

EFFECT OF N, K AND N APPLICATION TIME ON YIELD AND UPTAKE OF WHEAT PLANTS AT NORTH DELTA

Faizy, S. E. A.¹; M. M. Rezk¹; E. A. E. Gazia² and M. M. A. Amer²

¹Dept. of soil Sci. Fac. of Agric. Kafr El-Sheikh Univ.

² Soil, Water and Environment Res. Instit. A.R.C.

ABSTRACT

A field experiment was carried out during the two successive water seasons of 2002/2003 and 2003/ 2004. The objective of this works was to study the role of N application at tillering stage and effect of K on wheat (*Triticum aestivum L.*) yield, uptake of N, P, K and N-recovery . The obtained results could be summarized as follows:

Grain and straw yields were highly significantly increased with increasing N level up to 120 kg N/fed. (fed=4200 m²) of the two studied wheat varieties. The highest mean values were 21.91and 30.0 ardab grain/fed, (ardab=150 kg) and 5.19 and 6.0 tons straw/fed. for Giza 168 and Sids7, respectively.

Applications of N at tillering stage in the presence of K have a high significant effect on grain and straw yields, of the two wheat varieties.

Application of N by the rates of 24, 60, 18 and 18 kg/fed. at planting, tillering, booting and milk stages dry weight of wheat plants at maturity stage recorded the highest-mean value by about 172.2 %and 198.3 % for Giza 168 and Sids7, respectively.

Applying K increased dry matter at tillering stage, booting and maturity stage for Giza 168 and Sids7.However Sids7 pronounced Giza 168.

N, P and K-uptake by wheat plants was increased for the two studied varieties by N application up to 120 kg N/fed and applying K. Uptake of N, P and K by Sids7 surpassed Giza 168

Increasing N from 75 to 120 kg/fed increased N-recovery and recorded the highest value at tillering stage > booting > maturity stage of the two wheat varieties.

Applying N at tillering stage for Sids7, recorded high N-recovery which surpassed Giza 168 by about 18.69 %.

Applying K increased nitrogen use efficiency (NUE) by about 18.21 % and 19.24 % for Giza 168 and Sids7, respectively.

Increasing N from 75 to 120 kg/fed increased the crude protein content in grains by about 12.47 % and 16.2 % and applying K increased them by 5.48 and 7.06 % for Giza 168 and Sids7, respectively.

Keywords: Wheat (*Triticum aestivum L.*), Nitrogen, potassium, tillering stage, time application, NPK Uptake, NUE, N-recovery and crude protein content%.

INTRODUCTION

Wheat (*Triticum aestivum L.*) is strategic crop because of its indispensable part of food diet. Wheat cultivation is widely scattered all over Egypt. Reducing the gap between production and consumption of wheat is a national policy in Egypt. Wheat is very sensitive to insufficient N. Application of N for wheat as one dose was usually practiced in the past. Recently, Forestar (1973) found that, the grain and straw yields of wheat increased when the N fertilizer was splitted into two or three doses. Moreover, the addition of four N doses gave higher yield than 3 N doses (Rahman *et al* 2002). Also, Faizy *et al.* (1986) found that, the grain yield of wheat was higher when the nitrogen was split into 4 doses than when split into 3 or 2 doses.

Nitrogen use efficiency has been considerably improved by splitting N dressing in winter wheat (Faizy *et al.* 1986 and Mengel and Kirkby 2001).

Potassium is necessary for plant growth, where it plays an integral part. Enzymes are involved in many important plant physiological processes, and over 80 plant enzymes require K for their activation. K-fertilization has a role in decreasing certain plant diseases and improving quality. Thus the intensive agriculture reduced the level of available K in the soil; nowadays insufficient soil K is usually corrected by adding K fertilizer which has a beneficial influence on the development of endosperm cells and hence on the single grain weight of cereals. Genaidy and Hegazy (2001) indicated that 24 Kg K₂O / fed as K₂SO₄ fertilizer increased the yield of wheat by 20.76 %.

Amer (2009) pointed out that N-uptake and recovery by wheat yield was increased with application of nitrogen and potassium, nitrogen use efficiency (NUE) by wheat yield was decreased with increasing application of nitrogen but improved by addition of 50kg K₂O fed⁻¹

Therefore, the main target of this investigation is to study the effect of N level at tillering stage and K fertilization on the yield of two wheat varieties Giza 168 and Sids7 as well as N, P and K uptake by wheat plants.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Farm, Faculty of Agric., Kafr El Sheikh, Tanta Univ. (6 m altitude, 31° 07- latitude and 30° 52- longitude) during two successive seasons of 2002/2003 and 2003/2004 with two wheat varieties Giza 168 and Sids7, to study the effect of two N levels, two levels of K (with and without 50 kg/fed), timing of N application at different physiological stages (planting, tillering, booting and milk) on grain and straw yield, dry weight after tillering , booting and maturity stage, as well as N, P and K uptake by wheat plants.

The experiment was conducted in a split – split - split plot design, with four replicates. The main plots were randomly assigned to timing of doses of N, sub plot were assigned to N level (75 and 120kg/fed.), sub – sub plot to K level and the sub-sub-sub plot to wheat variety. The area of each plot was 3 X 3.5 square meter (1/400) fed. The N was applied as urea (46 % N) in four doses. The first dose was divided into two levels 15, 24, Kg N / fed and broadcasted with 22 Kg P₂O₅ / fed. with 50 Kg K₂O / fed. , as potassium sulphate (48 % K₂O) at sowing. The second dose of nitrogen was applied at the first irrigation with level: 0, 20, 30, 40, 50, 60 Kg N / fed and represented as: D₀, D₁, D₂, D₃, D₄, D₅ and D₆. The rest of N was splitted equally between booting and milk stages Table (1).

Soil samples from the surface layer (0-15) and (15-30) were taken from the experimental sites before planting in two seasons and prepared for physical and chemical analysis. The soil characteristics were presented in Table 2. Also, plant samples were taken randomly at age 45 and 90 day to estimate the wheat yield and dry weight.

Soil samples were air-dried crushed and passed through a 2.0 mm sieve for the chemical analysis, according to Jackson (1967). Cation exchange capacity (CEC): as described by Gohar (1954). Available P

according to Olsen *et al* (1954). and K according to Page (1982). Mechanical analysis was determined according to Piper (1950). Protein concentration (%) was calculated from total N percent in grain yield multiplied by 6.25 according (A. O. A. C. 1980).

Data were analyzed statistically according to procedures outlined by Cochran and Cox (1960).

Table (1). Layout of the Experiment:

TREATMENTS (Kg / fed.)							
D	N Level	Different doses of N at physiological growth stages				P	
		Planting	Tillering	Booting	Milk	P ₂ O ₅	K ₂ O
D0	0	0	0	0	0	0	0
D1	75	15	0	30	30	22	0 50
D2	75	15	20	20	20	22	0 50
D3	75	15	30	15	15	22	0 50
D4	75	15	40	10	10	22	0 50
D5	75	15	50	5	5	22	0 50
D6	75	15	60	0	0	22	0 50
D1	120	24	0	48	48	22	0 50
D2	120	24	20	38	38	22	0 50
D3	120	24	30	33	33	22	0 50
D4	120	24	40	28	28	22	0 50
D5	120	24	50	23	23	22	0 50
D6	120	24	60	18	18	22	0 50

Table (2). Some chemical and physical properties of soil surface layer (0-15 , 15-30) before planting.

Year		2002/2003		2003/2004	
Soil depth cm		0-15	15-30	0-15	15-30
*Soil pH		8.0	8.1	8.1	8.13
EC dsm ⁻¹		2.3	3.6	2.0	2.5
SAR		4	7	5.2	6.8
Available ppm	N	32	17	30	18
	P	12	10	11	10
	K	195	150	201	159
O.M		2.36	2.18	2.41	2.20
Total carbonate %		3.6	3.57	3.55	3.4
CEC m.e./100g soil		45.2	43.1	47.1	44.6
Saturation percent		93	90	91	89
Particle size distribution%	Clay	57.2	58.11	56.90	56.71
	Silt	32.0	31.41	30.29	30.90
	Sand	10.8	10.48	12.81	12.39
Texture grade		clayey	clayey	clayey	clayey

* soil pH : (1: 2.5 soil: water suspension).

**EC dsm⁻¹: (soil paste extract)

RESULTS AND DISCUSSION

-Grain yield:

Data in Table (3) revealed that time of N application has a high significant effect on grain yield of the studied varieties. The highest mean values were recorded at D₆ (15:60:0:0) (24:60:18:18) for both N₇₅ and N₁₂₀. These results were supported by El-Desokey *et al.* (2000) and Warraich *et al.* (2002).

Table (3). Effect of N, K and timing of N application and their interactions on grain and straw wheat yield.

Treatment N dose (D)					Grain yield ardab/fed		Straw yield ton/fed	
D	Plantin g	Tillerin g	Booting	Milk	2003	2004	2003	2004
D ₀	0	0	0	0	6.005	5.5	1.85	1.78
D ₁	15	0	30	30	17.013	17.24	4.15	4.23
D ₂	15	20	20	20	18.319	18.34	4.23	4.31
D ₃	15	30	15	15	19.954	20.007	4.35	4.48
D ₄	15	40	10	10	20.74	20.92	4.52	4.62
D ₅	15	50	5	5	21.070	21.40	4.64	4.69
D ₆	15	60	0	0	20.689	21.62	4.69	4.73
F . test					**	**	**	**
LSD_{0.05}					0.66	0.25	0.35	0.32
LSD_{0.01}					0.90	0.34	0.48	0.44
N level (N):								
N ₇₅					15.709	15.71	3.58	3.67
N ₁₂₀					19.662	20.01	4.54	4.57
F . test					**	**	**	**
K level (K):								
K ₀					16.696	16.75	3.87	3.95
K ₅₀					18.676	18.97	4.25	4.29
F . test					**	**	**	**
Variety (V):								
Sids 7					19.51	19.59	4.32	4.37
Giza 168					15.86	16.13	3.81	3.87
F . test					**	**	**	**
Interaction:								
D x N					**	**	**	**
D x K					**	**	**	**
N x K					*	**	**	**
D x V					**	**	**	**
N x V					**	**	*	*
K x V					**	**	**	**
D x N x K					**	**	**	**
D x N x V					**	**	**	**
D x K x V					**	**	**	**
V x K x N					**	**	**	**
D x N x K x V					**	**	**	**

Data indicated that there were high significant effects on grain yield during the two growing seasons due to the interaction between treatments used in the experiments (Table 3). These results were supported by El Kholy (2000). Data revealed that the highest mean values of grain yield was recorded by N₁₂₀ P₂₂ K₅₀ (D₆) for Giza 168 and Sids 7 (21.91 and 30.0, ardab/fed.), these results were supported by Koreish *et al* (2004).

-Straw yield:

Table (3) showed that straw yield of the studied wheat varieties were highly significantly increased with increasing N level up to 120 Kg/fed. The highest mean values were 5.26 and 6.0 tons/fed. for Giza 168 and Sids 7. These results were supported by El-Sherbieny *et al.* (1999) and Muhammad (2001).

Data revealed that the straw yields of the studied wheat varieties were highly significantly increased in the presence of potassium. The highest mean value was recorded with Sids 7 (6.0 tons/fed.) These results were supported by Genaidy and Hegazy (2001) and Singh and Pathak (2003).

Data showed that time of N application has a high significant effect on straw yield of the studied wheat varieties. The highest mean values were recorded at D₆ (15:60:0:0) (24:60:18:18) for both N₇₅ and N₁₂₀. similar results were reported by El Desouqi (2000).

Data indicated that there were high significant effects on straw yield due to the interaction between the applied treatments (Table 3). Data showed that the highest mean values of straw yield was recorded at N₁₂₀ P₂₂K₅₀ D₅ (15:50:5:5) (5.26 tons/fed. and 6.0 tons/fed respectively, for Giza 168 and Sids7). These results were supported by El – Banna (2000) and Wagan *et al* (2002).

-Dry weight :

- Dry weight of wheat plants at tillering stage:

Data in Table (4) indicated that the dry weight of wheat plants at tillering stage increased by 60.3 % and 59.10 % for Giza 168 and Sids 7 by increasing N level to 120 Kg / fed. Similar result was reported by El Yamany (1994).

Data showed that dry weight of the studied wheat varieties increased in the presence of potassium by about 15.93 %, 18.88 % for Giza 168 and Sids 7, these results supported by Hegab (1994).

Data of N time application revealed high effect on dry weight for the two wheat varieties. The highest relative increase was obtained under D₆ (60 kg N/feddan at tillering) for all N levels 348.2 % and 335.6 % for Giza 168 and Sids 7,. These results supported by El-Desokey *et al* (2000) and werraich *et al* (2002).

Dry weight of wheat plants at booting stage:

Table (4) indicated that the dry weight of wheat plants at booting stage increased 56.15 % and 74.10 % for Giza 168 and Sids 7 by increasing N level to 120 Kg / fed. These results were supported by Adjetey *et al* (2001).

Data revealed that dry weight of both wheat varieties Giza 168 and Sids 7 increased in the presence of potassium (50 Kg K₂O / fed.). The mean values increased by about 10.53 % and 33.64 %for Giza 168 and Sids 7, these results were supported by El Yamany (1994).

Data showed that time of N application have a high effect on the two wheat varieties, where the highest relative increase was obtained under D₆ (348.2 % and 335.6 % for Giza 168 and Sids 7). These results were supported by warraich *et al* (2002).

- Dry weight of wheat yield at maturity stage:

Data indicated that the dry weight of wheat yield was increased 22.24 % and 32.5 % for Giza 168 and Sids 7 by increasing N level to 120 Kg / fed. These results were supported by El-Sherbieny *et al* (1999) and El-Desouqi (2000).

Data in Table (4) showed that dry weight of wheat yield increased in the presence of potassium (50 Kg K₂O / fed.) where the mean value increased 9.49 % and 13.19 % for Giza 168 and Sids 7,. These results were supported by Genaidy and Hegazy (2001).

Data revealed that the time of N application have a high effect on dry weight of the two wheat yield varieties. The highest relative increases were 172.2 % and 198.3 % for Giza 168 and Sids 7 which obtained under D₆ (60 kg N/feddan at tillering) . These results were supported by Koreish *et al* (2004) and Amer (2009)

Table (4). Effect of N, K and timing of N application on the dry weight of wheat plants at different growth stages.

Treatments	Giza 168			Sids 7		
	Tillering	Booting	Maturity	Tillering	Booting	Maturity
N ₇₅	0.456	1.791	5.26	0.528	2.059	5.84
N ₁₂₀	0.731	2.797	6.43	0.842	3.586	7.74
Relative variation %	+60.03	+56.15	+22.24	+59.10	+74.10	+32.5
K ₀	0.549	2.179	5.58	0.625	2.524	6.37
K ₅₀	0.637	2.408	6.11	0.743	3.121	7.21
Relative variation %	+15.93	+10.53	+9.49	+18.88	+23.64	+13.19
Do	0.173	0.593	2.03	0.1995	0.632	2.41
Increase over Do	D1	127.5	198.1	125.2	131.38	159.3
	D2	177.7	243	135.7	177.7	171.8
	D3	224.7	275.4	155.2	225.9	179.3
	D4	266.5	309.9	165.7	271.1	188.8
	D5	314.8	334.5	171.7	316.4	193.8
	D6	348.2	357.5	172.2	335.6	198.3

N, P and K uptake by wheat plant:

1- Nitrogen uptake:

Data in Table (5) showed that N-uptake by grains were increased by about 22.89 % and 56.48 % for Giza 168 and Sids7, by increasing N up to 120 kg/fed. Also N-uptake by grains increased 15.32 % and 25.97 % for the two studied varieties by application of 50 kg K₂O/fed. Similar results were reported by Koch and Mengel (1977). The highest relative increment 486.41 % and 537.9 % for the two studied varieties were obtained under D₆ (24:60:18:18) kg N/fed. However N-uptake by grain yield of wheat variety

Sids7 pronounced N-uptake by grain yield of wheat variety Giza 168. These results were supported by El Sherbieny *et al* (1999) and Staggenborg *et al*. (2003)

Data in Table (5) indicated that N-uptake by straw yield increased by about 41.55 % and 33.32 % for the two studied varieties by increasing N up to 120 kg/fed. Also N-uptake by straw increased by about 12.96 % and 15.5 % for the two studied varieties by application 50 kg K₂O/fed the highest relative increment was 213 % for Giza 168 under D5 (24:50:23:23) kg N/fed and 226 % for Sids7 under D6 (24:60:18:18) kg N/fed. Similar results were reported by Kanani (1996). However N-uptake by straw yield of Sids7 pronounced N-uptake by straw yield of Giza 168 by 9.44%.

Data revealed that N-uptake by wheat plants at tillering stage increased by about 90.4 % and 90.0% over control N₇₅ for the two studied varieties by increasing N from 75 to 120 kg N/fed. Also N-uptake increased by about 19.36 % and 21.73 % for the two studied varieties by applying 50 kg K₂O/fed. The highest relative increments were 507.24 % and 510.5 % for the two studied varieties under D6 (24:60) kg N/fed. These results supported by Kanani (1996).

Data pointed out that N-uptake at booting stage was increased 38.5 % and 44.92 % for the two studied varieties by increasing N up to 120 kg/fed. Also N-uptake at booting stage was increased 12.76 % 17.75 % for the two studied varieties by applying 50 kg K₂O/fed. The highest relative increment 470.88 % and 510.5 % for the two studied varieties by applying 60 kg N/fed at tillering. However N-uptake by wheat variety Sids7 pronounced Giza 168 by 19.41%. Similar results were reported by Rahman *et al* (2002).

Table (5). Effect of N, K and timing of N application on N uptake (Kg/fed) of Giza 168 and Sids 7 (The mean values over two seasons).

Treatments	N uptake						
	Tillering		Booting		Maturity		
	G168	Sids7	G168	Sids7	G168	Sids7	
N75	17.6	20.5	31.2	36.24	51.9	57.3	
N120	33.5	38.7	50.7	61.58	57.5	86.5	
+ %	+90.4	+90.0	+62.7	+69.0	64.4	89.7	
Ko	23.3	26.7	38.5	44.92	55.3	62.9	
K50	27.8	32.5	43.4	52.89	63.4	77.7	
+ %	+19.4	+21.7	+12.7	+17.7	28.3	41.5	
Do	5.38	6.19	8.55	8.34	13.2	14.1	
Increment over Do	D1	216	220	267	295	569	657
	D2	281	283	322	364	577	692
	D3	348	352	365	618	653	691
	D4	406	417	407	512	682	738
	D5	463	484	442	608	699	748
	D6	507	511	471	641	698	764

- Phosphorus uptake:

Table (6) indicated that increasing N up to 120 kg N/fed increased P uptake by the studied wheat varieties at maturity stage 28.9 % and 51.95 % for the two studied varieties. Also P-uptake at maturity was increased 19.82 % and 20.0 % for the two studied varieties by applying 50 kg K₂O/fed. .The highest relative increments were 322.03 and 358.38 % for the two studied varieties by applying 50 kg N/fed. at tillering stage. While P-uptake by wheat variety Sids7 pronounced Giza 168 by 11 %. These results supported by Shams El Din (1989)

Data revealed that P-uptake by wheat plants at tillering stage increased 74.68 % and 72.38% for the two studied varieties by increased N from 75 to 120 kg N/fed. Also P-uptake at tillering stage increased 21.96 and 22.3 % for the two studied varieties by applying 50 kg K₂O/fed. The highest relative increments were 519.2 % and 487.03 % for the two studied varieties by applying 60 kg N/fed. in tillering stage. These results were supported by El-Sherbieny *et al* (1999)

Table (6) showed that P-uptake by wheat plants at booting stage was increased 66.46 % and 90.16 % for the two studied varieties by increased N from 75 to 120 kg N/fed. Also P-uptake was increased 21.03 % and 29.49 % for the two studied varieties by applying 50 kg K₂O/ fed. The highest relative increments were 483.7 and 576.13 % for the two studied varieties by applying 60 kg N/fed. in tillering stage. However P-uptake by Sids7 pronounced Giza 168 by 32.65%. These results were supported by Koreish *et al* (2004) and Amer (2009)

Table (6). Effect of N, K and timing of N application on P (Kg/fed) of Giza 168 and Sids 7 (The mean values over two seasons).

Treatments	P uptake						
	Tillering		Booting		Maturity		
	G 168	Sids7	G 168	Sids7	G 168	Sids7	
N75	1.6	1.81	5.01	5.69	12.16	12.26	
N120	2.8	3.12	8.34	10.82	15.67	18.63	
+ %	+74.68	+72.38	+66.46	+90.16	+28.90	+51.95	
Ko	1.98	2.22	6.04	7.19	12.66	14.04	
K50	2.42	2.72	7.31	9.31	15.17	16.85	
+ %	+21.96	+22.30	+21.03	+29.49	+19.82	+20.00	
Do	0.47	0.54	1.41	1.51	3.54	3.46	
Increment over Do	D1	206.38	198.15	267.38	251.65	244.63	323.12
	D2	272.34	264.81	324.11	325.17	267.79	336.99
	D3	340.42	342.60	365.25	455.6	305.68	347.68
	D4	414.89	396.30	409.92	499.3	311.86	356.06
	D5	470.21	464.81	446.1	554.30	322.03	358.38
	D6	519.15	487.03	483.7	576.13	309.03	355.78

3-Potassium uptake:

Table (7) pointed out that k-uptake by wheat yield was increased by about 35.32 % and 39.03 % for the two studied varieties, by increasing N from 75 to 120 kg/fed. Also K-uptake increased 15.68 % and 26.82 % for the

two studied varieties with applying 50 kg K₂O/fed. The highest increment was 247.39 % for Giza 168 by adding 50 kg N/fed and 234.62 % for Sids7 by applying 60 kg N/fed. at tillering stage. However K-uptake by wheat varieties. Sids7 pronounced Giza 168 by 3.23 %. These results were supported by El Yamany (1994) and El Sherbieny *et al* (1999).

Table (7) showed that k-uptake by wheat at tillering stage increased 64.5 % and 61.86 % for the two studied varieties by increasing N from 75 to 120 kg/fed. K-uptake increased by about 20.45 % 21.41 % for the two studied varieties by applying 50 kg K₂O/fed. The highest increments were 438.47 % and 469.96 % for the two studied varieties by applying 60 kg N/fed. at tillering . K-uptake by wheat plants at booting stage was increased 73.41 % and 69.15 % for the two studied varieties by increasing N from 75 to 120 kg/fed. Also K-uptake increased 30.52 % and 27.8 % for the two studied varieties by applying 50 kg K₂O/fed. However K-uptake by Sids7 pronounced Giza 168by19.64 %. These results were supported by El Beyali *et al*. (2000).

Table (7). Effect of N, K and timing of N application on K uptake (Kg/fed) of Giza 168 and Sids 7 (The mean values over two seasons).

Treatments	K uptake						
	Tillering		Booting		Maturity		
	G 168	Sids7	G 168	Sids7	G 168	Sids7	
N75	16.99	19.43	28.12	34.2	54.43	55.32	
N120	27.96	31.45	48.76	57.80	73.66	76.91	
+ %	+64.6	+61.9	+73.4	+69.2	+35.3	+39.0	
Ko	20.39	22.98	33.35	40.4	59.39	58.30	
K50	24.56	27.90	43.53	51.6	68.70	73.93	
+ %	+20.5	+21.4	+30.5	+27.8	+15.5	+26.8	
Do	5.38	6.18	9.22	9.82	19.52	20.62	
Increment over Do	D1	179.93	154.41	234.59	217.	199.9	204.4
	D2	240.33	233.82	283.84	275	209.58	211.2
	D3	296.84	292.88	317.68	372	224.89	218.6
	D4	345.72	237.06	353.1	435.	242.78	225.
	D5	406.69	401.29	381	468.0	247.39	229.8
	D6	438.47	424.59	404.89	470	244.42	234.6

- N-recovery:

Table (8) pointed out that N-recovery at tillering stage increased 91.95 % and 77.31 % for the two studied varieties by increasing N from75 to 120 kg/fed. Also N recovery by the two wheat varieties increased 27.99 % and 24.64 % for the two studied varieties by applying 50 kg K₂O/fed. However the N recovery was decreased by increasing N doses at tillering stage, where recorded highest value under D1. These results supported by Nankova (1985)

Data showed that N-recovery of wheat varieties at booting stage increased 32.98 % and 33.28 for the two studied varieties by increasing N up to 120 kg/fed. Also, N-recovery at booting stage increased 17.7 % and 26.15 % for the two studied varieties by applying 50 kg K₂O/fed. However N-recovery of

Sids7 pronounced Giza 168 by 26.43 %. These results were supported by Karlen and Sadler (1990).

Table (8) indicated that N-recovery of wheat variety Giza 168 at maturity stage was decreased by (-13.28 %) with increasing N to 120 kg/fed, while N-recovery of Sids7 was increased by 12.69 % with increasing N to 120 kg/fed., N-recovery of wheat variety at maturity was increased 21.92 % and 26.92 % for the two studied varieties with applying 50 kg K₂O/fed. The highest N-recovery was recorded under D5 (50 kg N/fed) for Giza 168 and D6 (60 kg N/fed.) at tillering for Sids7, N-recovery of wheat variety Sids7 (56.9 %) pronounced Giza 168 (47.97 %) by 18.69 %. These results were supported by Blankenau *et al.* (2000).and Amer (2009).

Table (8). Effect of N, K and timing of N application on the recovery percentage of N by Giza 168 and Sids 7 at different growth stages (the values over mean two seasons).

Treatments	Giza 168			Sids 7			
	Tillering	Booting	Maturity	Tillering	Booting	Maturity	
N-levels	75	26.97	35.69	51.35	33.62	45.07	53.50
	120	51.77	47.46	44.35	59.55	60.07	60.29
Relative variation %	%	+91.95	+33	-13.28	+77.1	+33.3	+12.69
K-levels	0	34.54	38.19	43.21	41.48	46.49	50.14
	50	44.21	44.95	52.68	51.70	58.65	63.64
Relative variation%	%	+27.99	+17.7	+21.9	+24.6	+26.2	+26.9
N-Doses	D1	54.83	36.47	39.11	67.5	41.78	51.68
	D2	37.34	39.05	42.82	43.35	44.69	52.69
	D3	36.86	41.66	47.79	42.89	54.57	54.92
	D4	35.94	42.83	52.60	42.33	57.07	58.70
	D5	36.16	44.48	52.69	42.05	60.24	59.69
	D6	34.76	44.92	52.62	41.40	59.12	61.22

N-use efficiency of the two wheat varieties:

Table (9) revealed that N-use efficiency (NUE) of wheat variety Giza 168 decreased about 28.23 % with increasing N from 75 to 120 kg N/fed. while NUE of wheat variety Sids7 increased by about 3.93 % with increasing N from 75 to N120 kg/fed. Also, NUE was increased by 18.21 % and 19.24 % for the two studied varieties by applying 50 kg K₂O/fed. The highest mean value of NUE (23.04 kg grain/kg N) was recorded under D5 (50 kg N/fed) for wheat variety Giza 168, and (27.1kg grain/Kg) and under D6 (60 kg N/fed) at tillering for wheat variety Sids7. However, NUE of wheat variety Sids7 pronounced Giza 168 by 20.39 %. These results supported by Amer (2009).

Table (9). Nitrogen use efficiency of Giza 168 and Sids 7 as effected by N, K and timing of N application (the mean values over two seasons)

Treatments		Giza 168	Sids 7
N-levels	75	23.59	23.91
	120	16.91	24.85
Relative variation %		-28.23	+3.93
K-levels	0	18.56	22.24
	50	21.94	26.52
Relative variation %		+18.21	+19.24
N-Doses	D ₁	14.69	20.93
	D ₂	16.87	22.62
	D ₃	21.39	23.86
	D ₄	22.65	25.14
	D ₅	23.04	26.0
	D ₆	22.86	27.1

-The crude protein content of wheat:

Data in Table (10) pointed that the crude protein content in grains of the two wheat varieties were increased by about 12.47 % and 16.2 % by increasing N from 75 to 120 kg/fed. and was increased by 5.48 and 7.06 % by applying 50 kg K₂O/fed. These results supported by Amer (2009).

Table (10). The crude protein content (%) in grains of two wheat varieties Giza168 and Sids7 (the mean values over two seasons).

Treatments		Giza 168	Sids 7
N-levels	75	11.47	11.25
	120	12.90	13.08
Relative variation %		%	+12.47
K-levels	0	11.86	11.75
	50	12.51	12.58
Relative variation %		%	+5.48
N-Doses	D ₀	6.99	7.49
	D ₁	12.39	12.37
	D ₂	12.32	12.28
	D ₃	12.15	12.15
	D ₄	12.1	12.13
	D ₅	12.07	12.01
	D ₆	12.05	12.03

Thus it can be concluded that

It is recommended to apply 120 kg N/fed. as 24, 60, 18 and 18 at planting, tillering, booting and milking stages, respectively as well as applications of 50 kg K₂O/fed. and 22 kg P₂O₅/fed. before planting. to obtain the maximum values of N-use efficiency, N-recovery, NPK-uptake, crude protein content % and yield for the studied wheat varieties Giza 168 and Sids7 under North Middle Delta conditions.

REFERENCES

- A.O.A.C. (1980). "Association of official Agriculture chemists". (Official methods of analysis) , 13th Ed., Washington, D.C.
- Adjetej.J.A;P.G.E. Searle and L.C. Campbell (2001). Rate and timing of nitrogen fertilizer applications on wheat grown under dry land and supplementary irrigation. South-African-J. of plant and soil, 18:1, 15-20.
- Amer, M.M.A (2009). Response of Wheat Yield to Fertilization by Nitrogen, Potassium and Biofertilizers in Salt Affected Soils. Ph. D Thesis; Soils, Fac Agric. Kafr El – Sheikh Univ., Egypt .
- Blankenau –K; H. Kuhlmann and H.W. OLFS (2000). Effect of increasing rates of 15 N- Labelled fertilizer on recovery of fertilizer N in plant and soil N pools in a pot experiment with winter wheat. J. of plant – nutrition and soil sci. 163:5, 475 – 480.
- Cochran, W.G. and, G. M. Cox (1960). "Experimental Designs", 2 ndded John welly , Newyork,: 293-316.
- El - Banna A. Y. A. (2000). Effect of seeding rates and PK fertilizer levels on grain yield and yield attributes of wheat under newly cultivated sandy soil conditions – Zagazig J . of Agric Res. 27 (5): 1161 – 1178 .
- EL - Beyali , U.S. ;A.I.EL-Shafi and A.H.Ahmed (2000). Efficiency of soil and foliar application of potassium fertilizer on yield , yield components and some nutritional constituents of wheat grain on alluvial Bahtim soil .Egyption Journal of Applied Sciences. 16 : 297-313.
- El - Desokey, M. A.; A. Ghallab and E. A. Teama (2000). Efficient use and uptake of nitrogen for wheat yield in a clay soil in relation to split nitrogen application. Assiut- J. of-Agric. Sci. 31:5, 153-167.
- El - Desouqi, S. A. (2000). Effect of some nitrogen sources on growth and yield of wheat plants. Conf. International Colloquium for the optimization of plant nutrients, yield quality, the environment. 10th . Cairo (EGY). Apr. 8-13.
- El - Sherbieny A. E.; K. G. Soliman and R. M. Ali (1999). Increasing the efficiency of nitrogen fertilizers in newly reclaimed sandy soil. Zagazig J. Agric. Res. 26 : 38, 895-906.
- El Kholy M. A. (2000). Response of wheat growth and yield to plant Density and methods of nitrogen and potassium fertilizers application Egypt. J. Agron. .22, (1-18) .
- El Yamany; S. M. (1994). Study of the Efficiency of some fertilizer treatments on wheat under Different irrigation conditions. ph. D Thesis, Fac. Agric. Kafr El – Sheikh , Tanta Univ., Egypt .

- Faizy, S. E. D. A.; T. M. El-Essawi; R. A. Ali and A. El-Shamly (1986). Splitting nitrogen and the effect of potassium fertilizer on grain yield of wheat, . J. Agric. Res. Tanta Univ., 12(4):1241-1247.
- Forster, H. (1973). Effect of potassium and nitrogen supply to plants on yield components and yield formation of cereals. Landw. Forsch. 26:221-227. (c. f. Mengel, and E. A. Kirkby (2001).
- Genaidy, S. A. and M.A Hegazy (2001). Evaluation for effects of potassium fertilization from sulfate and chloride sources on some main field crops Egypt. J. Agric . Res.,79(2).
- Gohar, A. T. (1954). The influence of Exchangeable cations on physical properties of Egyptian soil M. Sc Thesis, Fac. of Agric. Cairo univ.
- Hegab, M. T. (1994). Effect of nitrogen and potassium on wheat yield under wadi sidr conditions Annals of Agric. Sci.; Moshtohor, 32 (1) , 21-34.
- Jackson , M.L. (1967)." Soil Chemical Analysis" prentice Hall of India Ltd New Delhi.
- Kanani, R. E. E (1996), Effect of irrigation and fertilization on crop yield and nutrient uptake ; Thesis; ph. D.; Soil science; Fac . of Agric, Mansoura Univ.
- Karlen.D.L and J.E. Sadler (1990), Nutrient accumulation rates for wheat in the southeastern coastal plain. Proceedings, International symposium on soil testing and plant Analysis, Aug. 14-18, 1989, Fresno, California; 18 ref.
- Koch, K; and K. Mengel (1977). The effect of K on N fertilization by spring wheat during grain formation Agron. J. 69: 477 – 480.
- Koreish. E. A., M. E. El-Fayoumy, H. M. Ramadan, and W. H. Mohamed (2004). Interaction Effect of organic and mineral fertilization on Falabean and wheat productivity in calcareous soils. Alex. J. Agric. Res. 49 (2) : 101 - 114.
- Mengel; K and E. A. Kirkby (2001). "Principles of plant Nutrition". 5 th Edition KLUWER ACADEMIC publishers Dorotrecht / Boston / London.
- Muhammad ; N.A.(2001). Curve analysis for evaluation of the response of some wheat varieties to different nitrogen fertilization levels . Journal of Agric .sci . Mansoura university 24 (4), 1559-1571..
- Nankova.M (1985). Chemical composition of wheat plants depending on the developmental stage in relation to date and method of nitrogen fertilizer application. Rasteniev 'dnl -Nauki,, 22:8, 24-31.
- Olsen, S.R.; C. V. Cale; F. S. Watenable and L. A. Dean (1954). Estimation of available phosphorus in soil by extraction with sodium bicarbonate U. S. Dept., Agric. Circ., 939.
- Page, A. L. (1982) . Methods of soil analysis. Part 2: Chemical and microbiological properties (2nd ed.) Amer. Soc. Agron. In Soil Sci. Soc. Amr. Inc. Madison, Wisconsin, USA.
- Piper, C. S. (1950). Soil and plant analysis. Inter science Publication. New York.
- Rahman, M. A. ; M. A. Sufian; M. Saifuzzaman and J. Chikushi (2002). Nitrogen management in rice-wheat alternating cropping system and wheat genotype identification preferable to surface seeding condition. J.-of-the – Faculty-of Agric. Kyushu-Univ. 46:2,295-301.

- Shams El-Din, H. A. I. (1989). The efficiency of liquid ammonia and some solid nitrogenous fertilizers on wheat growth and yield. M. Sc. Thesis, Fac. Agric. Mansoura Univ., Egypt.
- Sing.R.N and R.K.Pathak (2003) Effect of potassium and magnesium on yield, their uptake and quality characteristics of wheat (*Triticum aestivum*). Journal of the Indian society of soil science, 2, 181-185.
- Staggenborg.S.A; D.A.whitney; D.L.Fjelland J.P. (2003). Shroyer seeding and nitrogen rates required to optimize winter wheat yields following grain sorghum and soybean.Agronomy-Journal., 95:2, 253-259.
- Wagan M. R; F. C . Oad and K. S. Nenwani (2002). Wheat growth and yield contributing characters under various sources and schedules of nitrogen fertilizer Pakistan – J. – of – Applied – sciences. 2:11, 1013 – 1015.
- Warraich, E. A.; Nazik-Ahmed; S. M. A. Basra and Irfan-Afzal (2002). Effect of nitrogen on source-sink relationship in wheat. International- J. of Agric.-and Biology. 4:2, 300-302.

تأثير إضافة التسميد الأزوتي والبوتاسي وميعاد الإضافة على محصول وامتصاص بعض العناصر لنبات القمح في شمال وسط الدلتا
صلاح الدين احمد فيظي¹، مصطفى محمد رزق¹، السيد عامر السيد جازية² و مجاهد محمد عوض عامر²
¹ قسم الأراضي-كلية الزراعة- جامعة كفر الشيخ
² معهد بحوث الأراضي والمياه والبيئة-مركز البحوث الزراعية

تم إجراء تجربة حقلية بمزرعة كلية الزراعة بكفر الشيخ خلال موسمي 2002/2003، 2003/2004 حيث كان الهدف هو دراسة تأثير إضافة الأزوت في مرحلة التفريع وكذلك التسميد البوتاسي على محصول القمح وامتصاص بعض العناصر، وقد لخصت النتائج المتحصل عليها فيما يلي:

تشير النتائج إلى أن معدلات إضافة النيتروجين ذات تأثير معنوي حتى مستوى 120 كجم نيتروجين / فدان لكل من الصنفين تحت الدراسة وكانت أعلى قيمة للمحصول (متوسط الموسمين) سجل الصنف جيزة 168 21.91 إردب /فدان، وسدس 7 (30.0 إردب/فدان) تم الحصول عليها بإضافة 120 كجم نيتروجين للفدان مقسمة كالتالي (24 : 60 : 18:18) كجم نيتروجين للفدان أثناء مراحل (البذرة-التفريع -الحمل-النضج اللبني) وكذلك بإضافة 50 كجم (بو 2 أ)، 22 كجم (فو 2 أ) مع الزراعة .

توضح النتائج أن معدلات إضافة النيتروجين لها تأثير معنوي على قش القمح حتى معدل 120 كجم نيتروجين /فدان حيث سجل الصنف جيزة 168 5.19 طن/فدان، سدس 7 6 طن /فدان، متوسط الموسمين تم الحصول عليها بإضافة 120 كجم نيتروجين/فدان (24 : 60 : 18: 18) مقسمة على أربع دفعات أثناء (الزراعة-التفريع-الحمل-النضج اللبني)، مع إضافة 50 كجم (بو 2 أ) ، 22 كجم (فو 2 أ) مع الزراعة .

تشير النتائج إلى زيادة المادة الجافة في مرحلة التفريع والحمل والنضج لكل من الصنفين جيزة 168، سدس 7 بينما تفوق صنف سدس 7 على جيزة 168.

تشير النتائج إلى زيادة امتصاص النيتروجين والفوسفور والبوتاسيوم لأصناف القمح تحت الدراسة مع زيادة التسميد الأزوتي والبوتاسي، وقد تم الحصول عليها بإضافة 120 كجم نيتروجين/فدان مقسمة على أربع دفعات (24 : 60 : 18: 18) أثناء الزراعة : التفريع :الحمل: طور النضج اللبني، مع إضافة 50 كجم (بو 2 أ)، 22 كجم (فو 2 أ).

«تبين زيادة النيتروجين المستعاد مع تزايد إضافة النيتروجين من 75 إلى 120 كجم نيتروجين/فدان ولوحظت أعلى القيم في مرحلة التفريع ثم مرحلة الحمل وأخيرا مرحلة النضج. وتبين تفوق الصنف سدس 7 (18.69%) على صنف جيزة 168 « تبين النتائج زيادة كفاءة استخدام النيتروجين مع إضافة البوتاسيوم (18.21%، 19.24%) لكل من الصنفين جيزة 168، سدس 7 بالترتيب مقارنة بدون إضافة. « تبين من النتائج زيادة محتوى الحبوب من البروتين بنسبة (12.47%، 16.2%) مع تزايد إضافة النيتروجين من 75 إلى 120 كجم نيتروجين/فدان لكل من الصنفين جيزة 168، سدس 7 بالترتيب. توضح النتائج زيادة محتوى الحبوب من البروتين بنسبة (5.48%، 7.06%) لكل من الصنفين جيزة 168، سدس 7 بالترتيب مع إضافة 50 كجم بوزاً 2/فدان . للحصول على أعلى محصول مع أعلى كفاءة استخدام للنيتروجين المضاف، والنيتروجين المستعاد، والنيتروجين والفسفور والبوتاسيوم الممتص وكذلك محتوى الحبوب من البروتين لأصناف القمح جيزة 168، و سدس 7 في منطقة شمال الدلتا يمكن التوصية بإضافة 120 كجم نيتروجين/فدان بمعدلات: (18:18:60:24) خلال مراحل النمو: مع الزراعة-التفريع-الحمل-النضج اللبني على الترتيب علاوة على إضافة 50 كجم بوزاً 2/فدان ، 22 كجم فوسفوراً 5/فدان مع الخدمة قبل الزراعة.

قام بتحكيم البحث

كلية الزراعة – جامعة المنصورة
مركز البحوث الزراعية

أ.د / أحمد عبد القادر طه
أ.د / محمد مصطفى رجب