EFFECT OF IRRIGATION, POTASSIUM APPLICATION AND DISTANCE FROM DRAIN LINE ON WHEAT CROP IN CLAY SOIL.

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ABSTRACT

Two field experiments were carried out at Sakha Agricultural Research Station. The field is provided by tile drains network spaced at 20 m with 1.2 m depth in order to study the effect of distances form drain line, potassium application and holding the last irrigation on yield and yield components of wheat crop. The experiments were conducted in a split-split-plot design.

Results showed that:

Decreasing distance from drain line L/2 to L/4 resulted in a significant increase in the dry matter at tillering and booting stages and grain yield at harvest. The values of dry matter at tillering, booting stages and grain yield near the drain were higher than that far from it by about 34, 139 and 53 kg/fed and 63, 123 and 65 kg/fed, for the first and the second seasons, respectively.

Grain and straw yields significantly decreased by withholding the last irrigation by about 1.22 and 1.50 (ardab/fed.) and 1.17 and 0.55 (heml/fed.) in the first and second seasons, respectively.

K-fertilization application realized favorable effect for yield and yield components of wheat in two seasons.

The interaction between distance from drain line and K-fertilization was significant decrease under zero K-fertilization in the dry matter at tillering stage, while, it was significant at booting stage under conditions of with and without k-fertilization, but grain and straw yields were insignificant.

Withholding the last irrigation resulted in a significant decreases with and without potassium in 1000 grain weight and grain yield.

Dry matter at tillering and booting stage were significantly decreased with increasing the distance from drain line with both irrigation treatments. Also, the increase of distance from drain line and irrigation regime gave a decreases in 1000 grain weight, grain and straw yields.

Keywords: drain line, potassium, irrigation regime, wheat crop, clay soil.

INTRODUCTION

Drainage is generally required to increase soil productivity by facing the twin problems of water logging and soil salinity and subsequently offer the suitable environments for plant growth and also for humanbeing. The tile drainage also causes very important changes in nutrients movement which make these nutrients more available for plant growth, (Abd El-Khalek, 2000 and Antar, 2005 and 2007). Wheat (*Triticum aestivum*) is the principal winter crop in Egypt, it is the most important grain crop in the world. The world production exceeds that of any other grain crop, and in many respects it is superior to any other human food. Wheat is the major breadmaking cereal, and Egypt has to supplement production by importing just over half of its needs to supply the annual demand. In clay soil at North Delta, Ramadan et al., (2006) found that 1000 grain weight, grain yield and straw yield significantly increased as the distance from drain line decreased from L/2 to L/4.

Water is one of the most important inputs essential for crop production. It profoundly influences photosynthesis, respiration, absorption, translocation and utilization of mineral nutrients as well as cell division besides some other processes. Either shortage ore excess of water affects the growth and development of plant directly and consequently, its yield and quality (Eid, et al., 2004). Buchong et al, (2006) found that, the optimum controlled soil water deficit levels, should range 50- 60% of field water capacity (FWC) at the middle vegetative growth period (jointing), and 65- 70% of FWC at both of the late vegetative period (booting), and early reproductive period (heading) followed by 50-60% of FWC at the late reproductive periods (the end of filling or filling and maturity). Omar et al, (2007) recommended that, wheat crop could be irrigated every three weeks during growth stages under conditions of North Delta Egypt.

Potassium is absorbed by roots in relatively large quantities, and commonly added as a fertilizer to stimulate plant growth and increase crop yields. Potassium plays an essential role in photosynthesis and helps maintain balanced anion/cation ratios within the plant (Mengel, 1985). It is involved is many essential physiological functions and its most important role is the regulation of the water status in plant tissues, and it is involved in cell expansion and stomatal movement, also it is involved in activation of more that 60 enzymes in protein synthesis (Suelter, 1985). Sing and Uttam (1993) applied 25 kg K/ha to wheat, on a sandy loam soil and obtained increased grain yield.

Prasad (1996) applied up to 50 mg K/kg to wheat on an alluvial soil and obtained increased grains and straw yield with increased K rates.
The objectives of the present work were to study the effect of distance from drain line, withholding the last irrigation and potassium application on yield component of wheat crop.

MATERIALS AND METHODS

Two field experiments were carried out at the experimental farm of Sakha Agricultural Research Station, Kafr El-Sheik Governorate, at North Delta. The field is provided by tile drains network spaced at 20 m with 1.2 m depth. During winter seasons of 2007/2008 and 2008/2009 in order to study the effect of distances from drain line, potassium application and holding the last irrigation on yield and yield components of wheat crop. The experiments were conducted in a split-split-plot design with three replicates. The main plots were distances from drain line, the sub-plots were potassium application and the sub-sub-plots were holding the last irrigation as follows:

Main plots (distances form drain line):

L/2: Distances of 1/2 from drain line.

L/4: Distances of 1/4 from drain line.

Sub-plots (potassium application):

K_0: Without of potassium application.

K_1: Potassium application at rate 25 kg K/fed.

Sub-Sub-plots (irrigation):

I1: Full irrigation.

I2: Holding the last irrigation.

Wheat (*Triticum aestivum L.*) Sakha 93 variety was planted in 15 November 2007and repeated in 2008. All plots received total of 100 kg/fed superphosphate (15.5% P_2O_5) before cultivation. Nitrogen fertilizer was applied at 75kg N/fed as recommended. The different agricultural practices were done as recommended through the two growing seasons. The soil samples were collected in 30cm increments to 90cm depth for analysis (Table, 1) according to Klute (1986) and Page, et al. (1982).

To monitor water table fluctuation, observation wells were installed midway between drains at 1/2 and 1/4 distances from tile drain as recommended by Dieleman and Trafford (1976). Whole wheat plant samples at tillering and booting stage were taken and dried at 70 °C for determined, and also, grains and straw at harvesting were taken for determined.

Statistical analysis: Data are subjected to statistical analysis according to Snedecor and Cochran (1980).

Table (1): The initial of some soil properties for the experimental field

Soil den	Particle size			Textu re	EC (dS/	O M	CaC O3	Available N.		
	Sand	Silt	Clay					N	P	K
Season 2007/2008										
0-	21.4	29.	49.1	Claye	1.40	0.9	3.22	45.	5.	26
30-	20.5	27.	52.0	Claye	1.10	0.8	3.61	44.	4.	22
60-	21.1	27.	51.7	Claye	1.40	0.6	2.71	36.	4.	19
Season 2008/2009										
0-	22.3	27.	49.6	Claye	1.58	1.5	3.81	48.	6.	25
30-	24.7	29.	45.9	Claye	0.98	1.1	3.68	36.	5.	23
60-	28.2	30.	41.6	Claye	1.37	0.8	2.69	33.	3.	19

RESULTS AND DISCUSSION

Water table levels and hydraulic head:

As shown in fig (1) water table level and hydraulic head in both studied seasons were decreased with increasing time after irrigation. The highest values of water table level and hydraulic head were found after one day from irrigation. While the lowest values were found before the next irrigation. Water table depth and hydraulic head near the drains (L/4) was higher than in midway between drains (L/2). This may be due to the improved drainage near the drains than midway between it which, in return, gave the top soil chance to dry and permitted for shrinkage and formation of water passage ways and allowed a rather easier movement of water into drain pipes. Similar results were obtained by Antar, (2005)

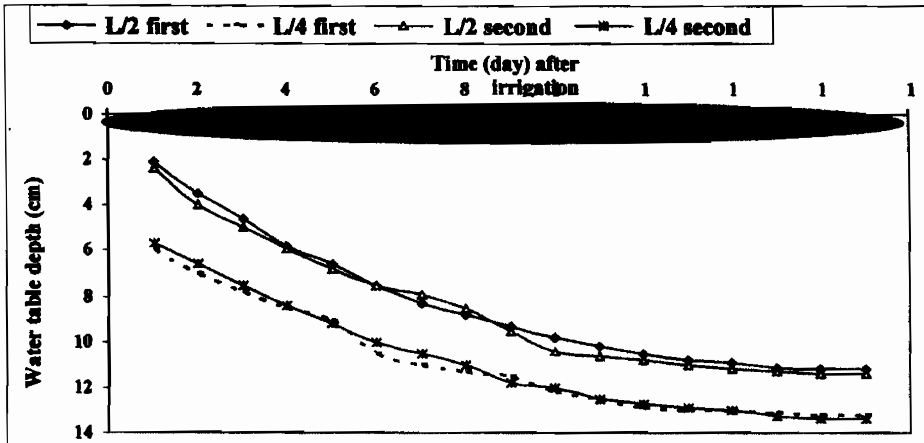

Fig (1): Average water table depth (cm) with time (day)after irrigation from different distance (L) from drain line.

Effect of distance from drain line on wheat yield characteristics:

Data in Table (2) showed that decreasing distance from drain line L/2 to L/4 resulted in a significant increase in the dry matter at tillering and booting stages (kg/fed.) and grains yield (ardab/fed.) at harvest. The values of dry matter at tillering, booting stages and grain yield near the drain (L/4) were higher than that far from it (L/2) by about 34, 139 and 53 kg/fed and 63, 123 and 65 kg/fed, for the first and the second seasons, respectively. This is due to the effect of drainage on conditioning water-air relationship in the root zone and its effect on mobility of nutrients to the plant roots which cause more vegetative growth and subsequently produce a higher yield. These results are in agreement with those obtained by Ramadan et al., (2006). Data also cleared that the increases of 1000-grain weight and straw yield in both studied seasons were insignificant for the two distance from drain line.

Table (2): Effect of distance from drain line on yield component of wheat crop.

Treatments	Dry matter at	Dry matter at	1000	Grains yield	Straw yield
			First season		
L/4	813	2041	41.13	20.23	18.78
L/2	779	1902	41.08	19.84	18.56
F. Test	*	**	NS	*	NS
LSD, 0.05	22	63		0.39	
			Second season		
L/4	805	2041	41.85	20.47	18.72
L/2	742	1918	41.48	20.05	18.42
F. Test	**	**	NS	*	NS
LSD, 0.05	23	65		0.42	

L/4 = 1/4 distance from drain line L/2 = 1/2 distance from drain line

Effect of irrigation regime on yield component of wheat crop:

As to irrigation regime, data in table (3) showed that withholding the last irrigation (I_2) caused a non-significant reduction in the dry matter at tillering and booting stages in the two studied seasons as compared to the normal irrigation (I_1). This may be attributed to occurrence of irrigation regime after booting stage. On the other hand, 1000 grain weight (g.), grain yield (ardab/fed.) and straw yield (Heml/fed.) significantly decreased in I_2 treatment as compared to I_1 one. These reduction were about 5.5, 6.3 and 6.5% in the first season, while they were 6.4, 7.7 and 3.0 % in the second season for the obovementioned wheat yield components, respectively. The decreases in wheat grain and straw yield due to withholding the lost irrigation were equal to 1.22 and 1.50 (ardab/fed.) and 1.17 and 0.55 (heml/fed.) in the first and second seasons, respectively. Eid et al (2004) noticed that, water affects performance of crops not only directly but also indirectly by influencing the availability of nutrients and the timing of cultural operations.

Table (3): Effect of irrigation regime on yield component of wheat crop.

Treatments	Dry	Dry	1000	Grains yield	Straw yield
First season					
I_1	795	1961	42.2	20.64	19.26
I_2	796	1957	40.01	19.42	18.09
F. Test	NS	NS	**	**	**
LSD, 0.05			0.53	0.39	0.73
Second season					
I_1	775	1981	42.95	21.01	18.85
I_2	772	1979	40.38	19.51	18.30
F. Test	NS	NS	**	**	*
LSD, 0.05			0.82	0.42	0.53

I_1 = Normal irrigation I_2 = Holding the last irrigation

Effect of k-fertilization on wheat yield characteristics:

Data in table (3) showed that K-fertilization realized favorable effect for yield components of wheat crop in two seasons. Dry matter at tillering and booting stages and 1000 grain weight significantly increased with k-fertilization in both studied seasons. These increases were equivalent to 25 and 47 (kg/fed.), 101 and 65(kg/fed.) and 0.53 and 1.63(g) in the first and second seasons, respectively. While the increases for grain and straw yields in the two seasons with k-fertilization were insignificant. The increases of the yield components of wheat crop may be attributed to the stimulation effect of potassium on nutritional balance and metabolic process in the plant. Also, importance of potassium nutrient on the absorption of more nitrogen which is essential for building new cells which is reflected on the production of wheat crop. Similar results was obtained by Abd El-Haleem (1994).

Table (4): Effect of k-fertilization on yield component of wheat crop.

Treatments	Dry matter	Dry matter	1000 grain	Grains yield	Straw yield
First season					
K_1	808	2010	41.37	20.15	18.73
K_0	783	1909	40.84	19.90	18.61
F. Test	*	**	*	NS	NS
LSD, 0.05	22	63	0.53		
Second season					
K_1	797	2012	42.48	20.31	18.59
K_0	750	1947	40.85	20.21	18.56
F. Test	**	*	**	NS	NS
LSD, 0.05	23	65	0.82		

K_1 = 25 kg K_2O/fed. K_0 = without K fertilization

Interaction between distance from drain line and k-fertilization on yield component:

Data in table (5) showed that, in both studied seasons, dry matter at tillering and booting stages (kg/fed.) decreased with increasing the distance from drain line (from L/4 to L/2) under two treatments of K-fertilization (zero and 25 kg K_2O/fed). On the other hand, addition of K increased dry matter at tillering and booting stages. The interaction was significantly decreased under without k-fertilization and insignificant with K-fertilization at tillering stage, whereas, it was significant at booting stage with and without K-fertilization in the two studied seasons. Results also indicated that 1000 grain weight (g), grain yield (ardab/fed.) and straw yield (Heml/fed.) slightly decreased with increasing the distance from drain line. The interaction between distance from drain line and the k-fertilization levels on 1000 grain weight, grain yield and straw yield were insignificant.

Table (5): The interaction between distance from drain line and k-fertilization on yield component of wheat crop.

Parameters	Treatments	First season		F.	Second season		F.
		K_1	K_0	Test	K_1	K_0	Test
Dry matter at tillering (kg/fed.)	L/4	824	803	NS	813	796	NS
	L/2	794	764	NS	781	704	**
F. Test		Ns	*		NS	**	
Dry matter at booting (kg/fed.)	L/4	2090	1993	NS	2082	1999	NS
	L/2	1930	1824	NS	1942	1895	NS
F. Test		**	**		**	*	
1000 grain weight (g)	L/4	41.18	41.07	NS	42.40	41.29	NS
	L/2	41.55	40.62	NS	42.56	40.40	*
F. Test		NS	NS		NS	NS	
Grain yield (ardab/fed.)	L/4	20.42	20.02	NS	20.68	20.36	NS
	L/2	19.88	19.77	NS	20.04	20.06	NS
F. Test		NS	NS		NS	NS	
Straw yield (heml/fed.)	L/4	18.86	18.69	NS	18.76	18.71	NS
	L/2	18.59	18.53	NS	18.42	18.42	NS
F. Test		NS	NS		NS	NS	

Interaction between irrigation regime and k-fertilization on yield component of wheat crop.

Data in Table (6) showed that dry matter at tillering and booting stages slightly increased when k-fertilization was applied at 25 kg K_2O/fed (K_1) with both irrigation treatments (I_1 and I_2) in the two seasons, but the increase of dry matter at tillering stage in the second season were significant. withholding the last irrigation was no different caused for the dry matter values at tillering and booting stages with and without K-fertilization in both studied seasons. Irrigation regime resulted in a significant decreases with and without potassium in 1000 grain weight (g), grain yield (ardab/fed.) and straw yield (heml/fed.) in the first and second seasons of study except straw yield in the second season. While, the effect of K-fertilization was insignificant under both irrigation treatments.

Interaction between irrigation regime and distance from drain line on yield component of wheat crop.

Data in Table (7) showed that, dry matter at tillering and booting stages (kg/fed.) was significantly decreased with increasing the distance from drain line in both studied season. While such values in both seasons were nearly the same in the two distances (l/2 and L/4) with irrigation studied. Data also showed that the increase of distance from drain line and irrigation regime in both studied seasons gave decreases in 1000 grain weight, grain yield (ardab/fed) and straw yield (heml/fed.). These decreases were significant in both distances(l/2 and L/4) with irrigation regime in both seasons except that straw yield in the second season.

Table (6): The interaction between irrigation regime and k-fertilization on yield component of wheat crop.

Parameters	Treatments	First season		F. Test	Second season		F. Test
		K_1	K_0		K_1	K_0	
Dry matter at tillering	I_1	809	781	NS	793	758	*
	I_2	807	785	NS	802	742	*
F. Test		NS	NS		NS	NS	
Dry matter at booting	I_1	2013	1910	NS	2011	1950	NS
	I_2	1007	1907	NS	2013	1944	NS
F. Test		NS	NS		NS	NS	
1000 grain weight (g)	I_1	41.97	42.44	NS	43.82	42.07	NS
	I_2	40.77	39.24	*	41.14	39.62	NS
F. Test		*	**		**	**	
Grain yield (ardab/fed.)	I_1	20.79	20.49	NS	21.10	20.92	NS
	I_2	19.53	19.30	NS	19.50	19.50	NS
F. Test		*	*		**	**	
Straw yield (heml/fed.)	I_1	19.35	19.16	NS	18.83	18.87	NS
	I_2	18.11	18.06	NS	18.35	18.26	NS
F. Test		*	*		NS	NS	

Table (7): The interaction between distance from drain line and irrigation regime on yield component of wheat crop.

Parameters	Treatments	First season		F. Test	Second season		F. Test
		I_1	I_2		I_1	I_2	
Dry matter at tillering	L/4	813	813	NS	803	806	NS
	L/2	778	780	NS	747	738	NS
F. Test		*	*		**	**	
Dry matter at booting	L/4	2047	2036	NS	2039	2043	NS
	L/2	1926	1878	NS	1922	1914	NS
F. Test		**	**		**	**	
1000 grain weight (g)	L/4	42.52	39.73	**	43.81	40.58	**
	L/2	41.89	40.28	**	42.79	40.18	**
F. Test		NS	NS		NS	NS	
Grain yield (ardab/fed.)	L/4	20.82	19.63	*	21.31	19.63	**
	L/2	20.46	19.21	*	20.71	19.39	**
F. Test		NS	NS		NS	NS	
Straw yield (heml/fed.)	L/4	19.36	18.20	*	19.11	18.34	NS
	L/2	19.15	17.97	*	18.58	18.42	NS
F. Test		Ns	NS		NS	NS	

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تأثير الري والتسميد بالبوتاسيوم والمسافة من المصرف على محصول القمح في الأرض الطينية

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أجريت تجربتين في حقل به صرف مغطى بمسافة ٢٠ متر بين الحقليات وعمق ١,٢ متر في محطة البحوث الزراعية بسخا وذلك لدراسة تأثير المسافة من خط المصرف وإضافة السماد البوتاسي وحرمان الرية الأخيرة على مكونات إنتاج ومحصول القمح. وصممت التجربة بنظام القطع المنشقة مرتين.

وقد أظهرت نتائج الدراسة ما يلي:-

زيادة وزن المادة الجافة عند مرحلتين التفريع وطرد السنابل وإنتاج الحبوب عند ربع المسافة من خط المصرف بمقدار ٣٤، ١٣٩، ٥٣ كيلوجرام للفدان و ٦٣، ١٢٣، ٦٥ كيلوجرام للفدان مقارنة بنصف المسافة من خط المصرف في الموسمين الأول والثاني على التوالي.

قل إنتاج الحبوب والتبن معنويا بمقدار ١,٢٢، ١,٥ أردب للفدان و١,١٧، ٠,٥٥ حمل للفدان نتيجة لحرمان الرية الأخيرة في الموسمين الأول والثاني على التوالي.

إضافة السماد البوتاسي أعطى نتيجة مرغوبة لمكونات الإنتاج ومحصول القمح في الموسمين.

حدث نقص معنوي للمادة الجافة عند مرحلة التفريع مع عدم إضافة سماد بوتاسي وزيادة المسافة من خط المصرف ، وأيضا حدث نقص معنوي للمادة الجافة عند مرحلة طرد السنابل مع إضافة وعدم إضافة سماد بوتاسي وزيادة

المسافة من خط المصرف، ولكن لم تظهر اختلافات معنوية مع إنتاج القــش والحبوب نتيجة ذلك التفاعل.

حدث نقص معنوي في وزن الألف حبة ومحــصول الحبــوب نتيجــة لحرمان الرية الأخيرة وعدم التسميد بالبوتاسيوم.

قلت المادة الجافة معنويا عند مرحلتين التفريع وطرد السنابل مع زيــادة المسافة من خط المصرف في كلا معاملتين الري. وأيــضا حرمــان الريــة الأخيرة مع كلا المسافتين من خط المصرف سبب نقص في وزن الألف حبة وإنتاج الحبوب والقش للقمح.