J. Agric. Sci. Mansoura Univ., 27(4): 2753 - 2760, 2002

EFFECT OF TILE DRAINAGE AND N. APPLICATION ON WHEAT CROP AND N. USE EFFICIENCY .

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ABSTRACT

Two field experiments were conducted during (1999/2000) and (2000/2001) seasons at El-Serw Agricultural Research Station to investigate the effect of three tile drainage spacings (15,30 and 60m.) and nitrogen application rate (0,45,60 and 75kg N/fed) on yield , nitrogen uptake by wheat plant , and nitrogen losses by leaching .

The obtained data revealed that decreasing drainage speasing up to 15 m. Led to an increase in grain , straw yields and nitrogen uptake .Also , N- losses by leaching increased significantly by decreasing drainage spacing up to 15 m , so dividing of N - application rate into 3 doses decreased N- loss by leaching .

On the other hand , the restults indicated that incerasing N- fertilizer rate up to full recommended dose increased significantly grain and straw yields , N- uptake by wheat plants and nitrogen losses by leaching .

From the obtained results , it could be concluded that the maximum wheat grain and straw yields could be achieved by using drainage spacing of 15 m and nitrogen application rate of 75 kg / fed added in three doses to decrease nitrogen loss by leaching .

INTRODUCTION

Tile drainage is playing an important role in improving the growth and yield of plants and subsequently increasing not only nitrogen uptake but also all nutrients. The tile drainage also causes very important changes in nutrients movement which make these nutrients more available for plant growth.

On the other hand , nitrogen is the most important nutrient required for all plants to obtain maximum yield . With regard to the effect of tile drainage on yield , N uptake and N looses , Singh *et al.* (1996) and Sharma *et al.* (1998) found that wheat grain and straw yields decreased with increasing drainage spacing . Also , Soskic *et al.* (1987) revealed that more No_3 -N was lost in the tile drainage system at the 15 m spacing than at 30m , while El-Hamshary *et al.* (1996) reported that nitrate losses decreased with increasing time after nitrogen applications . The losses of nitrate were affected by the hydraulic conductivity of the soil .

Regarding the effect of N fertilizer on crop yield , N uptake and N losses, Kotb (1998) and El-Naggar (1999), found that increasing N fertilizer significantly increased grain , straw yields and N uptake .

On the other hand, Lund *et al.* (1981) reported that about 60 % of added N fertilizer may be lost by leaching from irrigated soils, while when the N. Fertilizer was added in several small doses decreased nitrogen losses (Asseng *et al.*, 1998 and Webster *et al.*, 1990)

Thus, the purpose of this study was to investigate the effect of tile drainage and N - fertilizer rate on wheat yield , N uptake and N- losses by leaching .

MATERIALS AND METHODS

Two fields experiments were carried out at El - Serw Agricultural Research Station during winter seasons of (1999 / 2000 and 2000 /2001) in order to study the effect of nitrogen application and tile drainage distance on yield , N uptake and N - losses by leaching .

Soil samples were taken namely from the depths of 0 - 20 and 20 - 40 cm. The chemical and physical properties of tested soil were measured according to the standard methods reported by Hesse (1971) and Jackson (1967). Some physical and chemical properties of the experimental soil are shown in Table (1)

The experimental design was split plot with four replicates . The spaces between tile drains accupied the main plots , while sub plots were for nitrogen fertilization levels (0,45,60 and 75 kg N /fed). Each nitrogen fertilizer rate in the form of ammanium nitrate was divided into three doses. At harvest stage in both seasons, grain and straw yields were recorded . Samples of grains and straw were ground and wet digested as described by Hasse (1971) . Nitrogen was determined by using micro kjeldahl method , while N. uptake was calculated by multiplying the nitrogen concentration by dry weight of the grain and straw yields per feddan .

Samples of ground water were taken from each plot to determine the concentration of leached NO_3-N and NH_4-N according to the methods reported by Black (1982). All the obtained data were statistically analyzed according to Snedecor and Caochran (1967) using L.S.D. to compare the treatments values

Table (1):a- Physical and chemical properties of the soil samples before planting wheat (1st season)

Drains distance	Soil Depth,.cm	Texture Class	S.P. %	O.M. %	CaCo3 %	Available N,ppm	pH 1:2.5	EC dS/m
15 m	0-20	Clayey	96.5	0.48	2.40	40	7.8	3.5
	20-40	Clayey	98.0	0.60	2.63	33	8.1	3.2
30 m	0-20	Clayey	80.50	0.90	2.25	43	7.9	3.7
	20-40	Clayey	77.05	0.63	2.25	35	7.8	4.7
60 m	0-20	Clayey	100.0	0.60	2.61	45	8.1	4.7
	20-40	Clayey	103.0	0.50	2.81	36	8.0	5.5
b-Physical and chemical properties of the soil samples before planting wheat (2nd season)								
15.m	0-20	Clayey	95.5	1.10	2.24	40	8.00	1.2
	20-40	Clayey	88.5	0.92	2.51	36	8.10	1.2
30 m	0-20	Clayey	98.0	0.94	2.34	44	7.90	3.2
	20-40	Clayey	107.5	0.79	2.60	38	8.00	2.7
60 m	0-20	Clayey	96.5	0.86	2.64	47	8.10	3.1
	20-40	Clayey	109.0	0.57	2.81	39	8.20	4.4

RESULTS AND DISCUSSION

1- Grain and Straw yields:

1- Tile drainage spacing effect:

Data in Table (2) showed a significant increase in the grain and straw yields with decreasing drainage spacing . This is may be due to the effect of drainage on improving soil physical and chemical properties which affect water -air relations in the root zone , root penetration which leads to more water and nutrients intake. These results are in agreement with those obtained by single *et al.*(1996) and Sharma *et al.* (1998).

2- Nitrogen fertilization effect :-

Data in Table (2) revealed that nitrogen fertilization had a highly significant effect on grain and straw yields. There is a significant increase in grain and straw yields with increasing nitrogen level up to 75kg N /fed . The increment in grain and straw yields due to nitrogen fertilizer may be attributed to the beneficial effect of added available nitrogen on plant growth . These results are in accordance with those obtained by kotb (1998) and El- Naggar (1999) .

II - Nitrogen uptake in grains and straw at harvesting:

1 - Tile drainage spacing effects:

Data in Table (3) showed that N uptake in grains and straw were significantly increased with decreasing drainage spacing. This may be due to the effect of drainage spacing of 15 m , which improved drainage status resulting water - air balance in the root zone , and subsequently increasing the amount of available nutrients to the plants .

2 - Nitrogen fertilization effects:

Data in Table (3) indicated that N uptake of grains and straw significantly increased with increasing N levels in both seasons .It was seen that the amounts of N - uptake in grains along with all the level of N applied were higher than those in straw .The beneficial effect of N - fertilizer level on nutrients uptake might be due to the effect of N - fertilizer on improving vegetative and root growth , hence increasing the absorbing area of roots , and in addition to the increase of root size in the presence of nitrogen fertilizer .Similar results were obtained by Kotb (1998) and EL - Naggar (1999).

III - Nitrogen loss by leaching:

Nitrogen loss by leaching is considered an important one of nitrogen losses at all . It depends on soil texture, soil atmosphere, amount of irrigation water , drainage state and amount of nitrogen fertilizer added to the soil .

Data in Tables (4 , 5 and 6) showed the effect of drainage spacing and N - fertilization level on N - Loss by leaching through soil cultivated with wheat plants after different times from irrigation process during two seasons

Table (2). Mean of grain and straw yields at harvesting stage as affected by drainage spacing and N. fertilization level in the two seasons .

Treatment	Grain yield, (Ardab/ fed)			Straw yield ,(ton / fed)		
	1st season	2nd season	Mean	1st season	2nd season	Mean
1- Drainage spacing						
60 m	11.22	12.61	11.92	2.79	3.10	2.90
30 m	13.80	14.13	13.97	3.13	3.50	3.32
15 m	14.97	15.18	15.08	3.39	3.68	3.54
F. Test	xx	xx	xx	xx	xx	
L.S.D at 5 %	0.343	0.505		0.038	0.183	
2- N . Fertilization level						
N0	7.90	8.30	8.10	1.99	2.26	2.13
N45	13.43	14.18	13.81	3.00	3.29	3.15
N60	15.59	16.22	15.91	3.53	3.86	3.70
N75	16.38	17.18	16.78	3.89	4.17	4.03
F. Test	xx	xx		xx	xx	
L.S.D at 5 %	0.260	0.156		0.032	0.079	

Table (3). Means of nitrogen uptake in grain and straw at harvesting stage as affected by drainage spacing and N. fertilization level in the two seasons .

Treatment	Grain			Straw		
	N . uptake (kg / fed)			N. uptake (kg / fed)		
	1st season	2nd season	Mean	1st season	2nd season	Mean
1- Drainage spacing						
60 m	19.53	25.33	22.43	4.99	6.25	5.62
30 m	27.84	31.18	29.51	6.47	8.01	6.24
15 m	32.40	39.75	33.58	7.70	8.61	8.16
F. Test	xx	xx		xx	xx	
L.S.D at 5 %	0.818	0.937		0.135	0.361	
2- N . Fertilization level						
N0	13.40	15.08	14.24	3.69	4.62	4.16
N45	25.64	29.36	27.50	6.07	7.20	6.64
N60	31.48	36.52	34.00	7.43	8.91	8.16
N75	35.86	40.73	38.30	8.36	9.77	9.07
F. Test	xx	xx		xx	xx	
L.S.D at 5 %	0.52	0.45		0.07	0.18	

1 - Tile drainage spacing effects .

Data in Tables (4 ,5 and 6) indicated that N - loss (NO_3 -N and NH4 - N) by leaching significantly increased with decreasing tile drainage spacing, therefore to obtain the benefits of improving drainage and minimizing NO_3 -N and NH4 - N loss, nitrogen fertilizer must be applied in three equal doses at different times from planting . The decrease in NO_3-N and NH4- N leached with increasing the period after irrigation is attributed to less amount of water moved downward and then less water is carrying NO_3 - N and NH4 -N lost by leaching downward to water table or ground water .

The increases in NO_3- N and NH4 -N lost by leaching with decreasing drainage spacing may be explained on the assumption that the drainage spacing of 15 m obtains a good drainage, improving soil physical and chemical properties and subsequently developing a better structure and

improving hydraulic conductivity which affected water down movement carrying many nutrients in soluble forms . These results are similar to those obtained by EL -Hamshry *et al.*, (1996) and Zhag *et al.* , (1996) .

2 - Nitrogen fertilization level effects:

Data in Tables (4,5and 6) indicated that nitrogen loss by leaching (NO_3-N and NH4-N) significantly increased with increasing N- fertilization level . This is due to increasing soluble nitrogen in the soil solution ., where about half of each addition is lost with water downward movements .

The highest values for N. loss by leaching into ground water from N-fertilizer levels were obtained at three days after N- fertilizer addition , these values were pronouncedly decreased as days after N- fertilizer addition increased until it reached to its lowest values before the next irrigation . The results are similar to those obtained by Webster *et al.*(1990) and Asseng *et al.* (1998).

Table (4). Means of N-loss (ppm) by leaching after first irrigation as affected by tile drainage spacing and N- fertilization level during two seasons .

Treatments	3 days after irrigation				14 days after irrigation				Before the next irrigation			
	NO_3^-		$NH4^+$		NO_3^-		$NH4^+$		NO_3^-		$NH4^+$	
	1st Season		2nd Season		1st Season		2nd Season		1st Season		2nd Season	
A- Drainage spacing												
60m.	8.60	10.74	2.88	3.60	6.79	8.79	2.30	2.92	5.83	6.60	1.93	2.19
30m.	10.63	12.80	3.55	4.23	8.63	10.58	2.86	3.45	7.61	7.61	2.53	3.11
15m.	13.16	15.19	4.38	5.11	11.16	12.90	3.71	4.34	9.55	11.14	3.19	3.70
F.Test	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
L.S.D. at 5 %	0.586	0.756	0.064	0.128	0.238	0.214	0.094	0.030	0.433	0.207	0.157	0.122
B- N-fertilizer level												
N0	3.17	4.26	1.06	1.42	2.44	3.26	0.83	1.08	1.61	2.47	0.55	0.84
N45	10.67	12.51	3.56	4.09	8.49	10.48	2.81	3.46	7.72	8.58	2.57	2.87
N60	13.33	15.34	4.34	5.17	10.80	12.77	3.56	4.24	9.64	11.01	3.21	3.63
N75	16.00	19.53	5.37	6.58	13.93	16.53	4.62	5.50	11.68	14.16	3.88	4.66
F.Test	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
L.S.D. at 5 %	0.183	0.381	0.215	0.263	0.489	0.379	0.168	0.108	0.415	0.343	0.141	0.111

Table (5). Means of N-loss (ppm) by leaching after second irrigation as affected by tile drainage spacing and N- fertilization level during two seasons .

Treatments	3 days after irrigation				14 days after irrigation				Before the next irrigation			
	NO_3^-		$NH4^+$		NO_3^-		$NH4^+$		NO_3^-		$NH4^+$	
	1st Season		2nd Season		1st Season		2nd Season		1st Season		2nd Season	
A- Drainage spacing :												
60m.	12.88	13.78	4.27	4.61	11.23	12.29	3.70	4.03	9.43	10.26	3.03	3.39
30m.	14.94	15.93	4.95	2.28	12.86	13.68	4.28	4.68	10.83	11.48	3.52	3.80
15m.	17.63	18.63	5.88	6.33	14.81	15.54	4.50	5.10	12.79	13.41	4.23	4.49
F.Test	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
L.S.D. at 5 %	0.243	0.422	0.175	0.137	0.469	0.171	0.186	0.159	0.547	0.529	0.199	0.232
B- N-fertilizer level :												
N0	7.31	7.80	2.41	2.60	5.47	5.74	1.80	1.86	4.50	4.08	1.32	1.34
N45	11.63	13.26	3.83	4.36	9.73	11.50	3.14	3.80	8.43	9.97	2.74	3.32
N60	19.53	20.54	6.54	6.93	17.47	18.00	5.78	6.00	14.44	15.18	4.74	5.04
N75	22.12	22.84	7.36	7.74	19.19	20.11	6.44	6.87	16.77	17.68	5.56	5.87
F.Test	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
L.S.D. at 5 %	0.513	0.675	0.233	0.223	0.643	0.556	0.209	0147	0.532	0.475	0.261	0.303

Table (6). Means of N-loss (ppm) by leaching after third irrigation as affected by tile drainage spacing and N- fertilization level during two seasons .

Treatments	3 days after irrigation				14 days after irrigation				Before the next irrigation			
	NO_3^-		$NH4^+$		NO_3^-		$NH4^+$		NO_3^-		$NH4^+$	
	1st Season		2nd Season		1st Season		2nd Season		1st Season		2nd Season	
A- Drainage spacing												
60m.	15.61	16.48	5.18	5.53	13.05	14.26	4.33	4.80	11.38	12.64	3.80	4.07
30m.	19.78	20.71	6.57	6.98	16.12	16.83	5.85	5.59	13.42	14.67	4.46	4.89
15m.	23.07	23.86	7.67	7.91	19.42	20.31	6.45	6.76	16.48	17.78	5.49	5.77
F.Test	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
L.S.D. at 5 %	0.934	1.18	0.136	0.236	0.832	0.735	0.533	0.345	0.566	0.443	0.122	0.188
B- N-fertilizer level												
N0	8.99	9.56	3.01	3.29	7.11	7.63	3.38	2.49	5.87	6.30	1.92	2.12
N45	16.56	17.90	5.48	5.99	12.90	14.73	4.30	4.91	10.26	12.24	3.41	3.93
N60	22.93	24.46	7.90	8.19	20.52	21.19	7.04	7.12	18.17	18.90	6.04	6.31
N75	28.47	29.30	9.49	9.77	24.24	24.99	8.09	8.34	20.73	22.01	6.96	7.27
F.Test	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
L.S.D. at 5 %	0.850	0.715	0.250	0.298	0.791	0.473	0.307	0.131	0.619	0.647	0.211	0.168

CONCLUSION

In the light of the obtained results , it can be noted that the practical application of nitrogen fertilizers accompanied by tile drainage is important for sustainable soil fertility , economically by reducing N - loss by leaching , and ecolgically by reducing nitrate pollution in the ground water and other harmful impacts on the environment .

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تأثير نظام الصرف المغطى والتسميد النتروجيني على محصول القمح وكفاءة استخدام السماد النتروجيني

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أقيمت تجربتان حقليتان خلال موسمي ١٩٩٩/٢٠٠٠ و ٢٠٠٠/٢٠٠١ بمحطة البحوث الزراعية بالسرو لدراسة تأثير استخدام ثلاث مسافات لنظام الصرف المغطى (١٥-٣٠-٦٠ متر) وأربع معدلات من التسميد النتروجيني (صفر - ٤٥-٦٠-٧٥ كجم / فدان) على محصول القمح وكمية النتروجين الممتص وكذلك كمية النتروجين المفقود عن طريق الغسيل .

وقد أثبتت النتائج المتحصل عليها أن تقليل مسافات الصرف إلى ١٥ متر أدت إلى زيادة معنوية في محصولي الحب والقش ، وكذلك الكمية الممتصة من النتروجين وكذلك الكمية المفقودة من النتروجين عن طريق الغسيل ، ولهذا فإن تقسيم السماد النتروجيني إلى ثلاث دفعات متتالية أدى إلى نقص واضح في كمية النتروجين المفقود بالغسيل .

ومن ناحية أخرى أوضحت النتائج أن زيادة معدل التسميد النتروجيني إلى المعدل الموصى به (٧٥ كجم / فدان) أدى إلى زيادة معنوية في محصولي الحب والقش وزيادة في كمية النتروجين الممتص وكذلك كمية النتروجين المفقود عن طريق الغسيل .

ومن النتائج المتحصل عليها يمكن استنتاج أن تعظيم محصولي الحب والقش يكون عن طريق استخدام مسافات صرف ١٥ متر في نظام الصرف المغطى مع التسميد النتروجيني بمعدل ٧٥ كجم/فدان على ثلاث دفعات . وذلك لتقليل الفاقد من السماد النتروجيني عن طريق الغسيل .