of drought-resistance rice, (Oraby3 variety) which impact on water unit productivity saving water consumptive use. Field experiment was carried out in Balouza experimental station which belongs to Desert research center where it situated in north Sinai (latitude 31^{o} 3$^{\backslash}$ N and Longitude 32^{o} 36$^{\backslash}$ E). The mechanical and chemical properties of the used soil are shown in Table (1) according to **(Page *et al.*, 1984)**. The chemical analysis of the used water is shown in Table (2).The chemical analysis of organic manure is shown in Table (3).

Table (1). Some physical and chemical properties of the experimental soil.

Particle size distribution (%)			Texture class	EC ds/m	pH	O M %	Ca C	Soluble ions (mmol/l)								Available nutrients (mg/kg)		
								Cations				Anions						
Sand	Silt	Clay						Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	SO_4^{--}	Cl^{-}	N	P	K
86.2	5.7	8.1	Sand	3.82	8.02	0.56	8.82	8.2	12.4	16.85	0.75	-	5.4	19.9	12.9	36.4	3.65	144

Table (2). Chemical analysis of irrigation water.

Samples	pH	E.C. (ds/m)	SAR	Soluble cations (mmol/l)				Soluble anions (mmol/l)			
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	$SO_4^{=}$	Cl^{-}
1 st season	8.26	1.78	5.3	3.42	3.69	9.9	0.8	0.24	6.48	2.47	8.62
2nd. Season	8.3	1.8	4.48	3.53	3.35	10.67	0.45	0.5	4.3	4.1	9.1

pH: Acidity, E.C.: Electrical conductivity, dSm^{-1}: dec Siemen per meter, S.A.R: Sodium adsorption ratio, me/l: mille equivalent per liter

Table (3). Chemical analysis of Farm yard manure.

Analysis of farm yard manure	C%	N%	C/N ratio	P%	K%
	23.5	1.5	15.66	0.45	0.48

The treatments comprised two treatments. The first treatment included three irrigation water deficits from free available water, (i, e., 20,40 and 50% as soil moisture depletion). The second treatment was three distance among drip lines, (i.e, 20, 30 and40 cm).were designed. Three replicates for each treatment were taken in split plot design as a statistical program (statistic software version 9 (Analytical Software, 2008)).The excrement area well serviced, and then organic fertilizer was added with the rate of 15 m^3 / fed. below the planting lines. Seeds were soaked in water for 24 hours before planting at 20cm distances by putting

3to4 seeds in the hole at a rate of 60 kg/fed. Immediately after planting, irrigation drip lines were extended over the distance of the experiment and irrigation was given for the experiment, then another irrigation was given for the experiment at Sunset. Irrigation continued for the first three days of the experiment at a rate of twice a day to ensure the germination of all seeds and neither damaged. Nitrogen fertilization was added at a rate 200 kg nitrogen per fed. in four doses, the first when preparing the land for cultivation , the second at 20 days of cultivation , the third at 40 days, and the fourth at 60 days of planting and before expelling the spikes. After 10 days of planting, it was sprayed with calcium nitrate and magnesium sulfate 2% at a rate of 2 liters per fed. At the age of 20 days, sprayed with amino acid, potassium hamate, trace elements, calcium nitrate and magnesium sulfate, while spraying with potassium sulfate 2%was carried out at 65 days of planting. After days from planting crop production was measured as, weight of plant kg/fed. grain , straw and biological yield. Water consumptive use was calculated using the following equation of **Israelson and Hansen (1962).**

$$CU= ((M2-M1)\times dp\times D) \div 100$$

Where:

CU = Consumptive use (mm). Such CU is an estimate of actual evapotranspiration of the crop i.e. actual ET crop.

D = Depth (in mm) of the irrigated soil under consideration.

dp = Bulk density (g/cm3) of the soil in the relevant soil depth.

M_2 = Percentage of moisture in soil (w/w) following maximum irrigation within the relevant soil depth.

M_1 = Percentage of soil moisture (w/w) before next irrigation (within the relevant depth).

Soil moisture content was gravimetrically determined for 3 depths; 0-20, 20-40 and 40-60 cm, immediately before and after 24 hours of irrigation. The actual evapotranspiration (ETa) for each stage as well as for the total season were determined. Irrigation water use efficiency (WUE) was calculated as the ratio of grain, straw and biological yield (kg. fed. $^{-1}$) devided the total irrigation water volume applied per fed. (m^3 fed. $^{-1}$) seasonally. It was expressed as kg grain, straw or biological yield per cubic meters of irrigation water **(Howell, 2006).**

RESULTS AND DISCUSSION

Effect of depletion and lateral distance on rice actual evapotranspiration.

To obtain the actual water consumptive use (ETa), the soil moisture % was determined gravimetrically on dry basis just before and 24 hours after irrigation. By studying the effect of the treatments on water consumption, the results in tables (4 and 5) showed that the treatments had no effect in the germination stage , in order to unify the irrigation parameters. But by applying the treatments , the water consumption increased with the age of the plants, and the average life stage recorded the highest water consumption. With an increase in the depletion rate, the increased rates were 4.42-10.71, 1.2-3.05and 2.08-3.06 %for first season and 4.4-6.83 , 1.3- 3.8and 2.07-3.39 %for the second season of development stage , mid stage and late stage respectively compared with depletion ratio 20%, these results agree with **Naeem and Rai(2005)** who found that total water applied (mm)to wheat 214.8 and 251.42for 50 and 70% ASMD respectively .The same effect was observed for the distance between the lateral , water consumption increased by increasing the distance between laterals by ratio 1.2-3.34, 0.85-1.58and 0.54-1.28% for the first season, while the increase was in the second season 1.55- 2.76, 0.75-1.84 and 0.82-1.48% for each of the stages development, mid and late, respectively. Tables mentioned above show the interaction effect of depletion rate and the distance between the laterals. It was found that the consumed water increased by increasing both the distance between laterals and the depletion Percentages, the increase was 10.67-9.63, 4.57-4.74 and 4.36-4.55% for each of the stages development, mid and late stage for both seasons respectively, the percentage of increase in total water consumption was 5.8% for D_3C_3 and 5.62% for $D_2C_2$for both seasons respectively compared with D_1C_1treatment**751.67**mm.

Table (4). Effect of depletion and lateral distance on rice actual evapotranspiration(First season)

depletion ratio%	lines distance, cm	Initial Stage, mm	Develop. Stage, mm	Mid stage, mm	Late Stage, mm	Total ETa	
						mm	m^3/fed.
D_1*	C1	65.7	206.1	293.61	186.30	751.67	3157.0
	C2	65.7	208.9	295.12	187.32	757.08	3179.7
	C3	65.7	211.7	297.84	189.98	765.26	3214.1
Mean		65.7	208.9	295.52	189.09	758.0	3183.6
D_2	C1	65.7	215.2	296.13	190.58	767.64	3224.1
	C2	65.7	218.4	298.88	192.02	775.00	3255.0
	C3	65.7	220.8	302.19	192.70	781.37	3281.7
Mean		65.7	218.1	299.07	191.77	774.67	3253.6
D_3	C1	65.7	219.1	301.62	192.92	779.37	3273.4
	C2	65.7	223.9	304.95	193.53	788.09	3310.0
	C3	65.7	228.04	307.03	194.43	795.21	3339.9
Mean		65.7	223.68	304.53	193.63	787.56	3307.77
G. Mean		65.7	216.89	299.71	191.5	773.41	3248.32
L.S.D(0.05) for D		3.98	2.52	5.04	0.43	0.43	1.81
L.S.D(0.05) for C		6.25	1.98	3.95	0.35	0.35	1.47
L.S.D(0.05) for D and C		9.66	3.74	7.47	0.65	0.65	2.74

***D1=depletion 20%,D2=depletion 40%,D3=depletion 50%,C1=20cm, C2=30cm and C3=40cm**

Table (5). Effect of depletion and lateral distance on rice actual evapotranspiration(second season)

depletion ratio%	lines distance, cm	Initial Stage, mm	Develop. Stage, mm	Mid stage, mm	Late Stage, mm	Total ETa	
						mm	m^3/fed.
D1*	C1	65.7	205.61	292.40	185.47	749.19	3146.6
	C2	65.7	207.87	294.10	186.45	754.13	3167.4
	C3	65.7	210.92	297.27	188.62	762.53	3202.6
Main		65.7	208.13	294.59	186.85	755.28	3172.2
D2	C1	65.7	214.28	295.87	188.44	764.29	3210.0
	C2	65.7	217.91	297.63	191.46	772.72	3245.4
	C3	65.7	219.98	301.80	192.24	779.73	3274.9
Main		65.7	217.39	298.43	190.71	772.25	3243.43
D3	C1	65.7	218.8	300.73	192.50	777.75	3266.5
	C2	65.7	222.84	303.93	193.15	785.62	3299.6
	C3	65.7	225.41	306.27	193.90	791.29	3323.4
Main		65.7	222.35	303.64	193.18	784.89	3296.5
G. Main		65.7	215.96	298.89	190.25	770.81	3237.38
L.S.D(0.05) for D		0.13	0.64	0.57	0.59	0.88	3.7
L.S.D(0.05) for C		6.25	0.6	0.56	0.31	1.06	4.6
L.S.D(0.05) for D and C		0.02	1.05	0.97	0.73	1.73	7.27

***D1=depletion 20%,D2=depletion 40%,D3=depletion 50%,C1=20cm, C2=30cm and C3=40cm**

Effect of depletion and lateral distance on rice yield

According Table (6) data show that the depletion rate had significant effect on the yield of cereal , straw and biological crops, as with the decrease in the depletion rate . Significant increase occurred for the (grain, straw and biological yield). The percentage of increase that occurred were 37.3-35.55, 21.1-20.27 and 33.63- 20.64% for grain , straw and biological crops at 20% and 40 % depletion rate compared to 50% of available free water this results agree with **Venkatesan et al. (2005)** who found that yield reduction was less in 40% stress treatment compared to 60% stress treatment in various stages and the same trend was observed for the distance between pipe lines, regularly as by decreasing the distance between the lines which led to increase the crop production . The increase rates were 13.81- 13.03 , 7.57 - 7.73 and 13.41- 5.15% each of gain, straw and biological yield when applying distances 20 and 30 cm respectively compared to distance 40 cm these results agree with **Parthasarathi et al.(2013)** who found that increase in lateral distance from 0.6 to 1.0 m , caused reduction in water availability to root zone, therefore root biomass is reduced, consequently the lack of yield. The interfering effect of transaction on productivity (grain, straw and biological yield) show that the highest productivity were2861.2, 2910.9 and 5772.1kg. with treatment D_1C_1 and the lowest productivity1786.5, 1870.9 and3657.4kg. with treatment D_3C_3. So the increase rates were 60.61, 55.61 and 57.82% for the first season. While they were 2965.2, 3056.2 and 6021.4 with treatment D_1C_1 ,while it were 1767.8, 1820.5 and 3588.4 with treatment D_3C_3 for the second season. On the other hand when applying 20% depletion rate, grain, straw and biological yield increased in proportions 38.8, 37.5 -23.1, 23.73, 38.14 and 23.4% at rates of depletion 20 and 40% of available water, respectively. Reducing the distance between drip hoses led to increase the yield of grain , straw and biological with 15.82- 16.38, 8.05 -8.31 and16.11- 8.18% at spaces 20 and 30 cm, respectively .While the study of the interfering between the irrigation lines resulted in an increase in production at rates of 67.73 , 67.88 and 67.8% for cereal , straw and biological yields respectively when treatment D_1C_1achieved the highest productivity compared to treatment D_3C_3 which achieved the lowest productivity .

Table (6) Effect of depletion and lateral distance on rice yield

depletion ratio%	lines distance	first season			second season		
		grain kg/fed	straw kg/fed	Biological yield kg/fed.	grain kg/fed	straw kg/fed	Biological yield kg/fed
D1*	C1	2861.2	2910.9	5772.1	2965.2	3056.2	6021.4
	C2	2342.6	2781.5	5124.2	2712.9	2803.5	5516.3
	C3	2528.9	2601.3	5130.2	2594.8	2712.6	5307.5
Main		2577.6	2764.5	5342.2	2757.6	2857.4	5615.1
D2	C1	2490.5	2561.2	5051.7	2568.7	2703.5	5272.1
	C2	2388.1	2482.4	4870.5	2471.4	2605.2	5076.6
	C3	2236.2	2315.1	4551.2	2297.5	2401.4	4698.9
Main		2371.6	2452.9	4824.5	2445.9	2570.0	5015.9
D3	C1	2104.4	2199.9	4304.1	2180.3	2310.7	4491.1
	C2	1983.9	2047.6	4031.6	2012.4	2102.3	4114.6
	C3	1786.5	1870.9	3657.4	1767.8	1820.5	3588.4
Main		1958.3	2039.5	3997.8	1986.8	2077.8	4064.7
G. Main		2302.5	2419.0	4721.5	2396.7	2501.7	4898.6
L.S.D(0.05) for D		252.21	1.15	251.82	0.46	0.07	0.46
L.S.D(0.05) for C		197.51	0.62	157.39	0.24	0.10	0.29
L.S.D(0.05) for D and C		373.72	1.44	373.34	0.57	0.16	0.61

***D1=depletion 20%, D2=depletion 40%, D3=depletion 50%, C1=20cm, C2=30cm and C3=40cm**

Effect of depletion and lateral distance on rice water use efficiency

In the same direction , the results in table (7) indicated an increase in the efficiency of water consumption ,due to a decrease of depletion by rate 36.73,40.79and 38.82 % for grain straw and biological yields in the first season , when the rate were 44.2,42.85 and 43,51 in the second season ,this results agree with **El-Sayed and Abd El-Monem (2017)** who reached to crop water use efficiency and field water use efficiency were higher under 30% soil moisture depletion (SMD). Increasing distance between dripper liens decreased WUE 13.72, 13.14 and13.41%for grain, straw and biological yields at the first season respectively, and 15.2, 15.58 and 15.39% for second season. The best water use – efficiency was achieved with the treatment D_1C_1,incease rate achieved (69.43,64.58and 66.66.95%)for grain, straw and biological yields with first seasons and 77.18,77.31 and 77.23% for the three crops with the second season respectively, compared with D_3C_3.

Table (7) Effect of depletion and lateral distance on rice water use efficiency

depletion ratio%	lines distance	first season			second season		
		grain WUE	straw WUE	Biological WUE	grain WUE	straw WUE	Biological WUE
D1	C1	0.906	0.923	1.828	0.942	0.971	1.914
	C2	0.738	0.875	1.612	0.857	0.885	1742
	C3	0.787	0.809	1.596	0.810	0.847	1.657
Main		0.810	0869	1.679	0.870	0.901	1.771
D2	C1	0.773	0.794	1.567	0.800	0.842	1.642
	C2	0.734	0.763	1.496	0.762	0.803	1.564
	C3	0.681	0.705	1.387	0.702	0.733	1.435
Main		0.729	0.754	1.483	0.755	0.793	1.552
D3	C1	0.643	0.672	1.314	0.668	0.707	1.375
	C2	0.600	0.619	1.218	0.609	0.637	1.207
	C3	0.535	0.560	1.095	0.532	0.548	1.080
Main		0.593	0.617	1.209	0.603	0.631	1.221
G. Main		0.711	0.747	1.457	0.743	0.775	1.515
L.S.D(0.05) for D		0.79	5.70	0.79	1.09	1.09	2.17
L.S.D(0.05) for C		0.06	2.93	0.06	9.89	9.93	1.98
L.S.D(0.05) for D and C		0.12	6.99	0.12	1.76	1.76	3.52

***D1=depletion 20%, D2=depletion 40%, D3=depletion 50%, C1=20cm, C2=30cm and C3=40cm**

The economic return of rice production Investment Ratio, (IR)).

Table (8) show the effect of both moisture depletion rates, the distance between drip liens, and their effect on the economic return of rice production. All the components of the costs of rice cultivation and production were calculated and on the other hand the economic return was calculated to study the investment ratio **(IR)**

IR =Economic return/costs

Through the results, the best treatment was $\mathbf{D_1C_3}$, as it achieved the highest investment ratio of 1.84,1.92 and 3.77for each of cereal, straw and biological crops respectively .Therefor, it is recommended to plant drought rice with treatment $\mathbf{D_1C_3}$ under Balouza conditions to achieve the highest investment ratio, where a good moisture distribution was achieved with this treatment, a accompanied by good crop growth ,as it happened ,saving the cost of establishing a network of hoses.

Table (8): The economic return of rice production Investment Ratio, (IR).

Soil depletion	Liens spaces	First season			Second season		
		IR for grain	IR for straw	IR for biological yield	IR for grain	IR for straw	IR for biological yield
D1	C1	1.75	1.76	3.49	1.79	1.85	3.46
	C2	1.58	1.87	3.45	1.83	1.89	3.72
	C3	1.80	1.85	3.64	1.84	1.92	3.77
D2	C1	1.50	1.55	3.05	1.55	1.63	3.18
	C2	1.60	1.67	3.28	1.66	1.76	3.42
	C3	1.59	1.65	3.23	1.63	1.7	3.34
D3	C1	1.27	1.33	2.60	1.32	1.4	2.71
	C2	1.33	1.38	2.71	1.35	1.41	2.77
	C3	1.27	1.33	2.6	1.26	1.29	2.51

RECOMMENDATION

From the results obtained, it is might spread the cultivation of drought rice in the desert lands. About 59% of the consumed water can be saved in relation to the traditional rice varieties. The WUE values achieved by D_1C_1reached to about 1kg grains/1m^{3}consumed water which is triple that of traditional rice which 300 gm. /1m$^{3.}$ The saved water can be used to cultivate drought rice for the sake of an increase in production which estimated with 3715 kg/fed. Accordingly, the area cultivated with rice and production can be doubled .So the food gap resulting from the increase in population can be closed. The best treatment under Balouza condition was D1C3becouse it have the highest investment ratio, (1.84,1.92 and3.77 for grain, straw and biological crops respectively.

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تحسين كفاءة الأستخدام المائى للأرز المقاوم للجفاف ليتلاءم مع التغير المناخى وندرة المياه بشمال سيناء

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وحدة الأحتياجات المائية – قسم كيمياء وطبيعة الأرضى

تم أجراء تجربة حقلية بمحطة بحوث بالوظة التابعة لمركز بحوث الصحراء بشمال سيناء خلال عامى٢٠١٧و٢٠١٨ لزراعة صنف جديد من الارز المقاوم للجفاف (عرابى٣) تحت نظام الرى بالتنقيط بادارة مائية اشتملت على ثلاث نسب استنفاذ رطوبى، ٢٠و٤٠ و٥٠% من الماء الميسر المتاح كعامل رئيسى . وكان العامل التحت رئيسى ثلاث مسافات بين خطوط التنقيط ٢٠و٣٠و٤٠ سم ،وأخذ ثلاث مكررات تحت كل عامل وكان التصميم الاحصائى القطع المنشقة مرة واحدة.لاختبار تاثير العوامل السابقة على الاستهلاك المائى للارز المقاوم للجفاف تحت ظروف منطقة بالوظة وكذلك كل من الانتاجية وكفاءة الاستهلاك المائى للمحصول فى محاولة لتوفير المياه وتعظيم كفاءة وحدة المياة المستخدمة ، لمواجهة ظروف التغيرات المائية ومحاولة حل مشكلة نقص الماء بمصر وتوفير كميات مياه تفى بالتوسع الافقى لمواجهة النمو السكانى وماترتب عليه من فجوة غذائية . وقد اشارت النتائج الى نقص البخر نتح الفعلى بمعدل ٣.٧٥ % عند نسبة استنفاذ ٢٠% مقارنة بنسبة استنفاذ ٥٠% . كذلك حدثت ذيادة فى الانتاجية ٣١.٦٢ و٣٥.٥٥ و٣٣.٦٣ % بالنسبة لمحصول الحبوب والقش والمحصول البيولوجى على التوالى. كما لوحظ نفس الاتجاه فى النتائج بالنسبة للمسافة بين خطوط التنقيط فقد ذاد الاستهلاك المائى بزيادة المسافة بين خطوط التنقيط بنسبة ٤.٧% عند مسافة ٤٠ سم مقارنة بالمسافة ٢٠ سم بين الخطوط. كما اشارت النتائج الى ارتفاع الاستهلاك المائى الموسمى مع المعاملة D_3C_3 (٧٩٥.٢١ مم) مقارنة بالمعادلة D_1C_1(٧٥١.٦٧ مم) .كذلك اوضحت النتائج حدوث زيادة فى كفاء الاستهلاك المائى بنقص كل من نسبة الاستنفاذ والمسافة بين خطوط التنقيط فحققت المعاملة D_1C_1 اعلى نسبة كفاءة استهلاك مائى (٠.٩٠٦) حيث ان المتر الكعب من المياة استخدم فى انتاج حوالى ١ كجم من الحبوب وذلك يمثل ثلاثة اضعاف انتاج اصناف الارز التقليدية الذى يبلغ ٣٠٠ جم لكل متر مكعب من المياه مما يضع الارز الجفافى فى مصاف الحبوب العادية كالقمح والذرة من ناحية كفاءة الاستهلاك المائى . من النتائج نخلص الى انه يمكن التوسع فى زراعة الارزالجفافى بالمناطق الصحراوية تحت نظام الرى بالتنقيط .حيث تم توفير حوالى ٥٩ % من المياه المستهلكة بواسطة اصناف الارز التقليدية التى تستهلك كميات كبيرة من المياه من خلال الماء المتوفر يمكن اضافة ٣٧١٥ كجم/ف. وبالتالى يمكن مضاعفة كل من المساحة المزروعة ارز وايضا الانتاجية مما يسهم فى سد الفجوة الغذائية،وبحساب نسبة الاستثمار للمعاملات كانت المعاملة D_1C_3 أعلاهم حيث حققت نسب ١.٨٤و١.٩٢ و٣.٧٧ مع كل من الحبوب والقش والمحصول البيولوجى على التوالى لذلك ينصح بزراعة أرز عرابى٣ تحت ظروف بالوظة مع المعاملة D_1C_3.