RESPONE OF WHEAT PRODUCTIVITY TO DIFFERENT LEVELS OF SOIL MOISTURE REGIME AND MINERAL NITROGEN FERTILIZATION UNDER THE NILE ALLUVIAL SOILS.

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ABSTRACT

A field experiment was conducted during two successive seasons of 2004/2005 and 2005/2006 at Sids Agric. Res. Station Beni-Suef to study the response of wheat yield (grain and straw yields), its components (number of spike/m^2, number of grains/spike, grains weight/spike and 1000-grain weight), water consumptive use (WCU) and water use efficiency (WUE) to three levels of moisture regime (irrigation at 25-30, 50-55 and 75-80% of available soil moisture depletion) and nitrogen (50,75 and 100 kg N/fed.) under the prevailing conditions of the clayey Nile alluvial soil.

The most important results could be summarized as follows:

1- Irrigating the soil at 50-55% depletion of the available water range (SMD) produced the greatest values of number of spike/m^2, number of grains/spike, grains weight/spike, 1000-grain weight, grain yield and water use efficiency.
2- The highest values of straw yield and water consumptive use were recorded when plants subjected to irrigate at 25-30% SMD.
3- Increasing nitrogen levels up to 100 kg/fed. produced high increases in each of the studied plant characters as well as improved water consumptive use and water use efficiency.

Key words: Wheat, yield components, water consumptive use, water use efficiency.

INTRODUCTION

Wheat is the most important cereal crops in Egypt and many other parts of the world. Egypt is facing a considerable gab between its national production and consumption. The policy of the country aims to raising wheat production so as to meat the increase demand of the local consumption. The total annual national production of wheat can be increased by using the appropriate agricultural practices such as irrigation and fertilization.

Irrigation is considered one of the most important factors that play the greatest role in crop production. Water constituting higher percentage of the fresh weight of most herbaceous plant parts.

Fertilizer efficiency can be reduced by about 10-20% due to insufficient irrigation or drainage **(Ali-Maha, 2007).** Decreasing soil moisture content accompanied by loss of turgor and wilting, cessation of cell enlargement and reduction of photosynthesis. Grains weight/spike, 1000-grain weight, No. of spike/m^2 and No. of grains/spike are the most affected yield components for wheat production. **Zhang, and Rajaram (1994) and Menshawy *et al.* (2006)** found that grain and straw yields, number of kernels per spike, biomass and plant height and 1000-kernel weight were negatively affected by water stress. In this respect, **El-Hawary (2000)** indicated that increasing depletion of available soil moisture before irrigation caused a significant decrease in number of wheat spikes/m^2, weight of grains/spike, 1000-grain weight and grain and straw yields of wheat. While, **Hussein- Magda and El-**

Mahgoby (2006) reported that the maximum wheat production was obtained at soil moisture at 60% of field capacity.

The maximum value of water use efficiency was obtained at 45% SMD **(El-Sabbagh *et al,* 2002)** or 75 % SMD **(Abd- Allah,2003). Moussa and Abdel- Maksoud (2004)** stated that water consumptive use (WCU) for wheat was significantly increased as water stress increased.

Nitrogen is an essential element for plant growth and maintenance, since it is considered as a key nutrient in crops production. Many workers mentioned the importance of nitrogen for wheat such as **Singh and Brar (1994), Hassan and Gaballah (2000) and Salem (2005)** for No. of grains/spike and No of spikes/m^2 and **Ismail *et al.* (2006)** for grain and straw yields. Moreover **Galal (2007)** reported that grains weight/spike, 100- grain weight and grain and straw yield were significantly increased by increasing nitrogen levels.

Garabet *et al.* (1998), and Tamaki *et al.* (1999) stated that yields of wheat were increased by irrigation and N fertilizer application. Further-more, **Karim *et al.* (1997)** indicated that the highest yield of wheat was recorded under 35% depletion of soil available water with application of 120 kg N/ha.

In fact, nitrogen fertilizer is established to increase the water use efficiency of wheat. The additional N enables the crop to cover the ground quicker and develop a dense leaf canopy, resulting in reduced soil evaporation and better water use efficiency **(Holland *et al.* 1999).**

The objective of the present study was to evaluate the effect of different soil moisture regimes on yield and its components as well as water use efficiency and water consumptive use under different nitrogen rates for wheat crop.

MATERIALS AND METHODS

A field experiment was conducted during two successive seasons of 2004/2005 and 2005/2006 on wheat crop at the Experimental Farm of Sids, Agricultural Research Station, Beni Suif Governorate, Egypt.

The experimental soil site is clay loam in texture, with water table depth of more than 150 cm. Soil water constants were determined according to **Klute (1986)**, and are shown in Table (1).

The split plot design was adopted with four replicates, and the plot area was 1/100 fed. (7 m length and 6 m width).The main plots were occupied with soil moisture regimes, while sub-plots were devoted to nitrogen levels as follows:

1- Main plots:

I_1- Soil irrigated when moisture content reached 25-30% of the available water range.

I_2- Soil irrigation when moisture content reached 50-55% of the available water range.

I_3- Soil irrigation when moisture content reached 75-80% of the available water range.

2- Sub plots:

F_1 – 50 kg N/fed.

F_2 – 75 kg N/fed.

F_3 – 100 kg N/fed.

Wheat seeds (*Triticum aestivum*, cv. Beni Suif 1) were planted during the last week of November in both seasons. Nitrogen treatments were added in the form of urea (46.5% N) studied at two equal doses, the first was applied before the first irrigation and the second one was added three weeks later. Phosphor us was as added calcium superphosphate (15.5% P_2O_5) at a rate of 15.5 kg P_2O_5/fed. Potassium, as potassium sulphate (48 % K_2O), was being added after seed sowing and before irrigation at a rate of kg K_2O/fed.

Table (1). Field Capacity, wilting point, and available water content of the soil at the experimental soil.

Season	Soil depth (cm)	Field capacity (%)	Wilting point (%)	Available soil moisture (%)	Bulk density (g/cm^3)
2004/2005	0-15	44.56	22.17	22.39	1.17
	15-30	37.09	17.66	19.43	1.30
	30-45	35.55	16.92	18.63	1.36
	45-60	33.19	15.80	17.39	1.38
Mean		38.10	18.14	19.46	1.301
2005/2006	0-15	42.40	20.00	22.40	1.18
	15-30	35.90	18.80	17.10	1.24
	30-45	33.45	15.00	18.45	1.25
	45-60	31.71	14.50	17.21	1.43
Mean		35.86	17.08	18.79	1.276

Applied water was controlled throughout modified surface irrigation with gated pipes by the use of valve for each plot and water measured by measuring meter **(Table, 2).**

The studied plant characters were number of spikes/m^2, number of grains/ spike, grain weight/spike (g), 1000- grain weight (g), grain yield (ardab/fed) and, straw yield (ton/fed.) as well as water consumptive use (WCU m^3/fed)and water use efficiency (WUE, kg/m^3)

Water consumptive use (WCU) was calculated according to **Doorenbos *et al.* (1979)** as the following equation :-

$$WCU = \frac{Q_2 - Q_1}{100} \times B_d \times d$$

Where :-

C.U. = Actul water consumptive use in cm .

Q_2 = Soil moisture content after 48 hours from irrigation (%).

Q_1 = Soil moisture content befor irrigation (%).

B_d = Bulk density of the specified soil layer (g/cm^3).

d = Depth of soil layer (cm).

Water use efficiency (WUE) was calculated according to **Doorenbos and Pruitt (1984)** as follow:-

$$\text{WUE for grain yield} = \frac{\text{Grain yield in kg/fed}}{\text{Water consumptive use in m}^3\text{/fed}}$$

Data were statistically analyzed according to Snedecor and Cochran (1980).

Table (2). Date of sowing of irrigation water (Q) and accumulation water applied (cm) under different soil moisture in seasons of 2004/2005 and 2005/2006.

Irrigation regimes	Sowing date	1st Irrig.	2nd Irrig.	3rd Irrig.	4th irrig	5th Irrig.	6th Irrig.	Water Applied (cm)
				2004/2005				
Date I_1	2/12	25/12	21/1	11/2	3/3	22/3	9/4	
Q (cm)	10.71	5.36	8.60	11.07	11.88	10.95	9.76	68.33
Date I_2	2/12	25/12	31/1	25/2	20/3	11/4	-	
Q (cm)	10.17	5.36	9.10	12.36	12.12	11.67	-	60.78
Date I_3	2/12	25/12	8/2	9/3	6/4	-	-	
Q (cm)	10.71	5.36	10.30	14.61	13.66	-	-	54.64
				2005/2006				
Date I_1	22/11	14.12	10/1	1/2	22/2	13/3	30/3	
Q (cm)	11.31	5.59	8.21	10.83	11.90	10.76	9.28	67.88
Date I_2	22/11	14.12	21/1	16/2	11/3	1/4	-	
Q (cm)	11.31	5.59	9.01	12.11	11.96	11.43	-	61.41
Date I_3	22/11	14.12	28/1	1/3	27/3	-	-	
Q (cm)	11.31	5.59	10.23	14.46	13.52	-	-	55.11

RESULTS AND DISCUSSION

1- Number of spikes/m^2

Data presented in Table (3) showed the response of number of spikes/m^2 in the two growing seasons to soil moisture regime, as expressed by water quantity for the applied irrigations, and nitrogen levels. The results reveal that number of spikes/m^2 reached their greatest values of (360.8 and 357.7, as mean values), when wheat plants watered at 50-55 %, soil moisture depletion (SMD, I_2) in the two studied seasons, respectively. On the other hand the relatively high level of depletion (I_3 at 75- 80 SMD) recorded the lowest number of spikes/m^2 (346.9 and 349.5) as mean values in both seasons, respectively. It is obvious to notice that irrigation treatment at 50-55 SMD surpassed the other two treatments, i.e. I_1 and I_3 by about 1.7 and 1.05% in the first season. The same trend was obtained in the second one. It is worthy to mention that number of spikes per m^2 was the most important yield component determining final yield. Similar results were obtained by **El-Hawary (2002).**

As for nitrogen levels, the results clearly show that number of spikes/m^2 was significantly increased as nitrogen level increased up to 100 kg N/fed. The relative increase percentages due to added 75 and 100 kg N/fed was 2.9 and 6.7% as compared with recieved 50 kg N/fed in the first season, respectively. The corresponding values for the second season were 2.3 and 4.9%, respectively. The positive effect of N on this traits may be due to the increase in number of tillers/m^2. Similar results were obtained by **Hassan and Gaballah (2000).**

With regard to the effect of the interaction between soil moisture and nitrogen treatments, data clearly show that number of spikes/m^2 of wheat plants not affected by irrigation x nitrogen interaction. It could be noticed that irrigation of wheat plant at 50-55% depletion of the available soil moisture and supplied with 100 kg N/fed gave the best values of spikes/m^2.

2- Number of grains/spike

Data in Table (3) show that soil moisture regime and nitrogen treatments significantly affected the number of grains/ spike in the two growing seasons. Irrigation at 50-55 SMD (I_2) possessed the greatest values of number of grains per spike when compared with the two other irrigation treatments, i.e. 25-30 and 75-80 SMD. It is noticed that the differences in number of grains/spike for by I_1 and I_3 treatments were in significant in both seasons. The decrease of number of grains/spike due to on increase or reduce of soil moisture than 50-55% SMD may be attributed to the florets death at the terminal and basal ends of spike. This is probably due to male sterility caused by invariable water application **(Saini and Aspinall, 1981).** These results are in harmony with those obtained by **Singh and Brar (1994).**

Concerning the influence of nitrogen fertilization on number of grains/spike, the results indicate that wheat plants received nitrogen fertilizer level of 100 kg N/fed recorded significant increases of grains/spike (60.6 and 58.1 in both season, respectively) compared with those received 50 (56.4 and 55.1) or 75 (8.5 and 56.6) in the two studied seasons, respectively. The decrease in number of grains/spike due to reducing nitrogen levels is more attributed to the effect of nitrogen deficiency on spike fertility. These results agree with those obtained by **Hassan and Gaballah (2000) and Salem (2005)** who reported that number of grains/spike decreased with decreasing nitrogen levels.

The interaction between soil moisture regime and nitrogen fertilization had no significant effect on this plant character. It could be concluded that the highest number of grains per spike was obtained as a result of irrigation at 50-55% SMD (I_2) under use of 100 kg N/fed.

Table (3). Effect of soil moisture regime under nitrogen fertilization on number of spikes/m^2 and grains/spike.

Soil moisture regime(I) % SMD	N levels (F) kg/fed	No. of spikes/m^2		No. of grains/spike	
		2004/2005	2005/2006	2004/2005	2005/2006
I_1	F_1	343.8	342.3	53.8	53.0
	F_2	356.5	352.5	56.0	53.8
	F_3	362.0	360.3	58.5	55.0
Mean		354.1	351.4	56.1	53.9
I_2	F_1	349.8	350.8	63.5	61.0
	F_2	357.3	355.3	64.5	63.8
	F_3	375.3	367.0	66.5	65.8
Mean		360.8	357.7	64.8	63.5
I_3	F_1	335.3	340.3	51.8	51.3
	F_2	344.5	349.5	55.0	52.3
	F_3	361.0	357.3	56.8	53.3
Mean		346.9	349.0	54.5	52.4
Mean of nitrogen levels	F_1	343.0	344.5	56.4	55.1
	F_2	352.8	352.4	58.5	56.6
	F_3	366.1	361.5	60.6	58.1
L.S.D at 5 %	Irrig.(I)	5.57	1.92	1.89	1.77
	Ferti. (F)	5.94	3.71	1.97	1.86
	I X F	N.S	N.S	N.S	N.S

3- Grain weight / spike

Data presented in Table (4) show the response of grains weight per spike to irrigate and nitrogen levels in the two seasons. The results indicate that grains weight / spike markedly increased by increasing the amount of available water in the soil. The relative increases of grains weight/spike yielded by irrigation at 50-55% SMD, however the corresponding values, reached to 5.8 and 10.8 % compared with $I_1$and I_3 in the first season. As well as 8.6 and 13% in the second season, respectively. This finding might be attributed to the increase in all metabolism processes in plant organs under favorable water regimes. These results are in line with those obtained by **El-Hawary (2000).**

With respect to nitrogen fertilization, the results clearly show that increasing nitrogen levels up to 100 kg N/fed led to a significant increase in grain weight/spike in both seasons. The increase percentages of grains weight/spike due to added 100 kg N/fed reached 20.1 and 10.1% when compared with added 50 and 75 kg N/fed in the first season, respectively. The same trend was observed in the second season. The obtained results could be attributed to the role of nitrogen as the most important nutrient for plant growth and grain development. These results are similar to those obtained by **Galal (2007).**

Concerning the interaction between soil moisture regime and nitrogen treatments, the results show that grains weight/spike not affected by the interaction between the two studied treatments. In general, the greatest value of grains per spike was produced by watered when 50-55 % of soil available water was depleted and fertilized with 100 kg N/fed.

Table (4). Effect of soil moisture regime under nitrogen fertilization on grain weight / spike and 1000- grain weight.

Soil moisture regime (I) % SMD	N levels (F) kg/fed	Grains weight/ spike (g)		1000- grain weight (g).	
		2004/2005	2005/2006	2004/2005	2005/2006
I_1	F_1	4.52	4.01	49.8	47.8
	F_2	4.77	4.29	52.3	50.0
	F_3	5.23	4.89	54.4	52.7
Mean		4.84	4.40	52.2	50.2
I_2	F_1	4.62	4.25	56.0	53.9
	F_2	5.05	4.65	58.3	56.8
	F_3	5.69	5.44	60.1	57.9
Mean		5.12	4.78	58.1	56.2
I_3	F_1	4.14	3.87	45.9	43.5
	F_2	4.67	4.12	49.2	49.4
	F_3	5.05	4.70	50.8	49.8
Mean		4.62	4.23	48.6	47.6
Mean of nitrogen levels	F_1	4.43	4.04	50.6	48.4
	F_2	4.83	4.35	53.3	52.1
	F_3	5.32	5.01	55.1	53.5
L.S.D at 5 %	Irrig.(I)	0.20	0.15	2.29	1.23
	Ferti (F)	0.13	0.19	0.95	1.33
	I X F	N.S	N.S	N.S	N.S

4- 1000-grain weight

Data in Table (4) show the effect of soil moisture regime and nitrogen treatments on 1000-grain weight. The results reveal that plants received 50-55%

SMD exhibited a significant increase in 1000-grain weight compared with the other two soil moisture regimes, i.e. 25-30 and 75-80% SMD. An increase in 1000-grain weight caused by increasing soil available moisture at 50-55% SMD which to 19.5 and 24.9% an compared 10 I_1 and I_2 in the two seasons, respectively. The decreace in the later two soil moisture regime levels may be due to the deficiency of water during grain filling period of wheat plants caused a reduction in 1000-grain weight. These results agree with those obtained by Menshawy *et al.*(2006).On the other hand, an excess of water, i.e. from 50-55 to 25-30% SMD may be caused a dilute or lose of soil nutrients by leaching, which in turn reduce of grains weight.

As for nitrogen levels, the results clearly reveal that 1000-grain weight was significantly affected by increasing nitrogen levels. The highest values of 1000-grain weight were exhibited under 100 kg N/fed. (55.1and 53.5g in both seasons, respectively) followed by 75 kg N/fed. (53.3 and 52.1g in the same respect). The increases in 1000-grain weight associated with increasing nitrogen levels, are mostly due to the effect of nitrogen on grains weight/spike as mentioned before in the same table. These results agree with those obtained by **Galal (2007).**

The interaction between irrigation and nitrogen treatments did not affected the 1000-grain weight. The greatest 1000-grain was recorded for wheat plants irrigated when 50-55% of available soil moisture depleted and fertilized with 100 kg N/fed..

5- Grain yield

Grain yield as affected by soil moisture regime and nitrogen treatments are presented in Table (5). The results clearly show that grain yield (ardab/fed) was found to be appreciably influenced by water regimes in both seasons. Wheat plants irrigated (when 50-55% of available soil moisture was depleted) had significantly higher grain yield than the two other irrigation treatments, i.e. 25-30% and 75-80% SMD. It could be observed that the increases of grain yield under 50-55% SMD was 9.4 and 13.2% when compared with 25-30 and 75-80% SMD, respectively in the first season. The corresponding values for the second season were 12.52 and 17.38%, respectively. It is worthy to notice that the difference between the effect of 25-30 and 75-80% SMD on grain yield not significant in both seasons. Such increase in grain yield caused by 50-55% SMD treatment was mainly due to its effect on yield components, e.g. number of spike/m^2, number of grains/spike, grains weight/spike and 1000-grain weight as discussed before in Tables (3 and 4). In addition, irrigated wheat plants at the suitable amount (50-55% SMD) decreased the osmotic pressure of soil solution and consequently increased water and minerals uptake by growing wheat plants. These resulted agree with those obtained by **Hussein Magda and El-Mahgoby (2006)** who reported that the maximum wheat production was obtained at soil moisture of 60% of field capacity.

As for nitrogen fertilization, it is clear from Table (5) that the grain yield of wheat plant was significantly affected by nitrogen fertilization. Increasing the level of N up to 100 kg/fed caused a significant increase in grain yield. The relative increase percentages of grain yield due to application of 100kg N/fed. was 32.4 and 16.7% over 50 and 75 kg N/fed. in the first season. The same trend was obtained in the second season. The positive effect of nitrogen application is expected, since nitrogen is considered an essential major element found in both inorganic and organic forms in the plant that combined with C,H.O and sometimes S to form amino acids, amino enzymes, nucleic acids, chlorophyll, alkaloids and purine bases; organic N predominates as high molecular weight proteins in plants. Meanwhile, most soil of Egypt are poor in available nitrogen. Therefore, it could be concluded that, application of 100 kg N/fed. produced the highest grain yield of wheat plants grown on clay soil. These results are in a good agreement with those obtained by **Ismail *et al.* (2006).**

The interaction between soil moisture regime and nitrogen levels did not affected the grain yield of wheat plants. The highest grain yield was exerted for the plants irrigated at 50-55% SMD and received 100 kg N/fed.

Table (5). Effect of soil moisture regime and nitrogen fertilization on grain and straw yields.

Soil moisture regime (I) SMD%	N levels (F) kg/fed.	Grain yield (ardab/fed.)		Straw yield (ton/fed.)	
		2004/2005	2005/2006	2004/2005	2005/2006
I_1	F_1	18.55	17.40	3.44	3.06
	F_2	21.40	18.87	3.70	3.23
	F_3	24.85	21.73	3.95	3.52
Mean		21.60	19.33	3.70	3.27
I_2	F_1	20.16	19.85	3.36	2.93
	F_2	24.07	22.07	3.58	2.97
	F_3	26.67	23.33	3.87	3.34
Mean		23.64	21.75	3.60	3.08
I_3	F_1	17.97	16.47	3.20	2.60
	F_2	21.13	18.40	3.37	2.97
	F_3	23.53	20.72	3.66	3.18
Mean		20.88	18.53	3.41	2.92
Mean of nitrogen levels	F_1	18.90	17.08	3.33	2.86
	F_2	21.20	19.78	3.55	3.06
	F_3	25.02	21.92	3.83	3.34
L.S.D. at 5%	**Irrig.(I)**	1.12	0.89	0.03	0.06
	Ferti.(F)	0.74	0.69	0.02	0.18
	I X F	N.S	N.S	N.S	N.S

6- Straw yield

Straw yield as affected by soil moisture regime and nitrogen treatments are presented in Table (5). The results reveal that straw yield of wheat plant was significantly responded to irrigation treatments. Plants received the high amount of water, i.e. at 25-30% SMD exhibited the greatest straw yield in both seasons, and then gradually decreased as increasing water stress (50-55 and 75-80% SMD). The negative effect on straw yield caused by water stress could be explained on the basis of the loss of turgor, which affects the rate of cell expansion and intimate cell size **(Kramer and Boyer, 1995).** These results are similar to those obtained by **Menshawy *et al.* (2006).**

Regarding nitrogen levels, data show that straw yield of wheat plant was significantly affected by nitrogen levels in both seasons. Increasing nitrogen levels from 50 to 75 and 100 kg /fed increased straw yield in two growing seasons. Added 100 kg N/fed yielded a straw yield surpassed that caused by added 50 and 75 kg N/fed. by about 15.0 and 7.9% in the first season and 16.78 and 9.2% in the second season, respectively. These results, which were similar to the results of grain yield, emphasized that 100 kg N/fed is the favorable nitrogen dose of wheat production in clay soil. The improvement of wheat straw caused by increasing nitrogen level may be attributed to the increase in meristimatic activity as a result of N application, hence increase the number of cells in wheat plant. Thse findings are in accordance with those obtained by **Ismail *et al.* (2006) and Galal (2007).**

As for the interaction, the data show that straw yield did not affected by the interaction between the two studied treatments. The highest straw yield was produced by the plans irrigated at 25-30% SMD and supplied with 100 kg N/fed.

7- Water consumptive use (WCU)

Water consumptive use is defined as the water lost from the plant organs, specially leaves surface and namely transpiration, besides that evaporated from the soil surface during the entire growing season. The data in Table (6) represent the effect of irrigation and nitrogen treatments on water consumptive use in the two growing season and its average. The results clearly show that values of WCU were gradually increased as irrigation regime increased (the depletion of soil moisture decreased).The relative increases of WCU caused by 25-30% SMD treatment reached to 22.6 and 37.0% in comparison with 50-55 and 75-80% SMD treatments in the first season, respectively. The same trend was obtained for the second season and the average values for the two seasons. These results is mostly explained by the more available soil moisture under 25-30%SMD led to enhance both transpiration from plant leaves and evaporation from soil surface. Similar results were obtained by **El-Sabbagh *et al.* (2002) and Moussa and Abdel- Maksoud (2004)** who reported that water consumptive use increased as irrigation regime increased.

Table (6). Water consumptive use (WCU, m^3/fed.) as affected by soil moisture regime and nitrogen levels in 2004/2005 and 2005/2006 growing seasons.

Irrigation (I) SMD%	N levels (F) kg/fed.	WCU (m^3/fed.) 2004/2005	2005/2006	Mean
I_1	F_1	2122.3	1985.9	2054.1
	F_2	2218.7	2066.7	2142.7
	F_3	2335.6	2170.1	2252.9
Mean		2225.5	2074.2	2149.8
I_2	F_1	1635.6	1584.5	1610.1
	F_2	1877.2	1696.7	1786.9
	F_3	1932.8	1780.2	1856.5
Mean		1815.2	1687.1	1751.2
I_3	F_1	1501.9	1376.7	1439.3
	F_2	1661.3	1511.8	1586.6
	F_3	1711.7	1575.6	1643.7
Mean		1624.9	1488.3	1556.5
Mean of nitrogen levels	F_1	1753.3	1649.1	1701.2
	F_2	1919.1	1758.4	1838.8
	F_3	1993.4	1841.9	1917.7

With regard to nitrogen levels, the results indicate that nitrogen fertilization had a positive effect on water consumptive use in both seasons. Increasing nitrogen levels up to 100 kg/fed increased WCU. The increase percentages in WCU all over the two seasons due to added 100 kgN/fed were 12.7 and 4.3 as compared with 50 and 75 kg N/fed, respectively. The increment of WCU, caused by increasing nitrogen levels, is mainly due to the high yielding of wheat grain and straw as well as increased the root system which need excess of water, besides the increase of water transpiration from the succulent leaves caused by high nitrogen level.

8- Water use efficiency (WUE)

Water use efficiency, in the present work, means kgs of wheat grains produced due to m^3 of consumed water. The data in Table (7) illustrated the water use efficiency as influenced by irrigation and nitrogen treatments. The results reveal that irrigated wheat plants at 50-55% SMD improved the water use efficiency in the two growing seasons and all over the two seasons. Each cubic meter of water yielded 1.95 and 1.93 kg grains when plants irrigated at 50-55% SMD in both seasons, respectively. On the other hand, plants irrigated when soil moisture depletion reached 25-30 and 75-80% SMD yielded 1.45 and 1.92 kg grains for one cubic meter of water, respectively in the first season. The corresponding values for the second season were 1.39 and 1.89 kg grains/m^3 water, respectively. It is worthy to notice that the values of WUE caused by 50-55% and 75-80% SMD are somewhat similar, which means that WUE increased as increasing soil moisture depletion. This finding may be due to the more available soil moisture through decreasing the depletion of the available soil moisture, i.e. 25-30% SMD give a chance for more consumption of water ultimately resulted in increasing transpiration, besides the high evaporation from soil surface. These results are in harmony with those obtained by **El-Sabbagh *et al.* (2002).**

Table (7). Water use efficiency (WUE kg grains/m^3) as affected by soil moisture regime and nitrogen levels in 2004/2005 and 2005/2006 growing seasons.

Irrigation (I) SMD%	N levels (F) kg/fed.	WUE (Kg grains/m^3) 2004/2005	2005/2006	Mean
I_1	F_1	1.31	1.31	1.31
	F_2	1.45	1.37	1.41
	F_3	1.60	1.50	1.55
Mean		1.45	1.39	1.42
I_2	F_1	1.85	1.88	1.87
	F_2	1.92	1.95	1.94
	F_3	2.07	1.97	2.02
Mean		1.95	1.93	1.94
I_3	F_1	1.80	1.80	1.80
	F_2	1.91	1.83	1.87
	F_3	2.06	1.97	2.01
Mean		1.92	1.87	1.89
Mean of nitrogen levels	F_1	1.65	1.66	1.66
	F_2	1.76	1.72	1.74
	F_3	1.91	1.81	1.86

As for nitrogen fertilization, the results indicated that the water use efficiency was gradually increased as nitrogen levels increased. Each m^3 of water produced 1.91 kg grains under 100 kg N/fed in the first season, while one cubic meter of water yielded 1.65 and 1.76 kg grains of wheat under 50 and 75kg N/fed in the first season. A similar trend was obtained in the second season and for the average of the two growing seasons. In this respect, **Holland *et al.* (1999)** mentioned that nitrogen fertilizer is established to increase the water use efficiency, due to N enables the crop to cover the ground quicker and develop a dense leaf canopy, resulting in reduced soil evaporation and better water use efficiency. **Also, Tisdale *et al.* (1997)** reported that N increased WUE for wheat, while without N, water extraction was largely limited to the upper 3 feet. These results agree with those obtained by **El-Sabbagh *et al.* (2002)** who found that the maximum value of WUE was obtained at 45% SMD.

CONCLUSION

It can be concluded that under the clayey Nile alluvial soil of Middle Egypt, irrigating wheat plants when 50-55% of available soil moisture depletion and added 100 kg N/fed. were the best combination to achieve the greatest wheat yield, its components and improved the water use efficiency.

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استجابة انتاجيه القمح لمستويات مختلفة من الرطوبة الارضية والنيتروجين المعدنى تحت ظروف الأراضى النهرية الرسوبية

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اقيمت تجربة حقلية خلال موسمين متتاليين (٢٠٠٥/٢٠٠٤ ، ٢٠٠٦/٢٠٠٥)، بمحطه البحوث الزراعية بسدس - بنى سويف وذلك لدراسة استجابة محصول القمح ومكوناتة ، وكذا بعض العلاقات المائية (كفاءة استخدام مياه الرى) لبعض نظم الرى (الرى عند فقد ٢٥-٣٠ ، ٥٠-٥٥ ، ٧٥-٨٠ % من مدى الماء الميسر) والتسميد النيتروجينى (٥٠ ، ٧٥ ، ١٠٠ كجم نيتروجين للفدان) وكانت أهم النتائج التى أمكن الحصول عليها كما يلى:-

١- أدى الرى عند فقد ٥٠-٥٥ % من الماء الميسر الى زياده معنوية فى كل من عدد السنابل /م٢، عدد الحبوب فى السنبله، وزن الحبوب فى السنبله، وزن الالف حبه، محصول الحبوب والكفاءه الأستعماليه لمياه الرى.

٢- أدى الرى عند فقد ٢٥- ٣٠ % من الماء الميسر الى الحصول على أعلى قيم لمحصول القش وأعلى استهلاك مائى خلال موسمى النمو.

٣- أدى زياده معدل الاضافة من النيتروجين حتى ١٠٠كجم N للفدان الى الحصول على أعلى القيم لمحصول القمح ومكوناته وكذلك لقيم الكفاءه الأستعماليه لمياه الرى وكميه المياه المستهلكه خلال موسمى النمو.

من نتائج هذه الدراسة يمكن استنتاج أن رى القمح عند فقد ٥٠-٥٥% من الماء الميسر فى التربة وأضافه ١٠٠ كجم نيتروجين للفدان يعطى اعلى قيم لأنتاجيه القمح كما يحسن من الكفاءه الأستعماليه لمياه الرى تحت ظروف الأراضى الرسوبية النهرية ذات القوام الطيني بمنطقه مصر الوسطى.