Effect of Nitrogen and Potassium Fertilizer Application at Physiological Growth Stages on Yield of Two Wheat Varieties Grown in the North Middle Delta

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ABSTRACT

Field experiment was carried out at the experimental farm, faculty of Agric., Kafr El Sheikh Univ. during the two successive seasons (2003 and 2004).The objective of the study was to study effect the of N application at tillering stage on wheat (*Triticum aestivum*) yield, its components and harvest index (HI), as well as the effect of K. The obtained results could be summarized as follows:

The grain and straw yields of the two studied wheat varieties was highly significantly increased with increasing N level up to 120 kg N/fed. (fed=4200 m^2) 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. The number of spikes/m^2, number of grains per spike and 1000–grain weight were highly significantly increased with increasing N and K levels. The highest mean value over the two seasons (435 and 300), (83 and 103.5) and (40.45 and 62.9 g) for Giza 168 and Sids7 respectively. N application at tillering stage in the presence of K have a high significant effect on grain and straw yield, number of spikes/m2, number of grains per spike and 1000–grain weight of the two wheat varieties. The highest mean values were recorded at D6. Hence, application of K lead to increasing N U E.The maximum 1000-grains weight was 54 g could be obtained at about 36 kg N/fed. without K addition, while, in the presence of K it was 59 g and could be obtained at 29 kg N/fed. The highest mean values of HI were 41.21 and 42.26% for Giza 168 and Sids7 respectively. K increased the harvest index and were1.88% and 2.31% for Giza 168 and Sids7. 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 K$_2$O/fed. and 22 kg P$_2$O$_5$/fed. before planting. to obtain the maximum values of grain and straw yield for the studied wheat varieties Giza 168 and Sids7 grown under North Middle Delta conditions.

INTRODUCTION

Wheat (*Triticum aestivum*) is strategic crop because of its indispensable part of food diet. It is widely distributed all over the country (2.987 million feddan in 2008), with a mean production of about 2.745 tons/feddan. The national production of wheat is 8.2 million tons/2008 and the national consumption of wheat is about 12.0 million tons in 2008; there is a great gab between the consumption and production. 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. It is found that increasing N fertilizer rate up to 100 Kg N/fed increased number of grains/spike, grain, straw and biological yields (Abd-Elwahed 1997). Cox et al (1989) found that addition of N fertilizer in 2 doses were better. Recently, Faizy 1986a found that addition of N as three doses gave higher yield. Forestar (1973) found that, the grain and straw yields of wheat increased when the N fertilizer was splited 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. (1986b) 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 b and Mengel, 2001). Ministry of agricultural recommends applying N as 3 equal doses.

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 (Schacherer and Beringer 1984). Faizy et al. (1986 b) found that the grain yield of wheat, in the presence of K, was increased significantly at the low and high levels of N. The increase in grain yield by K fertilizer was 5.91 to 7.29%,. In field experiments in Egypt, the response of 6 wheat cultivars (Giza 162, Giza 163, Giza 164 Gimmeza 1, Sakha 69 and Sids 1) to four levels from K fertilizer (12, 24, 36 and 48 Kg K$_2$O / fed.) was studied and their effects on grain yield and some contributing characters. K rate affects all studied characters of wheat cultivars. The interaction effects of wheat cultivars and K fertilizer rate were significant on 1000 grain weight, straw and biological yields. Gennady and Hegazy (2001) that 24 Kg K$_2$O/fed as K$_2$SO$_4$ fertilizer increased the yield of

wheat by 20.76 %.Therefore, the main target of this investigation to study the effect of N and K application was found at tillering growth stage on wheat yield and its components and harvest index (HI) of two wheat varieties Giza 168 and Sids7.

MATERIALS AND METHODS

Field experiment was carried out at the experimental farm, faculty of Agric., Kafr El Sheikh Univ. (6 m altitude, 31° 07- latitude and 30° 52- longitude) during two successive seasons (2002/2003 and 2003/2004) with two wheat varieties: Giza 168 and Sids 7, to study the effect of N, K timing of N application at planting, tillering, booting and milk stages on grain and straw yields, number of spikes/m^2, number of grains per spike and 1000 grain weight. Harvest index (HI) was calculated as follows:

The experiments were conducted in split – split - split plot design, with four replicates. The main plots were assigned to timing of N application. Sub plots were assigned to N level (75 and 120kg/fed.), sub- sub plot assigned to K level (with and without 50 Kg K_2O/fed.) Sub-sub-sub plots assigned to wheat variety. The plot area was 10.5 m^2 (1/400 fed). The N was applied as urea (46 % N) in four doses. The first dose was broadcasted with 22 Kg P_2O_5 / fed. at sowing. The second dose of N was applied at the first irrigation (tillering stage) with levels: 0, 20, 30, 40, 50, 60 Kg N/fed and represented

as: D_1, D_2, D_3, D_4, D_5 and D_6. The rest of N was splited equally between booting and milking development stages, Table 2 show the Layout of the Experiment.

Soil samples, from the surface layers (0-15 and 15-30), were taken from the experimental sites before planting of the two seasons and prepared for physical and chemical analysis. The soil characteristics were presented in Table 1. Also, plant samples were taken randomly at age 45 and 90 day to estimate the wheat Yield and its components. Harvest index, was calculated. Soil samples were air-dried crushed and passed through 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) Total N content by micro-Kjeldahl method (Jackson, 1967). Total Pwas determined according to Snell and Snell, (1967). Total K content using flame photometer (Jackson 1967). Protein concentration (%): was calculated from total N 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).

$$\text{Harvest index} = \frac{\text{Grain yield}}{\text{grain yield + straw yield}} \times 100$$

Table 1. Chemical and physical properties of soil surface layer (0-15, 15-30)before growing seasons

Growing seasons		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 N%		0.17	0.16	0.18	0.15
Total carbonate %		3.6	3.57	3.55	3.4
CEC meq/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

Table 2. Layout of the Experiment

D	N Level	TREATMENTS (Kg / fed.)				P	K
		Different doses of N at physiological growth stages				P_2O_5	K_2O
		Planting	Tillering	Booting	Milk		
Cont.	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

RESULTS AND DISCUSSIONS

Effect of N and K and timing of N application on wheat yield:

Grain yield:

Table 3, Figs. 1 and 2 indicated that grain yield of wheat varieties $Giza_{168}$ and $Sids_7$ was highly significantly increased with increasing N level up to 120 Kg / fed.

The highest mean values of grain yield was 21.91 Ardab/ fed., 30.0 ardab / fed. for $Giza_{168}$ and $Sids_7$., respectively. Similar results was reported by El-Desouqi (2000), Muhammad (2001) and Amer (2009). Data Showed that the grain yield of the two wheat varieties significantly increased in the presence of potassium. The highest mean value was recorded under $Sids_7$ (30.0 ardab / fed.) These results were similar by the data obtained by Genaidy and Hegazay (2001) and Sing and Pathak (2003).Data revealed that time of N application have a high significant effect on grain yield of the studied varieties. The highest mean values were recorded at D_6 (15:60:0:0) (24:60:18:18) for both N_{75}

and N_{120}. Similar results were recorded by El-Desokey et al. (2000) and Warraich et al (2002).

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 8).similar results recorded by El Kholy (2000). Data revealed that the highest mean values of grain yield was recorded by $N_{120} P_{22} K_{50} D_6$ for $Giza_{168}$ and $Sids_7$ (21.91and 30.0, ardab/fed.), similar results were recorded by Wagan et al (2002) and Koreish et al (2004)

Straw yield:

Data in Table 4, Figs. 2 and 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, 6.0 tons/fed. for Giza 168 and Sids 7, respectively. Similar results were recorded 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.). Similar results recorded by Abd Allah et al (1999),

Genaidy and Hegazy(2001); Singh and Pathak (2003).Data showed that time of N application have a high significant effect on straw yield of the studied wheat varieties. The highest mean values were recorded at D_6 (15:60:0:0), (24:60:18:18) for both N_{75} and N_{120}. Ooro and Mwangi (1999), and El Desouqi et al. (2000) reported similar results. Data indicated that there were high significant effects on straw yield due to the interaction between the applied treatments (Table 8).Data showed that the highest mean values of straw yield was recorded at N_{120} $P_{22}K_{50}$ D_5 (15:50:5:5) (5.26 tons/fed. and 6.0 tons/fed for Giza $_{168}$ and Sids$_7$). Similar results were reported by Eisa (1996), El – Banna (2000) and Wagen et al (2002).

Table 3. Effect of N, K and timing of N application on grain yield (ardab/fed.) of Giza 168 and Sids 7 during 2002/2003- 2003/2004 growing seasons

Growth stage	N-level ((Kg/fed.)	Var. Giza 168						Var. Sids 7					
		2002/2003		2003/2004		Mean		2002/2003		2003/ 2004		Mean	
		k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}
Cont.		5.81 d	5.81 c	5.12 e	5.12 c	5.47	5.47	6.20 c	6.2 d	5.75 f	5.75 g	5.98	5.98
D1	75	11.17 c	14.70 b	11.21 d	14.83 d	11.19	14.77	15.96 b	16.94 c	15.92 e	18.96 f	15.94	16.95
D2	75	12.63 c	16.24 b	12.63 c	16.29 c	12.63	16.27	16.5 ab	17.37 c	16.52 e	17.41 f	16.52	17.39
D3	75	17.26 bc	19.04 a	16.6 b	19.21 b	16.93	19.13	16.6 ab	17.89 bc	16.71 cd	17.99 d	16.66	17.94
D4	75	17.89 ab	19.60 a	18.05 a	19.73 a	17.97	19.67	16.7 ab	19.32 ab	16.83 c	19.41 c	16.76	19.37
D5	75	17.81 ab	19.32 a	18.16 a	19.75 a	17.99	19.54	17.6 ab	19.6 ab	17.80 b	19.79 b	17.72	19.70
D6	75	17.82 a	19.29 a	18.09 a	19.76 a	17.96	19.53	18.34 a	20.16 a	18.45 a	20.19 a	18.40	20.18
D1	120	16.22 b	16.80 bc	15.63 e	16.85 e	16.43	16.83	18.4 c	25.90 d	20.64 d	25.89 f	19.52	25.89
D2	120	17.10 ab	17.51 b	17.12 d	17.52 d	17.11	17.15	22.4 b	26.77 cd	22.42 c	26.82 e	22.41	26.79
D3	120	17.92 ab	19.43 a	18.15 b	19.75 b	18.04	19.59	23.49 a	28.0 bc	23.53 b	28.11 d	23.51	28.05
D4	120	18.34 a	20.46 a	18.61 a	20.98 a	18.48	20.72	25.06 a	28.26 ab	23.13 a	28.69 c	25.09	28.62
D5	120	19.04 a	20.85 a	19.25 a	21.98 a	19.15	21.42	25.17 a	29.12 ab	25.29 a	29.19 b	25.23	29.15
D6	120	18.76 a	21.0 a	19.26 a	21.91 a	19.01	21.46	25.20 a	30.37 a	25.32 a	30.0 a	25.26	30.18

Where LSD for 2 D-means at each N x K x V equal (0.66)at 0.05 and (0.90) at 0.01 (2002/2003) and (0. 25) at 0.05 and (0.34) at 0.01 (2003/2004).

Table 4. Effect of N, K and timing of N application on straw yield (t/fed.) of Giza 168 and Sids 7 during 2002/2003 – 2003/2004 growing seasons

Growth stage	N level (Kg/fed)	Var. Giza 168						Var. Sids 7					
		2002/2003		2003/2004		Mean		2002/2003		2003/ 2004		Mean	
		k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}
Cont.		1.75 c	1.75 c	1.65 c	1.65 e	1.7	1.7	1.95 c	1.95 c	1.92 d	1.92 e	1.93	1.93
D1	75	3.15 b	3.65 b	3.20 b	3.68	3.17	3.66	4.0 b	4.0 b	4.10 c	4.12 d	4.0	4.06
D2	75	3.20 b	3.70 b	3.22 b	3.75 c	3.21	3.73	4.01 a	4.22 b	4.10 c	4.32 d	5.05	4.27
D3	75	3.28 b	3.78 b	3.78 a	3.80 c	3.53	3.79	4.0 b	4.30 a	4.1 c	4.38 b	4.0	4.34
D4	75	3.31 a	3.81 a	3.79 a	3.91 b	3.55	3.86	4.10 a	4.35 a	4.21 b	4.40 ab	4.15	4.37
D5	75	3.41 a	3.95 a	3.80 a	3.98 a	3.61	3.97	4.18 a	4.36 a	4.20 b	4.4 ab	4.19	4.38
D6	75	3.68 a	3.98 a	3.79 a	3.90 a	3.74	3.94	4.25 a	4.40 a	4.27 a	4.45 a	4.26	4.47
D1	120	4.11 c	4.51 c	4.21 e	4.61 f	4.16	4.56	4.65 c	5.17 c	4.67 d	5.27 f	4.66	5.22
D2	120	4.20 b	4.61 b	4.30 d	4.70 e	4.25	4.66	4.65 c	5.32 c	4.70 d	5.39 e	4.67	5.35
D3	120	4.31 b	4.90 b	4.41 c	4.92 d	4.36	4.90	4.70 b	5.60 b	4.80 c	5.69 d	4.75	5.64
D4	120	4.83 a	5.0 a	4.86 b	5.0 c	4.84	5.0	4.95 a	5.82 a	4.96 b	5.90 c	4.95	5.86
D5	120	4.98 a	5.25 a	4.97 a	5.28 a	4.97	5.26	5.08 a	5.95 a	5.0 b	5.96 b	5.0	5.95
D6	120	4.95 a	5.19 a	4.95 a	5.20 b	4.95	5.19	5.10 a	6.00 a	5.20 a	6.10 a	5.15	6.0

Where LSD for 2 D-means at eatch N x K x V equal (0.35)at 0.05 and (0.48) at 0.01 (2002/2003) and (0.32) at 0.05 and (0.44) at 0.01 (2003/2004)
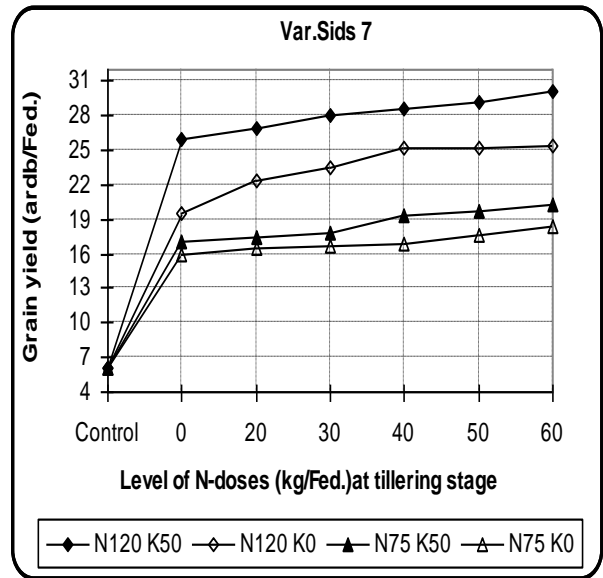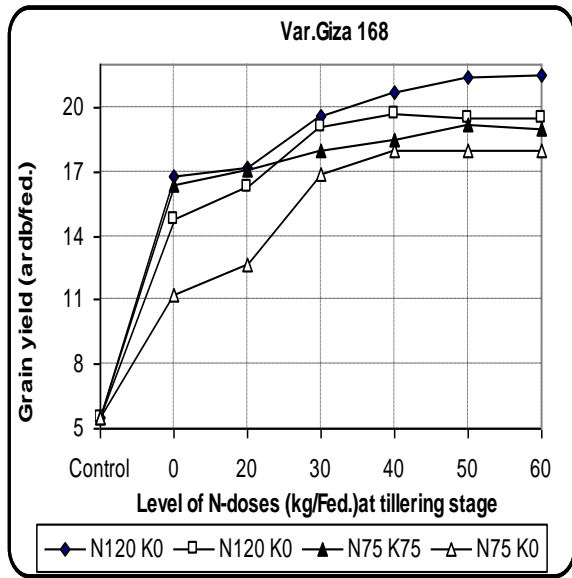
Fig. 1. Grain yield of wheat Giza 168 as affected by N, K and timing of N application

Fig. 2. Grain yield of wheat Sids 7 as affected by N, K and timing of N application
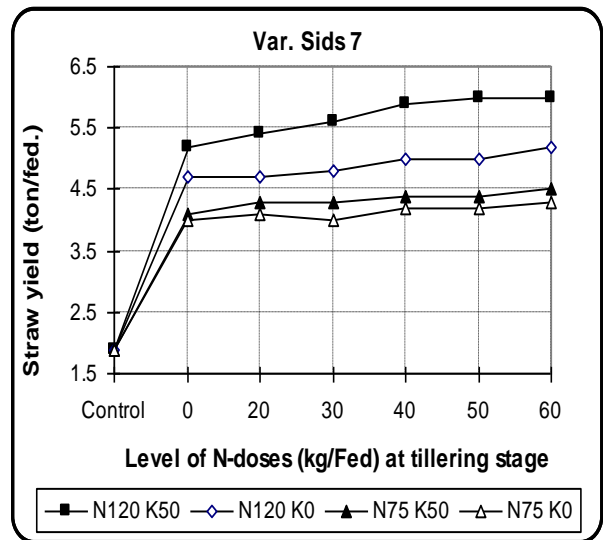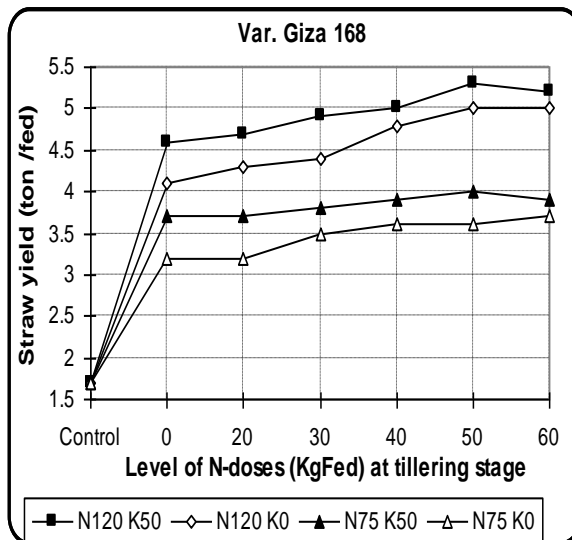
Fig. 3. Straw yield of wheat Giza 168 as affected by N, K and timing of N application

Fig. 4. Straw yield of wheat Sids 7 as affected by N, K and timing of N application

Number of spikes/m^2:

Table 5 showed that the number of spikes / m^2 of the two wheat varieties was highly significantly increased by increasing N level up to 120 Kg / fed. The highest mean values were 436 and 300 for Giza 168 and Sids 7. Similar results were reported by Sabry et al. (1999) and Amer (2009). Data showed that the number of spikes/m^2 of the studied wheat varieties were significantly increased in the presence of potassium and the highest

mean values was recorded with Giza 168 (436) similar results were reported by Singh and Pathak (2003).

Data revealed that time of N application have high significant effect on number of spikes/m^2 of the studied wheat varieties. The highest mean values were recorded at D_6 (15:60:0:0) (24:60:18:18) for N_{75} and N_{120}, similar results were reported by El far and El – Nagar (1995), Rahman et al. (2002) and Warraich et al. (2002).Data indicated that there were high significant effects on

number of spikes/m^2–due to the interaction between treatments (Table 8).

Number of grains/spike:

Data in Table 6 showed that the number of grains per spike of the studied wheat varieties was highly significantly increased by increasing N level up to 120 Kg / feddan. The highest mean values were 83 and 104 for Giza 168 and Sids 7. Similar results were reported by Abd El Wahed (1997), Maqsood et al (2002) and Muhammed (2001). Data showed that, number of grains per spike of the studied wheat varieties was highly significantly increased in the presence of potassium and the highest mean value was recorded under Sids 7. This result was similarly observed by Abd Allah et al. (1999).Data showed that time of N application have high significant effect on number of grains per spike of the studied wheat varieties. The highest mean values were recorded at D_6 (15:60:0:0) (24:60:18:18) for both N_{75} and N_{120} This result was similarly observed by Faizy et al. (1986 b) and Ewart and Honermeier (1999).Data indicated that there were high significant effects on number of grains /spike due to the interaction between treatments (Table 8). This result was similarly observed by El Kholy (2000).

Table 5. Effect of N, K and timing of N application on number of spikes /m2 of Giza 168 and Sids 7 during 2002/2003- 2003/2004 growing seasons

Growth stage	N- level (Kg/fed)	Var. Giza 168						Var. Sids 7					
		2002/2003		2003/2004		Mean		2002/2003		2003/ 2004		Mean	
		k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}
Cont.		186.5 f	186.5 g	180 g	180 g	183.3	183.3	180 e	180 d	175 g	175 f	177.5	177.5
D1	75	260 e	290 f	262 f	292 f	261	291	200 d	200 c	201 f	201 e	200.5	200.5
D2	75	290 d	310 e	292 e	312 f	291	311	210 cd	240 b	211 e	242 d	210.5	241
D3	75	300 cd	330 d	313 d	332 d	306.5	331	220 c	250 ab	226 d	253 c	223	251.5
D4	75	319 b	350 c	321 c	353 c	320	351.5	235 b	258 a	238 c	259 b	236.5	258.5
D5	75	314 bc	365 b	339 b	374 b	326.5	369.5	240 b	260 a	242 b	262 a	241	261
D6	75	350 a	400 a	352 a	390 a	351	395	259 a	260 a	260 a	263 a	259.5	261.5
D1	120	300 e	300 d	302 f	311 f	301	306.5	210 d	250 d	211 f	253 d	210.5	251.5
D2	120	316.75 de	345 c	313 e	347 e	314.9	346	225 c	275 c	228 e	278 c	226.5	276.5
D3	120	320 d	355.75 c	321 d	357 d	320.5	356.4	235 c	285 b	235 d	287 b	235	286
D4	120	346 c	380 b	347 c	382 c	346.5	381	250 b	286.75 b	252 c	289 b	251	287.9
D5	120	380 b	450 a	384 b	435 a	382	442.5	260 b	289.75 a	263 b	291 a	261.5	290.4
D6	120	400 a	440.75 a	400 a	431 b	400	435.9	285 a	299 a	298 a	301 a	291.5	300

Where LSD for 2 D-means at each N x K x V equal (6.96)at 0.05 and (9.55) at 0.01 (2002/2003) and (0.53) at 0.05 and (0.72) at 0.01 (2003/2004)

Table 6. Effect of N, K and timing of N application on number of grains per spike of Giza 168 and Sids 7 during 2002/2003 – 2003/2004 growing seasons

Growth stage	N level (Kg/fed)	Var. Giza 168						Var. Sids 7					
		2002/2003		2003/2004		Mean		2002/2003		2003/ 2004		Mean	
		k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}	k_o	K_{50}
Cont.		42.5 d	42.5 d	36 e	36 d	39.25	39.25	59.5 e	59.5 e	49 f	49 e	54.3	54.3
D1	75	68 c	69 c	69 d	71 c	68.50	70	81 d	89 d	82 e	89 d	81.5	89
D2	75	72.5 b	75 b	70 c	72 b	71.3	73.5	84.75 c	91.25 cd	85 d	92 c	84.9	91.7
D3	75	73 a	75.75 a	72 b	74 b	72.5	74.9	84.5 c	92.25 bc	86 d	93.5 b	85.3	92.9
D4	75	73 a	76.5 a	73 b	74 b	73	75.3	87.75 b	91.8 bcd	88 c	94.5 b	87.9	93.12
D5	75	73.75 a	76 a	75 a	76 a	74.4	76	92 a	94.75 ab	92 b	96 a	92	95.4
D6	75	74 a	77 a	75 a	77 a	74.5	77	93 a	96.75 a	94 a	97 a	93.5	96.9
D1	120	73.75 b	77 c	74 c	75 d	73.9	76	85.75 c	98.5 bc	86 e	96 d	85.88	97.3
D2	120	76.25 b	78 c	75 b	76 c	75.6	77	85.5 c	96.75 c	88 d	98 c	86.8	97.4
D3	120	77 ab	79 b	76 a	79 b	76.5	79	88.25 c	99 bc	94 c	99 b	94.03	99
D4	120	78 a	80 b	78 a	80 a	78	80	94.06 b	99 bc	95.75 b	100 b	92	99.5
D5	120	78 a	83 b	79 a	81 a	78.5	82	94 b	100.3 ab	96 b	104.5 a	95	102.4
D6	120	79 a	84 a	79 a	82a	79	83	99 a	102.75 a	100 a	104.3 a	99.5	103.5

Where LSD for 2 D-means at eatch N x K x V equal (1.45)at 0.05 and (1.99) at 0.01 (2002/2003) and (0.62) at 0.05 and (0.85) at 0.01 (2003/2004)

Table 7. Effect of N, K and timing of N application on 1000- grain weight(g) of Giza 168 and Sids 7 during 2002/2003 – 2003/2004 growing seasons

Growth stage	N level (Kg/fed)	Var. Giza 168						Var. Sids 7					
		2002/2003		2003/2004		Mean		2002/2003		2003/ 2004		Mean	
		k_0	K_{50}	k_0	K_{50}	k_0	K_{50}	k_0	K_{50}	k_0	K_{50}	k_0	K_{50}
Cont.		25.0 e	25.0 e	25.50 e	25.50 c	25.25	25.25	32.50 d	32.50 e	32. 0 c	32.0 e	32.25	32.25
D1	75	37.0 b	37.60 b	37.50 b	37.80 a	37.25	37.65	53.0 bc	55.10 c	53.31 b	55.30 d	53.15	55.2
D2	75	37.1 b	37.60 b	37.80 b	37.80 a	37.5	37.7	53.20 b	56.20 b	53.41 b	56.50 b	53.37	56.35
D3	75	38.0 a	38.50 a	38.0 a	38.11 a	38.0	38.31	53.0 bc	56.30 b	53.20 b	56.50 b	53.1	56.40
D4	75	36.0 c	36.30 c	37.0 c	37.15 b	36.50	36.73	54.50 a	57.0 a	54.0 a	57.0 a	54.25	57
D5	75	35.0 d	35.37 d	36.11 d	37.10 b	35.56	36.21	52.50 c	55.0 d	53.31 b	56.0 c	52.41	55.5
D6	75	35.10 d	35.53 d	36.19 d	36.88 b	35.65	36.21	52.60 bc	55.0 d	53.21 b	55.30 d	52.91	55.15
D1	120	37.6 a	37.7 b	37.5 a	37.9 d	37.55	37.8	54.5 c	61.1 c	54.6 b	61.5 c	54.55	61.3
D2	120	36.25 b	38.1 b	36.6 b	38.0 d	36.42	38.05	54.9 c	59.8 d	54.81 b	60.50 e	54.86	60.15
D3	120	36.0 a	40.15 a	36.4 b	40.75 a	36.20	40.45	56.8 a	65.6 a	55.91 a	62.9 a	56.36	62.75
D4	120	35.50d	38.9 c	36.03c	39.48c	35.76	39.19	56.1 b	61.75b	56.08a	62.41b	56.09	62.08
D5	120	35.40d	35.9 c	35.66d	40.11b	35.53	38	56.35b	59.70d	56.10a	60.97d	56.23	60.34
D6	120	35.0bc	35.9 d	35.9cd	38.10d	35.45	37	56.35 b	61.0 c	55.81a	61.05d	56.08	61.02

Where LSD for 2 D-means at each N x K x V equal (0.83)at 0.05 and (1.14) at 0.01 (2002/2003) and (0.21) at 0.05 and (0.29) at 0.01 (2003/2004).

Table 8. The main effect of N, K and timing of N application and its interactions on yield and some components

Treatment	Grain yield ardab/fed		Straw yield ton/fed		1000 grain weight(g)		No. of spikes / m^2		No of grains /spike	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Cont.	6.005	5.5	1.85	1.78	28.87	28.75	183.13	177.5	51.0	42.5
D1	17.013	17.24	4.15	4.23	46.72	46.92	251.25	254.13	80.82	80.25
D2	18.319	18.34	4.23	4.31	46.65	46.90	275.72	277.88	82.50	82.0
D3	19.954	20.007	4.35	4.48	48.17	47.72	286.97	290.50	82.75	84.19
D4	20.74	20.92	4.52	4.62	47.02	47.93	303.09	305.13	84.21	85.41
D5	21.070	21.40	4.64	4.69	45.67	46.92	307.34	323.75	86.53	87.44
D6	20.689	21.62	4.69	4.73	45.95	46.56	348.22	333.88	88.19	88.53
F . test	**	**	**	**	**	**	**	**	**	**
LSD $_{0.05}$	0.66	0.25	0.35	0.32	0.83	0.21	6.96	0.53	1.45	0.62
LSD $_{0.01}$	0.90	0.34	0.48	0.44	1.14	0.29	9.55	0.72	1.99	0.85
N_{75}	15.709	15.71	3.58	3.67	43.21	43.55	262.25	267.86	77.36	76.30
N_{120}	19.662	20.01	4.54	4.57	45.09	45.35	296.53	292.93	81.60	80.91
F . test	**	**	**	**	**	**	**	**	**	**
K_0	16.696	16.75	3.87	3.95	43.13	43.19	269.71	268.07	83.33	82.52
K_{50}	18.676	18.97	4.25	4.29	45.18	45.71	289.07	292.71	86.76	86.69
F . test	**	**	**	**	**	**	**	**	**	**
Sids 7	19.51	19.59	4.32	4.37	53.02	53.13	242.66	240	87.86	87.38
Giza 168	15.86	16.13	3.81	3.87	35.27	35.78	316.12	320.79	77.12	75.53
F . test	**	**	**	**	**	**	**	**	**	**
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	**	**	**	**	**	**	ns	**	**	Ns
V x K x N	**	**	**	**	**	**	**	**	ns	Ns
D x N x K x V	**	**	**	**	**	**	**	**	ns	**

Table 9. Effect of N, K and timing of N application on harvest index (HI)

Treatment		Giza 168	Sids 7	Relative variation (%)
N level (Kg/fed)	75	41.12	38.63	- 6.06
	120	37.14	42.26	+13.78
Relative variation (%)		-9.67	+ 9.39	
Kg K$_2$O/Fed.	0	38.75	39.98	+ 3.17
	50	39.48	40.19	+ 3.62
Relative variation (%)		+1.88	+ 2.31	
Different doses of N at physiological growth stages	Cont.	32.54	31.75	- 2.42
	D$_1$	36.28	39.25	+ 8.19
	D$_2$	37.84	40.11	+ 5.99
	D$_3$	39.98	40.41	+ 1.08
	D$_4$	40.73	40.81	+ 0.20
	D$_5$	41.64	41.03	- 1.46
	D$_6$	39.75	40.45	+ 3.37

1000 grain weight:

Table 7 indicated that 1000 grain weight of the studied wheat varieties were highly significantly increased by increasing N level up to 120 Kg N/ feddan. The highest mean values were 40.45 and 62.9 g for Giza $_{168}$ and Sids $_7$, respectively. This result was similarly observed by Muhammad (2001) and El Naggar (2003).

Data revealed that 1000-grain weight of the studied wheat varieties was highly significantly increased in the presence of potassium and the highest mean value was recorded under Sids 7. This result was similarly observed by Amer (2009)

Data showed that time of N application have a high significant effect on 1000 grain weight of the studied wheat varieties. The highest mean values were recorded at D$_3$(15:30:15:15),(24:30:33:33) for both N$_{75}$ and N$_{120}$ (38.31, 40.45) with Giza 168, while Sids 7 recorded highest mean value at N$_{75}$ D$_4$ (15:40:10:10) and N$_{120}$ D$_3$. The values were (57.0 and 62.75 g) for N$_{75}$, N$_{120}$. Data indicated there were high significant effects on 1000 grain weight due to the interaction between treatments (Table 8). This result was similarly observed by El Kholy (2000).

Effect of N, K and timing of N application on harvest index (HI):

Table (9) indicated that HI decreased with increasing N level with Giza 168 while it increased with Sids 7 by about 9.39 % by increasing N level from 75 to 120 Kg / feddan. Data showed that time of N application have a high significant effect on HI and recorded high value under D$_5$, D$_6$ for Giza $_{168}$ and Sids $_7$ This result was similarly observed by Wagan et al. (2002). HI was also, significantly affected by K application. Similar results were reported by Singh and Pathak (2003).

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الملخص العربي

تأثير إضافة التسميد الأزوتى والبوتاسى فى مراحل النمو الفسيولوجية على محصول صنفين من القمح النامية فى شمال وسط الدلتا

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تم إجراء تجرب حقلية بمزرعة كلية الزراعة بكفر الشيخ خلال موسمى 2002/2003،2003/2004 حيث كان الهدف دراسة تأثير إضافة الأزوت فى مرحلة التفريع على محصول القمح وبعض مكوناته وكذلك التسميد البوتاسى،وقد لخصت النتائج المتحصل عليها فيما يلى:

تشير النتائج إلى أن معدلات إضافة النيتروجين لها 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 (30.0أردب/فدان)تم الحصول عليها بالإضافة120كجم نيتروجين للفدان مقسمة كالتالى(24: 60: 18:18) كجم نيتروجين للفدان أثناء مراحل (البذرة–التفريع–الحمل–النضج اللبني) وكذلك بإضافة 50 كجم (بو2 أ)، 22كجم (فو 2أ 5) مع الزراعة.

توضح النتائج أن معدلات إضافة النيتروجين لها تأثير معنوي على قش القمح حتى معدل 120كجم نيتروجين/فدان حيث سجل الصنف جيزة 168 5.19 طن/فدان،سدس 67 طن/فدان، متوسط الموسمين تم الحصول عليها بإضافة 120كجم نيتروجين/فدان (24 :60: 18: 18) مقسمة على أربع دفعات أثناء (الزراعة–التفريع–الحمل– النضج البني)، مع إضافة 50كجم(بو2 أ)، 22كجم (فو 2أ5) مع الزراعة.

تبين النتائج إلى زيادة معنوية في عدد السنابل في المتر المربع مع الزيادة في معدل النيتروجين المضاف وكذلك التسميد البوتاسي وكانت أعلى قيمة في عدد السنابل المتر المربع متوسط الموسمين/ 435 سنبلة/م2 لصنف جيزة 168، 300سنبلة/م2صنف سدس 7 تم الحصول عليها مع إضافة120كجم نيتروجين/فدان مقسمة على أربع

دفعات (24 :60: 18:18)، مع إضافة 50كجم (بو2 أ)، 22 كجم (فو2أ5).

تشير النتائج إلى زيادة معنوية في عدد الحبوب في السنبلة لصنفي القمح تحت الدراسة مع زيادة التسميد الآزوتى والبوتاسي وسجلت أعلى القيم (83/سنبلة ، 103.5 /سنبلة) لكل من صنفي جيزة 168،سدس 7 على الترتيب، بإضافة 120كجم نيتروجين/فدان مقسمة على أربع دفعات (24 :60: 18:18)، مع إضافة 50كجم (بو2 أ) في وجود التسميد الفوسفاتي 22كجم (فو2أ5).

تشير النتائج إلى زيادة معنوية في وزن الألف حبة لأصناف القمح تحت الدراسة مع زيادة التسميد الآزوتى والبوتاسي حيث سجل الصنف جيزة 168 40.45 جم/1000حبة،صنف سدس 7 62.9 جم/1000 حبة متوسط الموسمين،وقد تم الحصول عليها بالإضافة 120كجم نيتروجين/فدان مقسمة على أربع دفعات (24 :60: 18: 18) أثناء الزراعة : التفريع :الحمل: طور النضج اللبني، مع إضافة 50كجم (بو2 أ)، 22 كجم (فو 2أ5).

تبين من النتائج أنة يمكن الحصول على أعلى وزن الألف حبة 54جم بإضافة 36كجم أزوت/فدان بدون إضافة البوتاسيوم، بينما مع إضافة البوتاسيوم كان اعلي وزن الألف حبة 59جم بإضافة 29كجم أزوت/فدان.

سجل دليل الحصاد أعلى القيم (41.12%) لصنف جيزة 168 تم الحصول عليها بإضافة 75كجم نيتروجين/فدان،(42.26%) بصنف سدس 7 وتم الحصول عليها بإضافة120 كجم نيتروجين/فدان.أدى التسميد البوتاسي إلى زيادة دليل الحصاد بمعدل (1.88%،2.31%) وسجل دليل الحصاد أعلى القيم عند تقسيم السماد النيتروجيني كالتالي (24: 50: 23: 23) مع الزراعة:

التفريـع:الحمـل: النضــج اللبــني. وتبــين تفـوق الصـنف ســدس 7 (40.45%) على صنف جيزة 168(39.13%)

للحصول على أعلى محصول من الحبوب والقش لأصناف القمح جيزة168، وسـدس 7 في منطقـة شمـال الـدلتا يمكـن التوصـية بإضـافة

120 كجـم نيتروجـين/فدان بمعـدلات: (18:18:60:24) خـلال مراحل النمو: مع الزراعة–التفريع–الحمل–النضج اللبني على الترتيب علاوة على إضافة 50 كجم بو2أ /فدان ، 22 كجم فو2أ5 /فدان مع الخدمة قبل الزراعة.