J. Agric. Sci. Mansoura Univ., 29 (1): 487 - 497, 2003

IRRIGATION AND FERTILIZATION MANAGEMENT FOR WHEAT CROP UNDER SPRINKLER IRRIGATION SYSTEM.

Abdel - Mawgoud, A. S. A.*; El - Gendi, S. A.; M. S. Awaad** and S. A. M. Hegab***

*** Soils & Water Sci. Dept., Fac. Agric., Al-Azhar Univ., Assiut, Egypt.**

****Soil, Water & Envir.Res. Inst., Agric. Res. Center, Giza, Egypt.**

ABSTRACT

A field trial was conducted in 2002/03 winter season at the experimental station, Fac. Agric., Al-Azhar Univ., Assuit Governorate to study the effect of different water regimes and nitrogen fertilizer on wheat yield, its quality and water use efficiency under sprinkler irrigation system. The obtained results indicated that increasing the applied water to ≈ 80 % of soil moisture depletion (SMD) increased the yield of wheat. Straw yield increased by 4.01 and 13.66 % in I_2 and I_3 treatment, respectively compared to I_1 treatment (equated ≈ 60 % SMD). Moreover, the grain yield (kg/fed) jumped from 3088 to 3884 then to 4455 in I_1, I_2 and I_3 treatment, respectively. Comparing to I_1 treatment, Seed index increased by 12.89 and 29.79% and harvesting index was higher by 8.18 and 10.61% at I_2 and I_3 treatment, respectively. Straw yield increased by 33.77, 47.0 and 73.85% at fertilization rate of 60, 90 and 120 kg N/fed respectively compared to non-fertilized treatment. The grain yield was higher by 73.72, 129.8 and 140.74% at the corresponding rates. The total yield increased by 53.07, 87.0 and 106.16% and seed index increased by 41.99, 51.54 and 57.43% at the corresponding rates. In wheat grain, the nitrogen percent increased by 31.62 and 43.38% as the available soil moisture increased to I_2 and I_3, respectively. The protein content increased by 31.96 and 43.40% in the corresponding treatments. The amount of consumed water (mm/season) may be ranked in a descending order as follows: I_3 (479) > I_2 (426) > I_1 (375). The amount of water losses was 35, 33 and 26% in I_1, I_2 and I_3 treatment, respectively. I_3 treatment (long irrigation interval) produced the highest water use efficiency (WUE) value (1.64 kg/m^3) followed by I_2 treatment (1.49 kg/m^3) and I_1 treatment (1.28 kg/m^3). The values of WUE for F_0, F_1, F_2 and F_3 treatments were 0.79, 1.36, 1.81 and 1.89 kg/m^3, respectively.

Keywords: Wheat crop, water regimes, nitrogen fertilization, water use efficiency, soil moisture depletion.

INTRODUCTION

Egypt has a finite amount of water that can be used for irrigation. Although it may be possible to increase the supply, it will still be finite at somewhat higher level. So, any procedure that can maximize the use of water in agriculture is of extreme importance to the security and economic welfare of Egypt.

Water is one of the most important inputs essential for crop production. Water affects the performance of crops not only directly but also indirectly by influencing the availability of other nutrients, the timing of cultural operations, etc. Water and other production inputs interact with one another. In proper combinations, the crop yields can be boosted manifold under irrigated agriculture. All applied irrigation water is not absorbed by the plant. Especially during early crop growth, leaching losses may be significant, and at any stage of crop growth it is difficult to provide the exact amount of water used by the crop without inducing some degree of moisture stress. Therefore, to reduce crop stress to a minimum, it is necessary to supply more water than that actually used by the crop (Decheng, 2002).

Irrigation management is very important nowadays in Egypt to determine the optimum water requirements and planning the best irrigation regime with optimum population per area for obtaining maximum yield. More attention was paid to maintain the water resources by minimizing the losses, decreasing the water consumption and cultivating more adapted varieties to water stress (Atta.Allah, 1996). Wise management of irrigation water and nitrogen fertilization is successful tools to achieve high production. There is an urgent necessity to make better use of irrigation water to secure water for newly-reclaimed areas and to avoid high water table hazards as the share of Egypt from Nile river is limited (Kandil, *et al.*, 2001).

Wheat (*Triticum aestivum, L.*) is the most important cereal crop in Egypt. The local consumption of wheat increases each year due to the continuous increase of population. The rapid increase in the Egyptian population has urged more attempts to increase wheat production and improve grain quality to face the great food demands. To increase wheat production efforts should be paid to improve several agronomic practices such as irrigation and fertilization (Metwally, 2000).

Singh *et al.* (1980) reported that the yield of wheat was significantly affected by irrigation water treatments. Maximum yield was obtained with irrigation at 50% depletion of available soil water. Hassanein *et al.* (1986) found that water consumptive use by wheat (cv.Sakha 69) ranged between 32 and to 34.92 cm and the water use efficiency (WUE) were 1.02 and 0.86 kg /m^3 water for the two water regimes, respectively. Nitrogen fertilizer is necessary for increasing the grain yield of wheat by increasing the metabolic process within the plant. Nitrogen is an essential element for the growth and dry matter production of plant. Many reports indicated that nitrogen was the most effective factor in increasing wheat growth and development. Nitrogen usually limits wheat yields more than any other elements. El-Karamity (1998) indicated that increasing nitrogen levels from 60 to 90 and 120 kg N/fed linearly increased plant height, spike length, grain and straw yield of wheat. El-Naggar (1999) revealed that increasing nitrogen levels from 17.5 to 35, 52.5 and 70. kg N/fed increased significantly grain and straw yield, 1000-grain weight at tillering and booting stage. Sarhan and Abdel-Salam (1999) indicated that increasing nitrogen fertilizers levels from 0,35,70 to 105 kg N/fed significantly increased nitrogen uptake by wheat plants.

The main objective of this work is to study the effect of water regimes and nitrogen fertilizer on wheat yield, its quality and water use efficiency under a sprinkler irrigation system.

MATERIALS AND METHODS

A field trial was conducted in 2002/03 winter season at the experimental station, Fac. Agric., Al-Azhar Univ., Assuit Governorate to study the effect of water regimes and nitrogen fertilizer on wheat yield, its quality and water use efficiency under sprinkler irrigation system. The sprinkled plots were irrigated by rotating sprinklers of fixed system with a discharge of 2-5 m3/hr at a working pressure of 500 kPa. The distance between sprinklers and laterals was 12 and 9m, respectively. Risers of 60 cm in height were carrying 2.5 mm nozzles at the beginning of the growing season, and then the riser height was increased to 120 cm with the advance of plant growth till the end of the experiment. The experiment included twelve treatments, which were the combination of three water regimes with four nitrogen fertilizer rates. Split-plot design in three replicates was adopted where water regime treatments occupied the main plots, while nitrogen fertilization rates were allocated in the sub-plots. Each plot (10.5 x 20 m) was bounded by buffer strips 1.5 m wide to avoid the effect of lateral movement of irrigation water. The irrigation treatment consists of three water regimes each of which irrigated whenever the soil moisture depletion (SMD) reaches to 50% of available water. The irrigation treatments were as follows: a) 12 mm water depth x 48 times donated as I_1, b) 24 mm water depth x 26 times donated as I_2 and c) 36 mm water depth x 18 times donated as I_3. The amounts of water were applied to restore available water contents in 0-60 cm soil depth to 60, 70 and 80%, respectively (table, 1). Soil moisture content was followed up using time-consuming technique. Soil of each treatment was sampled to 60 cm depth in 20 cm increments, then air-dried and ground to pass a 2 mm screen. Selected properties of the investigated area were determined according to Klute (1986) and Page (1982) and listed in table (1). Available N, P, K were determined according to Page (1982). Available Fe, Mn and Zn in soil were extracted as described by Soltanpour and Schwab (1977). Available NO3 and NH4 were determined according to Page (1982). Water use efficiency (WUE) was calculated by dividing the grain yield weight (kg/fed) by the seasonal water consumed (m^3/fed) and irrigation efficiency was calculated by dividing the amount of water consumed (mm/season) by the applied water (mm/season) according to Micheal (1978).

Table (1). Some physical and chemical analysis of the studied soil.

a) Physical properties

Soil depth (cm)	Percentage			Texture class	O.M. %	$CaCO_3$%	AW (W/W%)	B.D. (g/cm^3)
	Sand	Silt	Clay					
0 – 20	24.53	39.12	36.35	Clay loam	1.17	3.75	15.8	1.29
20 – 40	26.78	40.85	32.37	Clay loam	0.96	2.62	14.2	1.33
40 – 60	25.82	38.55	35.63	Clay loam	0.65	2.34	12.9	1.45
Mean	25.71	39.5	34.78	Clay loam	0.93	2.9	14.3	1.36

AW = available water B.D. = bulk density

b) Chemical properties

Soil depth (cm)	pH	SP	EC (dS/m)	Soluble ions (m mol_c / L)								SAR	Available nutrients (ppm)					
				CO_3	HCO_3	Cl	SO_4	Ca	Mg	Na	K		N	P	K	Zn	Fe	Mn
0 – 20	7.95	70.0	0.95	0	2.34	1.13	6.03	2.58	1.12	5.69	0.11	4.20	73.2	9.40	341.0	4.30	9.50	8.10
20 - 40	7.85	68.0	0.89	0	2.34	1.13	5.43	3.00	0.50	5.08	0.32	3.80	64.5	9.30	345.0	4.10	9.80	8.50
40 - 60	7.90	68.0	1.61	0	3.12	2.88	10.25	6.69	4.81	4.56	0.19	1.90	55.8	8.80	359.0	3.50	10.30	9.30
Mean	7.90	68.7	1.15	0	2.60	1.71	7.24	4.09	2.14	5.11	0.21	3.30	64.5	9.17	348.3	6.30	9.87	8.63

Wheat (*Triticum aestivum L*) grain of Sakha 69 cultivar was drilled in 15 cm rows at rate of 60 kg/fed on 28th November 2002. Superphosphate (15.5%) was applied prior to planting at a rate of 50 kg/fed. Whereas nitrogen fertilization was applied as ammonium nitrate (33.5%) at rates of 0.0, 60.0, 90.0 and 120.0 kg N /fed denoted as F_0, F_1, F_2 and F_3, respectively. The common agricultural practices for growing wheat were followed as recommended in the region.

Plant samples from each treatment (grain and straw) were dried at 70 °C, ground and digested. Total N, P and K content were determined as described by Page (1982). Micronutrients (Fe, Mn and Zn) were determined using atomic absorption. Plants of one m^2 were harvested from three replicates for each treatment for calculating grain, straw, total yields (kg/fed), harvest index (grain yield/ total yield) and seed index (1000-grain weight). Hard vitreous amber count (HVAC) was estimated from 100 kernels. Protein content (PC) in grains was calculated (N% x 6.25) according to A.O.A.C. (1982). The obtained data were subjected to statistical analysis as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSIONS

a) Yield attributes

Data presented in table (2) show that water regime treatments affected remarkably yield attributes of wheat. General speaking, increasing the applied water to ≈ 80 % of soil moisture depletion (SMD) increased the yield of wheat. Comparing to I_1 treatment (equal ≈ 60 % SMD), straw yield increased by 4.01 and 13.66 % in I_2 and I_3 treatment, respectively.

Table (2). The effect of irrigation and fertilization treatments on wheat yield.

Irrigation treatment	Fertilization treatment (Kg N/fed)	Yield (kg/fed)			Seed index	Harvest index	HVAC
		Straw	Grain	Total			
I_1	0	2025	1979	4004	25.63	49.43	41
	60	2814	2436	5250	33.28	46.40	66
	90	3150	3864	7014	37.18	55.09	71
	120	3486	4074	7560	38.87	53.89	72
	Average	2868.75	3088.25	5957.00	33.70	51.20	62.50
I_2	0	2138	2010	4148	28.15	48.46	39
	60	2948	3486	6434	39.58	54.18	68
	90	3236	4914	8150	41.50	60.29	79
	120	3614	5124	8738	43.12	58.64	82
	Average	2984.00	3883.50	6867.50	38.10	55.40	67.00
I_3	0	2409	2153	4562	30.17	47.19	42
	60	3031	4746	7777	46.32	61.03	88
	90	3276	5334	8610	48.52	61.95	92
	120	4326	5586	9912	50.16	56.36	90
	Average	3260.50	4454.75	7715.25	43.80	56.60	78.00
	LSD 5%	25.6	35.7	44.8	2.364	1.978	3.8

HVAC = hard vitreous amber count

Moreover, the grain yield (kg/fed) jumped from 3088 to 3884 then to 4455 in the corresponding treatments. With respect to the effect of irrigation treatments on total yield (grain + straw), the data in the table (2) show that I_3 treatment was the superior one followed in descending order by $I_2 > I_1$ treatment. The same trend hold true for both seed and harvest indices. Seed index increased by 13.10 and 29.97% and harvest index by 8.18 and 10.61% at I_2 and I_3 treatments, respectively. The same observations were also recorded for hard vitreous amber count value (HVAC).

Regarding the effect of nitrogenous fertilizer rates, the data show that increasing the rate of fertilization increased the wheat yield attributes. Straw yield increased by 33.77, 47.0 and 73.85% at fertilization rate of 60, 90 and 120 kg N/fed, respectively. The grain yield was higher by 73.72, 129.8 and 140.74% at the corresponding N rates. The total yield increased by 53.07, 87.0 and 106.16% and seed index increased by 41.99, 51.54 and 57.43% at the corresponding N rates. Compared to F_0 treatment, HVAC values increased by 80.49, 97.56 and 97.56% at F_1, F_2 and F_3 treatments, respectively.

Compared to F_0 treatment, the data showed that harvest index increased by 11.4, 22.23 and 16.42% in F_1, F_2 and F_3 treatments, respectively. The decline of increasing in F3 may be due to the effect of high dose of nitrogenous fertilizer (120 kg N/fed), which may hasten the time of flowering, consequently the harvesting index decreased as a result of increasing foliage weight (Gaber, 2000).

b) Nutrient content in wheat yield

The effect of irrigation regimes and nitrogen fertilization rates on N concentration on dry matter basis, for grain and straw are shown in table (3). It is worthy to mention that the percentage of nitrogen reflects the change in physiological mechanism of plant, whereas the absolute amount of N per plant would indicate the balance sheet of the element, and show clearly the actual amount absorbed. In wheat grain, the data show that the nitrogen percent increased by 31.62 and 43.38% as the available soil moisture increased to I_2 and I_3, respectively. The same trend was also observed for the concentration of P, K, Zn, and Mn. The higher concentration of such elements in grain yield was recorded for I_3 treatment.

In spite of that, increasing the N fertilization rate from 90 to 120 kg N/fed decreased the concentration of the most tested elements, especially in I_3 treatment. This may be attributed to the high rate of dry matter production in I_3 treatment that consists mainly of carbohydrate material that named as the dilution effect of dry matter.

As a result of increasing nitrogen content in grain yield, the protein content increased by 31.96 and 43.40% at I_2 and I_3 treatment, respectively. In the same connections, El-Kabbany *et al.* (1996) pointed out that the formation and / or the activity of the enzymes responsible for protein synthesis increased as available soil moisture increased. Moreover, Moussa (2000) attributed the effect of soil moisture content on yield of wheat for the slight increase of iron in soil that enhances growth and productivity of plant through its role on the formation of chlorophyll molecule or due to its function as an assistant factor for oxygen carrier for plant through oxidation-reduction processes.

Table (3). The effect of irrigation and fertilization treatments on nutrient content of wheat yield.

Irrigation treatment	Fertilization Treatment (Kg N/fed)	Nutrient in grain						Nutrient in straw						Protein content %
		Percentage			ppm			Percentage			ppm			
		N	P	K	Zn	Fe	Mn	N	P	K	Zn	Fe	Mn	
I_1	0	1.29	0.32	0.39	95	84	32	0.95	0.21	2.30	85	165	40	8.06
	60	1.33	0.44	0.42	100	150	40	1.19	0.22	3.30	88	200	40	8.31
	90	1.37	0.42	0.44	122	200	50	1.19	0.20	2.30	116	250	40	8.56
	120	1.44	0.35	0.45	100	225	50	1.12	0.30	1.70	114	200	60	9.00
	Average	1.36	0.38	0.43	104	165	43	1.11	0.23	2.40	101	204	45	8.48
I_2	0	1.32	0.35	0.42	100	120	38	0.90	0.26	1.65	118	175	45	8.25
	60	1.85	0.44	0.48	120	200	60	0.91	0.33	1.18	142	250	60	11.56
	90	2.05	0.50	0.50	140	225	75	0.33	0.40	1.15	142	300	65	12.81
	120	1.94	0.50	0.48	130	300	63	0.28	0.35	0.68	140	300	63	12.13
	Average	1.79	0.45	0.47	123	211	59	0.61	0.34	1.17	136	256	58	11.19
I_3	0	1.29	0.35	0.44	95	110	36	0.90	0.28	1.70	118	180	45	8.06
	60	2.12	0.70	0.52	140	250	80	0.21	0.40	0.55	152	300	65	13.25
	90	2.39	0.90	0.87	180	300	85	0.18	0.55	0.50	186	300	80	14.94
	120	1.98	0.80	0.52	174	300	80	0.14	0.50	0.40	170	300	75	12.38
	Average	1.95	0.69	0.59	147	320	70	0.36	0.43	0.79	157	270	66	12.16

C) Available nutrient

The data presented in table (4) and illustrated in fig. (1) show the effect of irrigation treatments and fertilization rates on redistribution of some nutrients in the tested soil. Concerning N concentration, the table emphasized two points, 1) the available portions of NO_3 and NH_4 were closely related to fertilization rates, and 2) elongation of the irrigation interval has a positive effect for growth of root mat and consequently, decreases the losses of nitrogen. For example, in I_3 treatment, the plant received only 18 times of irrigation (36 mm water depth of each) that may create favorable conditions for root growth e.i., decreasing physiological disturbance of root. At the same time, such a treatment of I3 may activate the root to render more N at root zone area, consequently decreasing N losses. Thereby, the table shows an accumulation of N (NO_3+NH_4) in I_3 treatment at 20-40 cm soil depth. On the other hand, concentration of P, Zn, Fe and Mn are slightly affected by irrigation and fertilization treatments, (table, 4). This may be because of low solubility of these elements. Meanwhile, K concentration elevated to somewhat. This may be attributed to its high mobility and solubility.

Table (4). Available nutrients after harvesting wheat crop as affect by irrigation treatment and fertilization rates.

Irrigation treatment	Fertilization rate (Kg/fed)	Soil depth (cm)	Available nutrient (ppm) after harvesting wheat crop							
			N-NH4	N-NO3	Total-N	P	K	Zn	Fe	Mn
I_1	0	0-20	11.0	19.0	30.0	8.60	268	3.10	8.40	8.00
		20-40	9.0	18.0	27.0	8.50	291	2.90	8.20	8.20
		40-60	7.0	11.0	18.0	8.60	287	3.00	9.700	8.30
	60	0-20	23.0	112.0	135.0	8.40	312	3.50	8.30	8.60
		20-40	33.0	133.0	166.0	8.60	298	3.70	8.30	8.50
		40-60	42.0	134.0	176.0	8.70	225	3.70	8.70	8.50
	90	0-20	28.0	128.0	156.0	9.00	201	4.10	8.00	8.70
		20-40	36.0	185.0	221.0	9.00	213	3.80	8.10	8.70
		40-60	74.0	210.0	284.0	8.90	234	3.70	8.20	8.80
	120	0-20	50.0	141.0	191.0	8.80	241	4.20	8.70	8.50
		20-40	71.0	189.0	260.0	8.90	254	4.10	8.70	8.40
		40-60	105.0	225.0	330.0	9.00	230	4.00	8.90	8.50
I_2	0	0-20	13.0	20.0	33.0	8.50	258	3.00	7.90	8.20
		20-40	10.0	19.0	29.0	8.60	247	3.20	7.90	8.20
		40-60	7.0	16.0	23.0	8.40	240	3.30	8.40	8.30
	60	0-20	24.0	118.0	142.0	8.80	284	3.20	8.30	8.40
		20-40	36.0	126.0	162.0	8.70	285	3.40	8.50	8.30
		40-60	44.0	146.0	190.0	8.90	262	3.30	8.40	8.40
	90	0-20	31.0	144.0	175.0	9.10	243	3.60	9.00	8.70
		20-40	42.0	168.0	210.0	9.00	238	3.80	8.70	8.80
		40-60	76.0	197.0	273.0	8.90	242	3.70	8.80	8.60
	120	0-20	56.0	105.0	161.0	9.00	259	3.90	9.10	8.00
		20-40	84.0	197.0	281.0	9.00	286	3.90	8.90	8.10
		40-60	132.0	223.0	355.0	8.70	273	3.80	8.90	8.30
I_3	0	0-20	13.0	19.0	32.0	7.90	253	3.00	8.00	7.80
		20-40	11.0	18.0	29.0	7.80	274	3.10	8.10	7.90
		40-60	7.0	14.0	21.0	7.90	281	3.20	8.50	8.00
	60	0-20	27.0	124.0	151.0	8.10	269	3.60	9.00	8.10
		20-40	45.0	186.0	231.0	8.10	280	3.90	8.90	8.10
		40-60	22.0	93.0	115.0	8.00	275	3.80	9.00	8.00
	90	0-20	36.0	155.0	191.0	8.20.	285	4.20	9.20	8.50
		20-40	72.0	267.0	339.0	8.10	280	4.30	9.10	8.50
		40-60	33.0	113.0	116.0	8.10	280	4.20	9.70	8.60
	120	0-20	97.0	124.0	221.0	8.50	263	4.40	8.70	8.40
		20-40	117.0	248.0	365.0	8.40	257	4.40	8.60	8.20
		40-60	54.0	153.0	207.0	8.40	246	4.30	8.80	8.30

d) Water consumption and water use efficiency

The data presented in table (5) show the effect of the studied treatments on water consumption and water use efficiency. It is obvious that the water consumption increased as the available moisture increased in the root zone. The consumed water (mm/season) may be ranked in ascending order as follows: I_1 (375) < I_2 (426) < I_3 (479). The most probable explanation for these findings is that more available soil moisture provided a chance for more luxury water use, which ultimately resulted in increasing transpiration. In the same concern, the amount of water losses were 35, 33 and 26% in I_1, I_2 and I_3 treatments, respectively. These findings illustrate that the amount of water losses can be decreased by increasing irrigation intervals. Also, the recorded data indicate that I_3 treatment (long irrigation interval) produced the highest average of water use efficiency (WUE) value (1.64 kg/m^3) followed by I_2 treatment (1.49 kg/m^3) and I_1 treatment (1.28 kg/m^3).

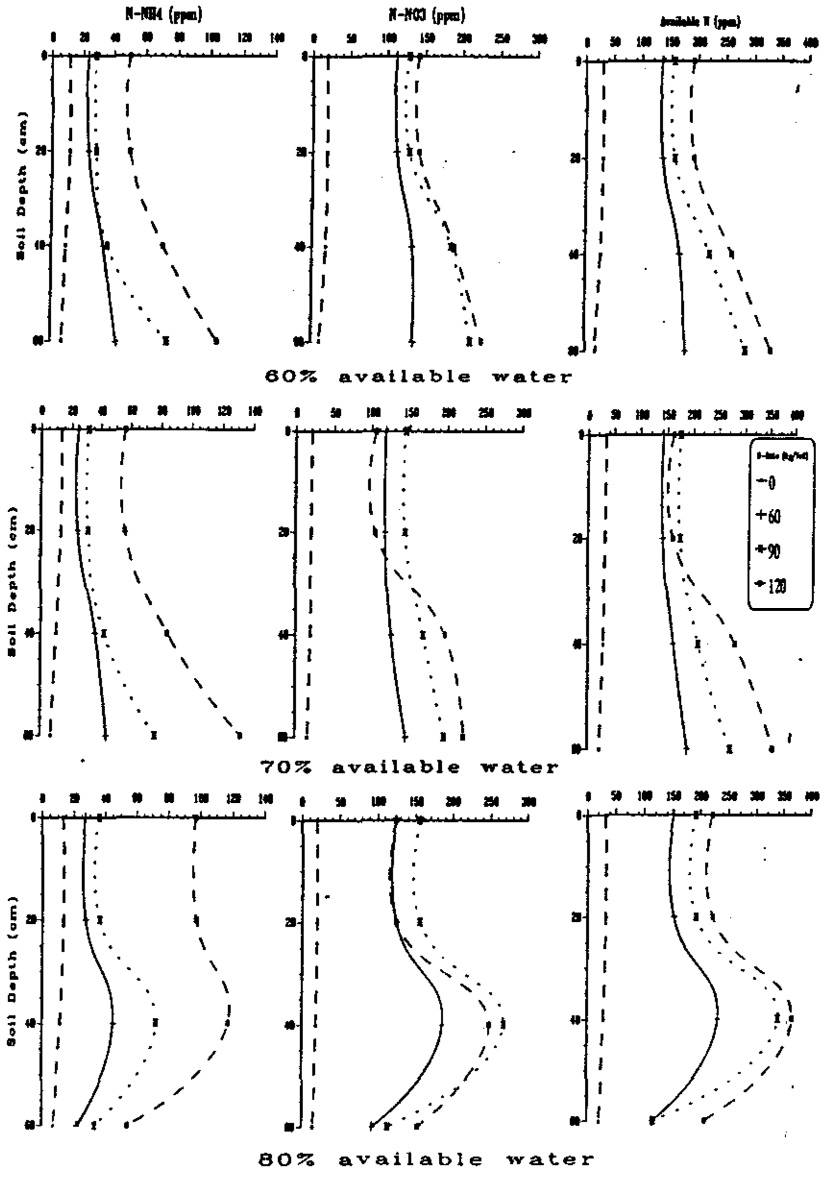

Fig. 1.Nitrogen forms distribution through soil depth in relation to irrigation and nitrogen fertilization rate.

It is worthy to mention that the influence of nitrogenous fertilization rates on WUE values is more pronounced than water regime treatments. The values of WUE for F_0, F_1, F_2 and F_3 treatments were 0.79, 1.36, 1.81 and 1.89 kg/m^3, respectively.

Under the experiment conditions, one could conclude that the irrigation interval had a significant contribution in yield and yield quality of wheat. That is through decreasing disturbance in root mate resulting from increasing irrigation frequency (short interval period). Consequently, prolonged irrigation interval realized low operation costs of sprinkler irrigation system and high water use efficiency as well as minimizing water losses. It worth to mention also that under adequate soil moisture depletion, the fertilization rates was the critical factor controlling yield and water use efficiency of wheat.

Table (5). Irrigation efficiency and water use efficiency as affected by irrigation treatments under sprinkler irrigation.

Irrigation treatment	Fertilization treatment (Kg N/fed)	Consumed water (mm/ season)	Grain		Irrigation efficiency %
			(Kg/fed)	WUE (Kg/m^3)	
I_1	0	375	1979	0.82	65
	60		2436	1.01	
	90		3864	1.60	
	120		4074	1.68	
	Average		3088	1.28	
I_2	0	426	2010	0.77	67
	60		3486	1.33	
	90		4914	1.88	
	120		5124	1.96	
	Average		3884	1.49	
I_3	0	479	2153	0.79	74
	60		4746	1.74	
	90		5334	1.96	
	120		5586	2.05	
	Average		4455	1.64	

REFERENCES

A.O.A.C. (1982). "Official Methods of Analysis". 12th ed. Association Official Agricultural Chemists. Washington, D.C., USA.

Atta Allah, S.A.A. (1996). Effect of irrigation intervals and plant densities on growth, yield and its components of some maize varieties.Proc.7th Conf. Agronomy, Fac. Agric., Mansoura univ., 9-10 sept., vol (1) 59-70.

Decheng, Z.(2002). Water – One of the important factors for sustainable development of agriculture. Sec. Inter. Conf. on Sustainable Agriculture for Food, Energy and Industry, Sept.8-13, 2002, Beijing, China, pp:1969-1970.

El-Kabbany, E.A.Y., M.A. Mahrous, A.A. Hamada and A.A. Darwech (1996). Response of wheat to foliar application of zinc, iron and copper. Proc. 7th Conf. Agronomy, 9-10 Sept., Fac. Agric., Mansoura Univ., vol 1:1-9.

El-Karamity, A.E.(1998).Response of some wheat cultivars to seeding and N-fertilization rates.J.Agric. sci., Mansoura Univ., 23(2):643-655.

El-Naggar, S.M.A. (1999). Efficiency use of bio and chemical fertilization on wheat. Ph.D. thesis, Fac. Agric., Mansoura Univ., Egypt.

Gaber, A.M. (2000). Water consumptive use, water use efficiency and production of some wheat varieties. Egypt. J. Soil Sci. 40 NO. 4, pp. 545-556.

Hassanein, S.A., A.M. El-Bershamgy and S.A. Abdel-Hafez (1986). Effect of water regimes on wheat water consumptive use and its water use efficiency. Agric. Res. Review 64 (4): 609-616.

Kandil,S.A.,M.S.A. Abo-El-Kheir and H.A.El-zeiny.(2001). Response of some wheat cultivars to water stress imposed at certain growth stages. Egypt. J. Appl. Sci., 16(1): 82-98.

Klute, A.(Ed.). (1986). "Methods of Soil Analysis". Part I: Physical and Mineralogical Methods, (2nd Ed.), Agron. 9: A.S.A., Inc., Madison, Wisc., USA.

Metwally, S.G. (2000). Fertilizer use efficiency of wheat as affected by microbial inoculation and soil conditions. Ph.D. Thesis, Fac. Agric., Mansoura Univ., Egypt.

Micheal, A.M. (1978). "Irrigation Theory and Practice". Vikas Publishing House, New Delhi, India.

Moussa, B.I.M. (2000). Response of wheat plants grown in sandy soils to K and some micronutrients fertilization. Egypt. J. Soil Sci. 40, No. 4, pp. 481-493.

Page, A.L.(Ed.). (1982). "Methods of Soil Analysis", part 2: Chemical and Microbiological Properties, (2nd ed). Soil Sci. Soc. Am. Inc., Madison, USA.

Sarhan,S.H. and Abdel-Salam,H.Z.(1999). Effect of soil salinity, nitrogen fertilization and their interactions on wheat plant.J.Agric.Sci.Mansoura univ., 24(4):2071-2075.

Singh, G., Singh, P.N. and Bhushan, L.S. (1980). Water use and wheat yields in northern India under different irrigation regimes. Agric. Water management, 3:107-114.

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods, 7th ed. Iowa State Univ. Press, Iowa, USA.

Soltanpour, P.N. and A.R. Schwab (1977). A new soil test for simultaneous extraction of macro- and micro-nutrients in alkaline soils. Comm. In Soil Sci. and Plant Anal. 8, 195

الإدارة المائية والتسميد لمحصول القمح تحت نظام الرى بالرش

على سيد على عبدالموجود*، سمير عبدالظاهر الجندى**، محمد سعيد عواد**، صبرى أمين محمد حجاب*
* قسم علوم الأراضى والمياه – كلية الزراعة – جامعة الأزهر – أسيوط– مصر
** معهد بحوث الأراضى والمياه والبيئة – مركز البحوث الزراعية – الجيزة– مصر

أجريت تجربة حقلية بمحطة البحوث الزراعية، كلية الزراعة، جامعة الأزهر بأسيوط خلال الموسم الزراعى ٢٠٠٣/٢٠٠٢ تحت نظام الرى بالرش لدراسة تأثير مستويات مختلفة من الرطوبة الأرضية والتسميد النيتروجنى على محصول القمح ونوعيته وكفاءة استخدام المياه.

وقد أوضحت النتائج أن زيادة الماء المضاف الى حوالى ٨٠% من الرطوبة الميسرة المفقودة (SMD) أدى الى زيادة محصول القمح. ومقارنة مع معاملة الرى I_1 (حوالى ٦٠% من SMD)، فإن محصول القش قد زاد بنسبة ٤,٠١ ، ١٣,٦٦% فى معاملات الرى I_2 ، I_3 على الترتيب.بينما قفز محصول الحبوب الى ٣٠٨٨، ٣٨٨٤ ، ٤٤٥٥ كجم / للفدان فى المعاملة I_1، I_2 ، I_3 على الترتيب. وقد زاد دليل البذور بحوالى ١٢,٨٩، ٢٩,٧٩ ودليل الحصاد بحوالى ٨,١٨، ١٠,٦١ فى معاملات الرى I_2 ، I_3 على الترتيب مقارنة بمعاملة الرى I_1. وقد زاد محصول القش بنسبة ٣٣,٧٧، ٤٧,٠، ٧٣,٨٥% عند معدل تسميد نيتروجنى ٦٠، ٩٠، ١٢٠ كجم / فدان على الترتيب. بينما كان محصول الحبوب أعلى بنسبة ٧٣,٧٢، ١٢٩,٨، ١٤٠,٧٤% عند نفس المعدلات السابقة مقارنة مع الكنترول (بدون إضافة). وكانت نسبة الزيادة فى المحصول الكلى ٥٣,٠٧، ٨٧,٠، ١٠٦,١٦% ودليل البذور زاد بنسبة ٤١,٩٩، ٥١,٥٤، ٥٧,٤٣% عند معدل تسميد نيتروجنى ٦٠، ٩٠، ١٢٠ كجم / فدان على الترتيب. وقد زادت نسبة النيتروجين فى الحبوب بحوالى ٣١,٦٢، ٤٣,٣٨ عند زيادة المحتوى الرطوبى الميسر الى I_2 ، I_3 على الترتيب. وقد أدى هذا الى زيادة المحتوى البروتينى بنسبة ٣١,٩٦، ٤٣,٤٠% عند نفس معاملات الرى السابقة. ويمكن ترتيب كمية المياه المستهلكة (مم / موسم) كالآتى I_1 (٣٧٥)، I_2 (٤٢٦)، I_3 (٤٧٦). وكانت نسبة كمية المياه المفقودة حوالى ٣٥، ٣٣، ٢٦% تحت معاملات الرى I_1، I_2 ، I_3 على الترتيب. وقد أظهرت معاملة الرى I_3 (أطول فترة بين الريات) أعلى كفاءة لاستخدام المياه حيث كانت ١,٦٤ كجم / م٣ مياه بينما كانت ١,٤٩ كجم / م٣ مياه فى معاملة الرى I_2 ، وكانت ١,٢٨ كجم / م٣ مياه فى معاملة الرى I_1. وكانت قيم كفاءة استخدام المياه تحت معاملات التسميد النيتروجينى ٠، ٦٠، ٩٠، ١٢٠ كجم ن / فدان ٠,٧٩، ١,٣٦، ١,٨١، ١,٨٩ كجم / م٣ مياه على الترتيب.