J. Agric. Sci. Mansoura Univ., 33(11): 8339 - 8346, 2008

EFFECT OF DIFFERENT BORDER WIDTHS, WATER DISCHARGE AND NITROGEN FERTILIZER LEVELS ON WHEAT CROP AT NORTH NILE DELTA

El-Arqan, M.Y.S.*; M.M. Saied; M.M. Ragab** and W.M. Mosalm***

*** Soil Science Dept., Faculty of Agric., Mansoura University**

**** Soil, Water and Environmental Research Institute, ARC, Giza, Egypt**

ABSTRACT

Two field experiments were conduced during the two growing seasons of 2004/2005 and 2005/2006 at Sakha Agricultural Research Station Farm to Study the effect of different border widths, irrigation discharge and nitrogen fertilizer levels on wheat crop yield. The split split plot design with four replicates was used. The main plots randomly assigned to three border widths (7, 11 and 15 m), the sub plots to three irrigation discharges (2.5, 3 and 3.5 $L.sec^{-1}m^{-1}$) and the sub sub plots to three nitrogen fertilizer levels (80, 100 and 120% N) from recommended dose (75 kg N fed^{-1}).

The results revealed that the combination between 11 m border width, 3.5 $L.sec^{-1}m^{-1}$ and 120% N from recommended dose increased wheat grain, straw and 1000 grains weight in the two season of study followed by the treatments; 15 m border width, 3 or 3.5 $L.sec^{-1}m^{-1}$ irrigation discharge and 120% N from recommended dose. Moreover, the above mentioned treatments produced the highest protein percentage.

The highest concentration of nitrogen and its uptake by wheat grains and straw were achieved with 11 m border width, 3.5 $L.sec^{-1}m^{-1}$ and 120% N from recommended dose. While the highest values of fertilizer use efficacy were achieved under 15 border width, 3.5 $L.sec^{-1}m^{-1}$ water discharge and 120% N from recommended dose.

It could be concluded that the interaction between 11 m border width, 3.5 $L.sec^{-1}m^{-1}$ water discharge and 120% N from recommended dose achieved the best highest wheat yield at North Nile Delta.

INTRODUCTION

The agricultural sector is the largest user and consumer of water in Egypt, with its share exceeding 85% of the total water supply for. Irrigation is considered to be one of the most important operations of crop production through its effect on the availability of soil moisture and nutrients to the plant. Under the limited of both irrigation water and the agricultural land in Egypt, enhancement of effective irrigation water management plan is needed to reach the maximum water and land use efficiency.

The wheat grain yield increased with increasing nitrogen rate and irrigation frequency. The highest grain yield of 3.65 ton ha^{-1} was obtained with 180 kg N + irrigation at: cumulative pan evaporation ratio of 1.2. The N content in shoot at the spike initiation stage was higher in irrigated than in unirrigated crops, but the reverse was true for N content in grain and straw at maturity. Total N uptake was the highest with 180 kg N. N use efficiency was the highest with 60 kg N + irrigation at 1.2 irrigation water: cumulative pan evaporation ratio. (Askok *et al.,* 1995).

The wheat grain yield was affected more with fertilizer combination 128 N, 111 P and 25 K kg h^{-1} with 100 mm depth of irrigation water than with other combinations of fertilizer and irrigation depths. This combination yielded

6223 kg ha^{-1} of wheat grain (Akhtar *et al.,* 1995). Firzzone *et al.* (1996) found that the maximum grain yield (5466.5 kg ha^{-1}) was observed for 274 mm irrigation depth and 80 kg N ha^{-1}. The number of grains per spike increased with the water depth and N level, with the maximum 40.7 for 157 mm of water and 160 kg. N. ha^{-1}. The weight of 1000 grains decreased and the fertile tillers ratio increased up to 240 mm of water and 160 kg N ha^{-1}.

The water stream size of 4 L. $sec^{-1}m^{-1}$ achieved the highest grain yield and yield components under all different border length (El-Mowelhi *et al.,* 1999).

El–Sherbieny *et al.* (1999) found that the N, P uptake was significantly increased due to increasing N level from 75 to 125 kg N fed^{-1}. Also, the grain protein content was increased from 9.38 to 12.5%.

El-Zeky (2005) and El-Sebaey (2006) showed that increasing applied nitrogen fertilizer gradually increased the amount of nitrogen uptake by wheat plant.

MATERIALS AND METHODS

Two field experiments were conduced during the two growing seasons of 2004/2005 and 2005/2006 at Sakha Agricultural Research Station Farm to study the effect of different border widths, irrigation water discharge and nitrogen fertilizer levels on wheat crop yield. Some physical and chemical properties of experimental field are shown in Table (1) and were determined according to standard methods after Black (1965), Vomocil (1957), Jackson (1967) and Garcia (1979).

Table (1): Main physical and chemical properties of soil experimental field during the two seasons of study.

Seasons of study	Soil moisture characteristics % (0-60 cm)			Soil pH (1: 2.5)	EC. dSm^{-1}	Bulk density, g cm^{-3}	Texture class
	F.C.	W.P	A.S.M.				
2004/2005	39.34	21.43	17.90	7.99	1.75	1.22	Clay
2005/2006	39.41	21.01	18.40	8.05	2.1	1.20	Clay

A split split plot design with four replicates was used, the main plots were border width, the sub plots were irrigation water discharge and sub sub plots assigned to nitrogen fertilizer levels. These treatments were carried out under cultivation of wheat crop as follows:

- Border widths (W): 7, 11 and 15 m.
- Irrigation water discharge (D): 2.5, 3.0 and 3.5 L. $sec^{-1}m^{-1}$.
- Nitrogen fertilizer levels (N): 80, 100, 120% N from recommended dose (75 kg N fed^{-1}).

Wheat crop variety Sakha 93 was cultivated on Nov. 18th and harvested in May 7th, 2004/2005 in the first season. While, the second season the same variety was planted on Nov. 23rd, 2005/2006 and harvested on May 2nd.

Character studies:

- Grain yield (kg fed^{-1}).
- Straw yield (kg fed^{-1})

- 1000 grain weight (g)

Nutritional analysis:

1. Total nitrogen was determined using micro-kjeldahl method described by Jackson (1967).
2. Crude protein content was calculated by multiplying the nitrogen percentage by 5.7 (A.O.A.C. 1980).

Statistical analysis:

Almost all the data collected were subjected to the statistical analysis according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Effect of different applied treatments on:

1. Yield and yield components:

Data in Table (2) indicated that the different treatments had a significant effect on wheat yield and its components for both seasons. The border width of 11 m produced the highest values of grain yield, straw yield and 1000 grains weight of (2256.22 and 2230.67 kg fed^{-1}), (4880.00 and 5130.67 kg fed^{-1}) and (48.96 and 49.15 g), respectively.,

Table (2): Effect of different border widths, water discharge and nitrogen fertilizer levels on grain, straw yields and weight of 1000 grain of wheat in the two season of study.

Treatments	2004/2005			2005/2006		
	Grain yield kg fed^{-1}	Straw yield Kg fed^{-1}	1000 grain (g)	Grain yield kg fed^{-1}	Straw yield Kg fed^{-1}	1000 grain (g)
Width (w)						
W_1 = 7 m	1990.00	4354.44	47.976	2027.78	4690.56	47.436
W_2 = 11 m	2256.22	4880.00	48.961	2230.67	5130.67	49.158
W_3 = 15 m	2187.22	4159.11	47.336	2161.78	4180.33	48.238
F-test	**	**	**	**	**	**
LSD 5%	157.725	232.51	0.707	137.64	353.36	0.736
LSD 1%	222.50	446.98	0.991	184.31	478.35	1.038
Discharge (D)						
D_1 = 2.5 L. sec^{-1} m^{-1}	2000.78	4249.11	47.483	2006.44	4441.78	47.630
D_2 = 3.0 L. sec^{-1} m^{-1}	2146.78	4474.67	48.112	2164.00	4552.67	48.300
D_3 = 3.5 L. sec^{-1} m^{-1}	2232.89	4669.78	49.025	2139.78	5023.11	48.402
F-test	**	*	*	**	*	**
LSD 5%	146.33	332.34	0.691	145.76	331.48	0.681
LSD 1%	198.11	443.81	0.929	195.08	442.23	0.917
Nitrogen (N)						
N_1 = 80%	2000.44	4154.89	47.751	1989.00	4232.44	47.959
N_2 = 100%	2100.00	4473.44	47.836	2153.78	4585.78	48.080
N_3 = 120 %	2235.11	4864.22	48.716	2306.44	4999.3	48.794
F-test	**	**	**	**	**	*
LSD 5%	134.05	340.38	0.658	137.46	350.81	0.657
LSD 1%	177.91	451.74	0.877	182.44	465.59	0.875
	Interaction			Interaction		
W x D	NS	**	*	NS	**	N.S
W x N	*	*	N.S	*	*	*
D x N	*	N.S	*	*	N.S	*
W x D x N	*	*	*	*	*	*

Concerning irrigation water discharge data indicated that, the highest wheat yield (2232.89 and 2139.78 kg grain yield fed^{-1}) (4669.78 and 5023.11 kg straw yield fed^{-1}) and (49.025 and 48.402 for 1000 grain weight, g) were obtained with 3.5 L. $sec^{-1}m^{-1}$ water discharge in both season of study, respectively.

Data clearly show that application of 120% N from recommended dose gave the highest wheat yield and yield components. These results are in agreement with those reported by Firzzone *et al.* (1996). The interaction between (W x D x N) was significant with grain yield, straw yield and 1000 grain weight. From the above mentioned discussion it could be concluded that using 11 m border width, 3.5 L.$sec^{-1}m^{-1}$ water discharge and application of 120% N from recommended dose markedly increased wheat yield and their components.

2. Nitrogen concentration % in grain, straw and protein content in wheat:

Data in Table (3) indicated that there was highly significant effect of different treatments on nitrogen concentration in grain, straw and protein content in grain wheat for both seasons of study.

Table (3): Nitrogen concentration (%) in wheat grain, straw and protein concentration % as affected by different treatments during the two seasons of study.

Treatments	N% in grains		N% in straw		Protein % in grains	
	2004/2005	2005/2006	2004/2005	2005/2006	2004/2005	2005/2006
Width (w)						
W_1 = 7 m	2.03	2.06	0.34	0.34	11.57	11.74
W_2 = 11 m	2.22	2.18	0.39	0.40	12.65	12.43
W_3 = 15 m	2.21	2.18	0.38	0.39	12.43	12.43
F-test	**	**	**	**	**	**
LSD 5%	0.063	0.034	0.004	0.004	0.33	0.30
LSD 1%	0.95	0.047	0.005	0.006	0.60	0.62
Discharge (D)						
D_1 = 2.5 L. sec^{-1} m^{-1}	2.12	2.11	0.36	0.37	12.08	12.03
D_2 = 3.0 L. sec^{-1} m^{-1}	2.15	2.13	0.38	0.39	12.26	12.14
D_3 = 3.5 L. sec^{-1} m^{-1}	2.16	2.19	0.39	0.40	12.31	12.48
F-test	*	**	**	**	*	**
LSD 5%	0.033	0.032	0.004	0.004	0.20	0.30
LSD 1%	0.047	0.043	0.006	0.006	0.61	0.40
Nitrogen (N)						
N_1 = 80%	1.93	1.86	0.35	0.36	11.00	10.60
N_2 = 100%	2.25	2.23	0.38	0.39	12.82	12.71
N_3 = 120 %	2.27	2.34	0.40	0.41	12.94	13.33
F-test	**	**	**	**	**	**
LSD 5%	0.095	0.033	0.04	0.003	0.42	0.51
LSD 1%	0.127	0.044	0.005	0.005	0.72	0.81
	Interaction			Interaction		
W x D	*	**	N.s	*	*	*
W x N	**	**	**	**	**	**
D x N	*	N.S	*	*	*	*
W x D x N	**	**	**	**	*	*

Under 11 m border width, it was produced the highest values of nitrogen concentration in grain, straw and protein content in grain (2.72 and 2.18% N in grain content), (0.39 and 0.40% N from straw) and (12.65 and 12.43% protein), respectively. The highest values of nitrogen concentration in grain, straw and protein were obtained with 3.5 L. $sec^{-1}m^{-1}$ water discharge. Also, 120% N from recommended dose gave the highest values. These results are corresponded to those obtained by El-Sherbieny *et al.* (1999).

The interaction between (W x D x N) was significant with nitrogen concentration in grain, straw and protein %.

From the above mentioned discussion, it could be concluded that the 11 m border width, 3.5 L. $sec^{-1}m^{-1}$ water discharge and 120% N from recommended dose are suitable in old land.

3. Nitrogen uptake of wheat grain and straw:

Data in Table (4) show that the nitrogen uptake of wheat grain and straw were affected significantly by different treatments. The highest values of nitrogen uptake were achieved with 11 m border width, 3.5 L. $sec^{-1}m^{-1}$ water discharge and 120 % N from recommended dose in the two seasons of study. These results are similar with those reported El-Zeky (2005) and El-Sebaey (2006).

Table (4): Nitrogen uptake (kg N fed^{-1}) of wheat grain and straw of wheat crop as affected by different treatments during the two growing seasons.

Treatments	N uptake by wheat grains (kg fed^{-1})		N uptake by wheat straw (kg fed^{-1})	
	2004/2005	2005/2006	2004/2005	2005/2006
Width (W)				
W_1 = 7 m	40.5	42.0	14.8	16.0
W_2 = 11 m	49.7	49.3	19.3	20.5
W_3 = 15 m	49.5	47.6	16.4	16.5
F-test	**	**	**	**
LSD 5%	2.952	0.739	0.176	0.232
LSD 1%	3.943	1.013	0.238	0.322
Discharge (D)				
D_1 = 2.5 $LS^{-1}m^{-1}$	44.0	42.8	16.3	16.1
D_2 = 3.0 $LS^{-1}m^{-1}$	46.7	47.9	16.5	17.8
D_3 = 3.5 $LS^{-1}m^{-1}$	47.0	48.2	17.8	19.2
F-test	*	**	**	**
LSD 5%	2.965	0.692	0.188	0.213
LSD 1%	3.956	0.929	0.253	0.288
Nitrogen (N)				
N_1 = 80%	41.6	42.1	13.4	14.2
N_2 = 100%	47.7	48.1	16.9	18.0
N_3 = 120%	50.4	55.6	20.1	21.0
F-test	**	**	**	**
LSD 5%	3.503	0.711	0.172	0.191
LSD 1%	4.665	0.947	0.228	0.255
	Interaction		Interaction	
W x D	**	**	**	**
W x N	N.S	*	**	**
D x N	*	**	**	**
W x D X N	**	**	**	**

Fertilizer use efficiency:

Data in Table (5) show that the fertilizer use efficiency values were affected by different treatments in the two seasons of study. The highest values of fertilizer use efficiency (88.06 and 85.87%) were achieved by 15 m border width, 3.5 L. $sec^{-1}m^{-1}$ water discharge and 120% N from recommended dose in the two seasons of study. These results could be confirmed by those obtained by Askok *et al.* (1995).

It could be concluded that, the combination of 11 m border width, 3.5 L. $sec^{-1}m^{-1}$ water discharge and 120% N from recommended dose achieved the best highest wheat yield at North Nile Delta.

Table (5): Effect of different border widths, water discharge and nitrogen fertilizer levels on fertilizer use efficiency in the two growing seasons.

Treatments			Fertilizer use efficiency %	
m	L. $sec^{-1}m^{-1}$	N %	2004/2005	2005/2006
7	2.5	80	68.81	69.95
		100	74.92	76.89
		120	68.98	77.16
	3.0	80	78.7	76.73
		100	82.59	76.70
		120	77.30	74.43
	3.5	80	70.80	72.60
		100	69.20	7.08
		120	73.68	77.64
11	2.5	80	79.45	78.87
		100	76.67	79.08
		120	83.04	81.29
	3.0	80	78.21	79.18
		100	84.8	79.37
		120	85.01	79.54
	3.5	80	80.71	82.06
		100	84.09	84.20
		120	82.74	84.55
15	2.5	80	81.96	74.20
		100	78.48	78.81
		120	80.43	70.46
	3.0	80	79.28	77.200
		100	81.59	78.30
		120	80.40	84.05
	3.5	80	81.91	79.87
		100	85.00	83.13
		120	88.06	85.87

REFERENCES

Akhtar, B.; A. Hussain; N. Mahmod; M. Saleem; A. Ahmad and M. Aslam (1995). Effect of different depths of irrigation and fertilizer combination on wheat yield-a field study. Pakistan Journal of Agric. Sciences. 199,. 32; 4: 274-278; 6 ref.

A.O.A.C. (1980). Official of Analysis. Association of Official Agricultural Chemists, 13th ed. Wash, DC., USA.

Askok, K.; D.K. Sharma; H.C. Sharma and A. Kumar (1995). Nitrogen uptake, recovery and N-use efficiency in wheat (*Triticum aestivum*) as influenced by nitrogen and irrigation levels in semi-reclaimed sodic soils. Indian, Journal of Agronomy. 195, 40: 2, 198-203; 10 ref.

Black, C.A. (1965). Methods of Soil Analysis. Part 1. Amer. Soc. Agronomic. Publisher, Adison. U.S.A., 374-390 pp.

El-Mowelhi, N.M.; M.A. Abo El-Soud; M.A. Ghazy and M.H. Hegazy (1999). On-farm water management for maize and sunflower crops under Northern delta conditions. Third conference of on-farm irrigation and agroclimatology Vol., 1 (No. 1) papers January 25-27, 1999, 18-36, Dokki, Egypt.

El-Sebaey, M.M. (2006). Effect of inorganic, organic and bio-fertilizer on wheat plant grown in new cultivated land. Zagazig J. Agric. Res., 33(5): 863-876.

El-Sherbieny, A.E.; K.G. Soliman and R.M. Ali (1999). Increasing the efficiency of nitrogen fertilizers in newly reclaimed soil. Zagazig. J. Agric. Res. 26: 38, 895-906.

El-Zeky, M.M. (2005). Response of wheat to biofertilizer inoculation under different levels of inorganic nitrogen. J. Agric. Sci. Mansoura Univ., 30(1): 701-710.

Frizzone, J.A.; Av. Jr. Mello; M.V. Folegatti and T.A. Botrel (1996). Different water depth and nitrogen fertilization effects on wheat crop yield Pesquisa, Agroepcuaira, Brasileira, 1996, 31: 6, 425-434; 36 ref.

Garcia, I. (1979). Soil Water Engineering Laboratory Manual. Dept. of Agriculture and Chemical Engineer, Colorado State Univ. Fort Collins, USA, 355-427 pp.

Jackson, M., I. (1967). Soil chemical analysis prentice Hall, India.

Snedecor, G.A. and W.C. Cochran (1967). Statistical method 6th Dxford and IB4. Publishing Co., Calcutta, India.

Vomocil, C.A. (1957). Measurements of soil bulk density and penetrability. A Review of Methods. Adv. Agr. 9: 159-176.

دراسة تأثير عروض مختلفة لشريحة الرى وتصرفات مياه الرى والتسميد النيتروجينى على محصول القمح بشمال الدلتا

محمد يحيى سيد العرقان* - محمود محمد سعيد ـ محمد مصطفى رجب** و وائل مسعد مسلم***

* كلية الزراعة ـ قسم الأراضى ـ جامعة المنصورة

** معهد بحوث الأراضى والمياه والبيئة

أقيمت تجربتين حقليتين بمزرعة محطة البحوث الزراعية بسخا ـ فى موسمين زراعيين 2005/2004م ، 2006/2005م لدراسة تاثير عروض مختلفة لشريحة الرى وتصرفات مياه الرى ومستويات التسميد النيتروجينى على محصول القمح وتركيز النيتروجين وامتصاصه فى الحبوب والقش لمحصول القمح ومحتوى البروتين.

تم تنفيذ التجربة بنظام القطع المنشقة مرتين فى أربع مكررات حيث مثلت القطع الرئيسية ثلاث عروض للشرائح (7 ، 11 ، 15 متر) بينما وضعت تصرفات مياه الرى (2.5 ، 3.0 ، 3.5 لتر/ثانية/متر) فى القطع المنشقة مرة واحدة مستويات التسميد النيتروجينى (80 ، 100 ، 120%) فى القطع المنشقة مرتين من الجرعة الموصى بها.

وأوضحت النتائج أن عرض الشريحة 11 متر وتصرف مياه الرى 3.5 لتر/ثانية/متر من عرض الشريحة وإضافة التسميد النيتروجينى بمعدل 120% من الكمية الموصى بها أدت إلى زيادة محصول حبوب وقش القمح ووزن 1000 حبة خلال موسمى الدراسة.

وأن المعاملة التى تليها هى عرض الشريحة 15 متر وتصرف المياه 3.5 لتر/ثانية/متر ومستوى تسميد نيتروجينى 120% من الجرعة الموصى بها والتى أعطت نتائج جيدة فى نسبة البروتين فى حبوب القمح.

أن أعلى تركيز لنسبة النيتروجين والنيتروجين الممتص فى حبوب وقش القمح عندما كانت عرض الشريحة 11 متر وتصرف مياه الرى 3.5 لتر/ثانية/متر ومستوى تسميد نيتروجينى 120% من الجرعة الموصى بها بينما كانت أعلى قيمة لكفاءة استخدام السماد عند معاملة 15 متر عرض شريحة ، وتصرف مياه الرى 3.5 لتر/ثانية/متر وتسميد نيتروجينى 120% من الجرعة الموصى بها.

للحصول على أفضل محصول يمكن التوصية باستخدام شريحة عرضه 11 متر وأن يكون تصرف مياه الرى 3.5 لتر/ثانية/متر وأن يكون مستوى التسميد النيتروجينى 120% من الجرعة الموصى بها.