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EFFECT OF NITROGEN FERTILIZATION LVELS ON POTASSIUM ABSORPTION BY SOME WHEAT VARIETIES IN NORTHERN DELTA REGION

Atia, R.H.
Soils, Water and Environment Research Inst., Agric. Res. Center, Egypt.

ABSTRACT

A field experiment was conducted at Sakha Agricultural Research Station farm, Kafr El-Sheikh Governorate, Egypt during 2008/2009 winter season to assess the effect of nitrogen fertilization levels on potassium. absorption by some wheat (*Triticum aestivum* L.) varieties. Split plot design with four replicates was applied, the main plots were assigned by four wheat varieties , Gimiza 9, Sakha 61, Sakha 93 and Giza 168. The subplots were assigned by four nitrogen levels of 0, 30, 60 and 90 kg N fed.$^{-1}$ (ha = 2.4 fed.). Eight plant samples were collected during the growth periods to determine the daily increase of dry plant weight, N%, and K% in the dry matter, K uptake during the growing periods and K/N ratio during the physiological stages.

The obtained results can be summarized as follow:

- Potassium percentage high significantly decreased during the growth periods up to 111 days from sowing.
- Wheat plant absorbed potassium rapid at tillering stage followed by moderately absorption at stem extension stage followed by relatively slow absorption at heading stage and finally followed by slow absorption at flowering stage.
- There were highly significant differences in potassium percentage between the used varieties after 40 days from sowing.
- Potassium percentage high significantly increased by increasing nitrogen levels up to 90 kg N/ fed.
- The mean values of potassium percentage of the used varieties can be arranged according to the following order : Giza 168 > Sakha 61 > Sakha 93 > Gimiza 9.
- The mean values of K uptake showed that the used varieties arranged in the following order, Giza 168 > Sakha 61 > Gimiza 9 > Sakha 93.
- The highest three mean values of growing stages of 3.697, 4.042 and 3.087 (mg K/plant/day) obtained at the (50-83 days) middle of plant age.
- Potassium uptake increased as nitrogen levels increased from N_0, to N_{30}, N_{60} and N_{90}, respectively.
- The highest values of potassium uptake were obtained at the periods of (50-61), (61-69), and (69-83) days from sowing, at the heading stage..
- The highest K/N ratio values of wheat varieties of 2.93, 2.32, 2.95 and 2.74 were obtained through the period of (69-83) days
- Increasing nitrogen fertilizer levels from N_0 to N_{30}, N_{60} and N_{90} led to decrease K/N ratio from 2.04 to 1.91, 1.97 and 1.86, respectively.
- The K/N ratio values reached its highest value at head development stage in all varieties
- Increasing the wheat yield of different varieties was associated with decreasing K/N ratio .

Keywords: Wheat varieties, N fertilization levels, K%, K uptake and K/N ratio.

INTRODUCTION

Wheat (*Triticum aestivum*, L.) is one of the most important major cereal crops overall the world. Due to its high adaptation and multiple uses, high nutritive value associated with high crop production, it is used as staple food

for more than one third of the world population (Abd Allah and El-Gammaal, 2009). The annual consumption of wheat in Egypt is about 12.4 million tons, while the annual local production is about 8.2 million tons (Ministry of Agric.,2009). Efforts of scientists to minimize the gap between local production and consumption are directed towards two ways i.,e. expanding the cultivated wheat area and increasing the wheat productivity from the land unit area by select the high yielding varieties and balanced fertilization.

Results of many researchers that achieved in Egypt revealed that nitrogen fertilizer levels significantly affected most of plant growth traits, yield and its component. The optimum nitrogen fertilizer level for wheat vary widely in amounts and ranged between 70 to 120 kg N fed.$^{-1}$ according to environmental conditions (Atta Allah and Mohammed, 2003; Tammam and Tawfils, 2004; Salem, 2005; Mowafy, 2008; Mansour and Bassiouny, 2009 and Knany, *et al.* 2011). Application of very high nitrogen rate can reduce grain yield by increasing lodging and disease incidence.

Potassium (K) is an essential nutrient for plant growth. Because large amounts are absorbed from the root zone in the production of most agronomic crops, it is classified as a macronutrient., soils can supply some K for crop production, but when the supply from the soil is not adequate, K must be supplied in a fertilizer program. The content and distribution of inorganic nutrients in different plant stages and removed amounts with the harvest crop determined the nutritive requirements of individual crops (El-Sayied, 2005). Keleg and Abdel-Halim, (1975) stated that the different organs of corn plant showed the highest K% in their first sample, then gradually decreased till the end of experiment.

Much attention is being given recently (after building the High Dam) to the efficient use of potassium fertilizer in Egypt (Keleg and Abdel-Halim,1975). Many investigators (Mohamed, 2005; Mahdy, 2009; Knany, *et al.* 2009 and El-Hamdi,*et al.* 2011) stated that the crops significantly increased as potassium fertilizer added to crops in Egypt.

Knowledge of wheat nutrients requirements and uptake capacities are therefore fundamental to the development of improved nutrients management on wheat, just as they are for other crops (Baethgen and Alley, 1989; and Peng and Cassman, 1998).

The present study aims to investigate the relationships between nitrogen fertilization levels and potassium percentage and potassium uptake during the growth stage periods. and the relationships between K/N ratio and grain yield of four wheat varieties

MATERIALS AND METHODS

A field experiment was conducted at Sakha Agricultural Research Station farm during the winter season of 2008/2009 to study the effect of nitrogen fertilization on potassium absorption by some wheat (*Triticum aestivum* L.) varieties at Northern Delta region (31^{o}05' N latitude and 30^{o}56' E longitude). Four wheat varieties were used, Gemiza 9, Sakha 61, Sakha 93 and Giza 168. The experimental soil was prepared by suitable plowing and

land leveler. The recommended grains weight from each wheat variety (60 kg fed.$^{-1}$) were sown by seed planter 20 cm between the lines on 19th November 2008. Split plot design was used with four replicates. The main plots were randomly assigned by the four wheat varieties and the sub plots were randomly assigned by four nitrogen levels of zero (N_0), 30 kg N fed.$^{-1}$ (N_{30}), 60 kg N fed.$^{-1}$ (N_{60}) and 90 kg N fed.$^{-1}$ (N_{90}), (ha.=2.4 fed.). The subplot area was 12 m^2, 3 m in width (15 wheat lines), and 4 m in length. The previous crop was corn. Phosphorus fertilization was added at the rate of 15.5 kg P_2O_5 fed^{-1} in the form of single superphosphate 15.5 % P_2O_5 during the soil preparation (P_2O_5 = 2.29 x P). Potassium fertilization was added at the rate of 24 kg K_2O fed.$^{-1}$ in one dose with the first irrigation in the form of potassium sulphate 48% K_2O (K_2O = 1.2 x K). Nitrogen fertilization was added at two equal doses with the first and second irrigations (24/12/2008 and 21/1/2009) in the form of urea 46.5% N. Composite soil sample was collected from the experimental soil, prepared to determine some soil properties according to Black *et al.* (1965). Some physical and chemical characteristics are presented in Table (1). Eight plant samples (whole plant) were collected from each sub plot during the main stages of growth period i.e, 30, 40, 50, 61, 69, 83, 97 and 111 days from sowing. The samples consisted from constant number of plants from each plot (4 plants). The plant samples were cleaned thoroughly by the distilled water. After that the fresh plant weight was detected. The samples were oven dried at 70^{o}C for 24 hours. The dry plant weight was determined. Crop growth rate (CGR) defined as the dry matter increase with time was noticed according to Radford (1965) using the formula:

$$CGR = (W_2-W_1)/(T_2-T_1) \text{ gram/plant/day}$$

Where, W_1, W_2, refer to total dry weigh (g/plant) at times, T_1, T_2 days, respectively.

Plant samples were wet digested using sulphuric and perchloric acids, total nitrogen was determined in the plant samples digestion by the microkjldahel method according to Jackson (1967). Potassium was determined using flame photometer. Potassium uptake was calculated by multiplying the potassium concentration by the dry matter as follow:

$$\text{Potassium uptake (g)} = \frac{\text{potassium\% x CGR}}{100} \text{(g)}$$

The obtained results were statistically analyzed using MSTATC computer program.

Table 1: Some physical and chemical soil properties of the experimental soil.

Particle size distribution			Texture	pH*	EC** dSm^{-1}	O.M. %	Available nutrients mg kg^{-1}		
Sand %	Silt %	Clay %					N	P	K
4.9	33.1	62.0	Clayey	8.0	0.53	1.87	21.0	5.5	200

*** pH in 1:2:5 soil: water suspension**
**** EC in 1:5 soil water extract**

RESULTS AND DISCUSSION

1**- Potassium percentage (K%)**

Data in Table (2) show the K% concentration in wheat plant during the growth periods from (0-30) days to,(30-40), (40-50), (50-61), (61-69), (69-83), (83-97) and (97-111) days. It is clear from Table 2 and Fig.1 that the values high significantly decreased along the growth periods up to 111 days from sowing. The mean values decreased from 6.66 % to, 6.23, 5.32, 4.56, 4.18, 3.84, 2.81 and 2.33%, respectively. Data show that the wheat plant absorbed potassium element in the first stage more than the second and the second was more than the third and so on. The potassium % concentration in the first stage was approximately three folds than the final stage. The decreases of K % between the first and second stages and between the second and third and so on were 6.5%, 14.6%, 14.3%, 8.3%, 8.1%, 26.8%, and 17.1%, respectively. This can be divided to four stages, a very rapid absorption at the 40 days followed by moderately absorption at 61 days followed by relatively slow absorption at 83 days and finally followed by slow absorption at 111 days. According to Large (1954), wheat plant absorbed potassium element very rapid in tillering stage followed by moderately absorption at stem extension stage followed by relatively slow absorption at heading stage and finally followed by slow absorption at flowering stage. Data also show that there were insignificant differences between the used wheat varieties in the first period. After 40 days from sowing there were highly significant differences in K% concentration between the used varieties. The mean values of the used varieties can be arranged according to the following order : Giza 168 > Sakha 61 > Sakha 93 > Gimiza 9. Similar results were reported by Keleg and Abdel-Halim (1975), they stated that K% concentration in corn increased to reach their highest values ranging between 4.6% and 6.0% at the age of 45 days and decreased to 1.7% to 2.6% in the later. With respect to irrigation process results showed that the very rapid absorption of k% occurred at the first irrigation (24/12/2009).

Table 2: K% in wheat plant varieties during the growth periods (day).

Varieties	K% during growth periods (day)								
	0-30	**30-40**	**40-50**	**50-61**	**61-69**	**69-83**	**83-97**	**97-111**	**Mean**
Gimiza 9	6.51	5.67	5.18	4.47	4.40	4.15	2.41	2.16	4.37
Sakha 61	6.63	6.42	5.67	4.62	4.16	3.82	3.06	2.09	4.56
Sakha 93	6.75	6.53	5.01	4.33	4.14	3.71	2.83	2.30	4.45
Giza 168	6.75	6.29	5.40	4.83	4.01	3.67	2.92	2.75	4.58
Mean	6.66	6.23	5.32	4.56	4.18	3.84	2.81	2.33	4.49
F. test	---	**	**	**	**	**	**	**	
L.S.D.0.5	---	0.31	0.13	0.17	0.14	0.30	0.090.	0.063	

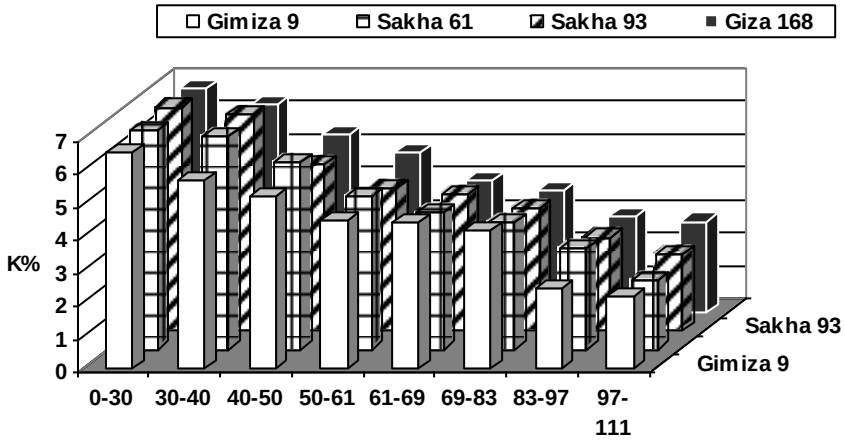

Fig. 1: Effect of N levels on K% of wheat varieties during the growth periods.

Results in Table (3) reveal that K% concentration high significantly increased by increasing nitrogen levels in all the collected samples except (0-30) days from sowing, it was insignificant. The mean values of K% concentration increased from 3.84 % to 4.50%, 4.90% and 4.69 % as nitrogen levels increased from N_0 to N_{30}, N_{60} and N_{90} respectively. The increase values from N_0 to $N_{30,}$ N_{60} and N_{90} were 17.2%, 28.1% and 22.1% respectively. The values in Table 3 showed that K% concentration was the highest as N_{60} level used in all periods except (0- 30) days. These results illustrate the importance of potassum fertilization to increase wheat yeild. El-Hamdi, *et al.* indicated that the highest value of K% in tomato fruits was obtained with multi commercial nutrient (NPK 20-20-20).

Table 3: Effect of N levels on K% during the growth periods (day).

Treatments	K% during growth periods (day)								
	0-30	30-40	40-50	50-61	61-69	69-83	83-97	97-111	Mean
N_0	6.66	5.84	4.60	4.04	3.29	2.78	2.13	1.40	3.84
N_{30}	6.66	6.30	5,52	4,45	4.14	3.81	2.74	2.40	4.50
N_{60}	6.66	6.49	5,68	4.99	4,72	4.53	3.23	3.07	4.92
N_{90}	6.66	6.27	5.47	4.76	4.57	4.24	3,12	2.42	4.69
Mean	6.66	6.23	5.32	4.56	4.18	3.84	2.81	2.32	4.49
F. test	---	**	**	**	**	**	**	**	
L.S.D.0.5	---	0.09	0.11	0.053	0.053	0.14	0.027	0.027	

Data presented in Table (4) show the interaction between the wheat varieties and N levels which were high significantly in all the collected samples except (0- 30) days from sowing. The mean values of (0-40), (40-61), (61-83), and (83-111) days were 6.09%, 4.83%, 4.28 % and 2.29%, respectively as Gimiza 9 was used. While the mean values were 6.53%, 5.15%, 3.99% and 2.58% respectively as Sakha 61 was used. As Sakha 93

and Giza 168 were used the mean values were (6.53%, 5.15%, 3.99%,2.58%) and (6.52%, 5.12%, 3.84%, 2.84%), respectively. At (0-40) period Sakha93 recorded the highest K% followed by Sakha 61, Giza 168 and Gimiza 9,but at (40-61) period Sakha 61 recorded the highest value compared with other varieties. At (61-83) period the Gimiza 9 was the highest value, while Giza 168 recorded the highest value at (83-111) period. With respect to the first and second irrigations (24/12/2009 and 21/1/2009) results showed that the highest values was obtained in this stage. The differences between wheat varieties may be due to the differences in the root volume and the root surface area. In general all the study varieties , potassium percentage decreased with increasing wheat age, also increasing N levels due to increasing K uptake.

Table 4: Effect of N levels on K% of wheat varieties during the growth periods (day)..

Treatments		K% during growth periods (day)								
		0-30	**30 -40**	**40-50**	**50-61**	**61-69**	**69-83**	**83-97**	**97-111**	**Mean**
Gimiza 9	N_0	6.51	4.84	4.17	3.71	3.51	3.12	2.00	1.42	3.66
	N_1	6.51	5.69	5.40	4.33	4.25	4.17	2.24	2.09	4.34
	N_2	6.51	6.14	5.58	5.23	5.23	4.95	2.81	2.59	4.88
	N_3	6.51	5.99	5.58	4.60	4.60	4.37	2.59	2.52	4.60
Mean		6.51	5.67	5.18	4.47	4.40	4.15	2.41	2.16	4.37
Mean		6.09		4.83		4.28		2.29		4.37
Sakha61	N_0	6.63	6.60	4.68	4.33	3.51	3.35	2.55	1.50	4.14
	N_1	6.63	6.53	6.06	4.42	4.04	3.43	2.96	2.59	4.58
	N_2	6.63	6.55	6.16	5.07	4.60	4.25	3.65	2.75	4.96
	N_3	6.63	5.99	5.77	4.64	4.50	4.25	3.08	1.50	4.55
Mean		6.63	6.42	5.67	4.62	4.16	3.82	3.06	2.09	4.56
Mean		6.53		5.15		3.99		2.58		4.56
Sakha93	N_0	6.75	6.10	4.60	3.51	3.28	2.50	1.89	1.37	3.75
	N_1	6.75	6.67	5.03	4.25	4.00	3.59	2.81	2.46	4.45
	N_2	6.75	6.69	5.19	4.60	4.43	4.43	3.12	2.89	4.76
	N_3	6.75	6.67	5.23	4.95	4.86	4.33	3.51	2.46	4.85
Mean		6.75	6.53	5.01	4.33	4.14	3.71	2.83	2.30	4.45
Mean		6.64		4.67		3.93		2.57		4.45
Giza 168	N_0	6.75	5.81	4.95	4.60	2.85	2.16	2.09	1.31	3.82
	N_1	6.75	6.30	5.58	4.78	4.25	4.04	2.96	2.46	4.64
	N_2	6.75	6.59	5.77	5.07	4.60	4.47	3.35	4.04	5.08
	N_3	6.75	6.44	5.30	4.86	4.33	4.00	3.28	3.20	4.77
Mean		6.75	6.29	5.40	4.83	4.01	3.67	2.92	2.75	4.58
Mean		6.52		5.12		3.84		2.84		4.58
Average		6.66	6.23	5.32	4.56	4.18	3.84	2.81	2.33	4.49
F. test		---	**	**	**	**	**	**	**	
L.S.D.0.05			0.18	0.22	0.11	0.11	0.28	0.053	0.053	

2- K uptake

Data presented in Table (5) show that there were highly significant differences in potassium uptake (mg/plant/day) between the used wheat varieties in the periods of (30-40), (40-50), (61-69), (69-83), (83-97) and (97-111). The periods of (0-30) and (50-61) were insignificant. The mean values of K uptake showed that the used varieties arranged in the following order, Giza 168 > Sakha 61 > Gimiza 9 > Sakha 93. Giza 168 had the highest potassium uptake value of 0.493, 3.048, 4.001, 5.643, and 4.073 (mg

K/plant/day) through the periods of (0-30), (30-40), (50-61) (61-69) and (97-111) days from sowing, respectively. The highest K uptake value for Sakha 61 variety was 4.298 (mg K/plant/day) in the period of (40-50) days from sowing, while the highest K uptake value for Gimiza 9 variety was 3.990 (mg K/plant/day) in the period of (69-83) days from sowing. Data also show that the highest three mean values of growing stages of 3.697, 4.042 and 3.087 (mg K/plant/day) obtained at the (50-61),(61-69) and (69-83) day, the middle of plant age.

Table 5: Effect of wheat varieties on K uptake in plant tissue during growth period (mg/plant/day)..

Varieties	K uptake during growth periods (mg/plant/day)								
	0-30	30-40	40-50	50-61	61-69	69-83	83-97	97-111	Mean
Gimiza 9	0.391	3.014	1.712	3.951	2.954	3.990	1.561	2.880	2.557
Sakha 61	0.444	2.523	4.298	2.903	3.780	3.780	2.184	1.277	2.649
Sakha 93	0.473	2.885	1.768	3.932	3.790	1.530	3.033	2.415	2.478
Giza 168	0.493	3.048	1.149	4.001	5.643	3.048	2.218	4.073	2.958
Mean	0.450	2.868	2.232	3.697	4.042	3.087	2.249	2.661	2.661
F. test	---	**	**	---	**	**	**	**	
L.S.D.0.5	---	0.071	0.089	---	0.015	0.032	0.045	0.032	

Results in Table (6) show that K uptake by wheat varieties high significantly affected by the nitrogen levels. In most growth periods, K uptake increased as nitrogen levels increased. The mean values increased from 1.428 mg/plant/day to 2.471, 3.304, and 3.407 mg/plant/day as nitrogen levels increased from N_0, to N_{30}, N_{60} and N_{90}, respectively. It is clear that the increase of nitrogen addition enhance potassium uptake along the growing plant periods. The highest K uptake values obtained in the periods (50-61), (61-69) and (69-83). This may be due to the increase in vegetative growth. The decrease of K uptake in the first period (0-30) due to the plant weight , but the decrease of K uptake in the periods (83-97) and (97-111) due to the K % concentration.

Table 6: Effect of N levels on K uptake in plant tissue during growth periods (mg/plant/day)..

Treatments	K uptake during growth periods (mg/plant/day)								
	0-30	30-40	40-50	50-61	61-69	69-83	83-97	97-111	Mean
N_0	0.450	2.061	0.828	2.024	2.416	1.857	1.002	0.791	1.428
N_{30}	0.450	2.762	1.951	3.533	3.850	2.224	2.187	3.108	2.471
N_{60}	0.450	3.217	3.021	3.977	4.968	3.868	2.831	4.099	3.304
N_{90}	0.450	3.429	3.129	5.254	4.934	4.398	2.976	2.646	3.407
Mean	0.450	2.867	2.232	3.697	4.042	3.087	2.249	2.661	2.661
F. test	---	**	**	**	**	**	**	**	
L.S.D.0.5	---	0.063	0.063	0.87	0.16	0.032	0.063	0.055	

Results in Table (7) show the interaction between the wheat varieties and N levels which were highly significant in all the collected samples except (0- 30) period, which was insignificant. The mean values of (0-40), (40-61), (61-83), and (83-111) days were 1.703, 2.832, 3.472, and 2.221(mg/plant/day) respectively as Gimiza 9 was used. This results show that K uptake increased until it reached the maximum value at (61-83) period and then decreased at the next period. The mean values of Sakha 61 were

1.484, 3.601, 3.780 and 1.731(mg/plant/day), respectively at (0-40), (40-61), (61-83) and (83-111) days. As Sakha 93 and Giza 168 were tested the mean values were (1.679, 2.850, 2.66,2.724) and (1.771, 2.575, 4.346, 3.146) at (0-40), (40-61), (61-83) and (83-111) days, respectively. The average of results in table 7 show that K uptake reached its maximum values at (61-69) days and decreased after that. This means that the highest K uptake value obtained at the heading stage. Also data show that K uptake increased as N levels increased where the highest values of (3.347 and 3.228) were obtained as N_{90} levels used with Sakha 61 and Sakha 93 varieties, but with Gimiza 9 and Giza 168 the highest values of (3.340 and 4.001) were obtained as N_{60} level. Antoun *et al.* (2010) stated that increasing the rate of applied nitrogen fertilizer up to 100 Kg/fed. gradually increased the amount of NPK uptake . This might be attributed to the role of nitrogen nutrient in increasing the root surface unit of soil volume and the high capacity of the plant supplied with N in building metabolites, which increase the dry matter content and subsequently increase nutrients uptake by wheat plant.

Table 7: Effect of wheat varieties and N levels on K uptake in plant tissue during growth periods (mg/plant/day).

Treatments		K uptake during growth periods (mg/plant/day)								
		0-30	30 -40	40-50	50-61	61-69	69-83	83-97	97-111	Mean
Gimiza 9	N_0	0.391	1.742	0.584	0.965	1.158	2.621	0.620	2.016	1.262
	N_1	0.391	2.674	1.242	4.287	3.315	2.127	1.165	4.389	2.449
	N_2	0.391	3.745	2.399	5.125	4.446	5.792	2.051	2.771	3.340
	N_3	0.391	3.894	2.623	5.428	2.898	5.419	2.409	2.344	3.175
Mean		0391	3.014	1.712	3.951	2.954	3.990	1.561	2.880	2.557
Mean		1.703		2.832		3.472		2.221		2.557
Sakha61	N_0	0.444	1.980	1.404	2.988	3.370	2.479	1.046	0.615	1.791
	N_1	0.444	2.416	4.181	2.387	3.555	2.950	2.546	1.399	2.485
	N_2	0.444	2.882	5.606	1.876	4.416	4.420	2.373	1.760	2.972
	N_3	0.444	2.815	6.001	4.362	3.780	5.270	2.772	1.335	3.347
Mean		0.444	2.523	4.298	2.903	3.780	3.780	2.184	1.277	2.649
Mean		1.484		3.601		3.780		1.731		2.649
Sakha93	N_0	0.473	2.257	0.828	3.405	1.345	0.600	0.775	0.164	1.231
	N_1	0.473	2.935	1.710	3.443	3.600	1.113	3.794	3.346	2.552
	N_2	0.473	3.011	2.284	3.634	4.430	1.506	4.087	3.786	2.901
	N_3	0.473	3.335	2.249	5.247	5.783	2.901	3.475	2.362	3.228
Mean		0.473	2.885	1.768	3.932	3.790	1.530	3.033	2.415	2.478
Mean		1.679		2.850		2.660		2.724		2.478
Giza 168	N_0	0.493	2.266	0.495	0.736	3.791	1.728	1.566	0.370	1.429
	N_1	0.493	3.024	0.670	4.015	4.930	2.707	1.243	3.296	2.547
	N_2	0.493	3.229	1.789	5.273	6.578	3.755	2.814	8.080	4.001
	N_3	0.493	3.671	1.643	5.978	7.274	4.000	3.247	4.544	3.856
Mean		0.493	3.048	1.149	4.001	5.643	3.048	2.218	4.073	2.958
Mean		1.771		2.575		4.346		3.146		2.958
Average		0.450	2.868	2.232	3.824	4.039	3.087	2.249	2.672	2.662
F. test		---	**	**	**	**	**	**	**	
L.S.D.0.05		---	0.107	0.13	1.47	0.272	0.053	0107	0.092	

3- K/N Ratio

Data presented in Table (8) show that there were high significantly differences in K/N ratio between the tested wheat varieties. The highest K/N

ratio values of 2.93, 2.32, 2.95 and 2.74 were obtained through the period of (69-83) days from sowing as Gimiza 9, Sakha 61, Sakha 93 and Giza 168 were used, respectively. These results reveal to highly absorption of potassium in this period. The mean values of K/N ratio of wheat varieties increased from 1.61 to 1.84, 1.96, 1.65, 2.14, 2.74, 1.62, and 2.00 in the periods of (30-40), (40-50), (50-61), (61-69), (69-83), (83-97) and (97-111) days.These results show that the absorption was active in the first three periods followed by a low absorption which followed by highly active absorption in heading stage followed by a little value and again increased. These results reveal to effect of irrigation water on availability of potassium ion adsorbed on clay minerals surfaces. The mean values of K/N ratio can be arranged as following : Giza 168 > Sakha 93 > Gimiza 9 > Sakha 61. Data in Table 8 show that there is no clear relationship between K/N ratio and wheat varieties.

Table 8 : K/N ratio of wheat varieties in the plant tissue during growth periods(day).

Varieties	K/N ratio during growth periods (day)									Yield
	0-30	30-40	40-50	50-61	61-69	69-83	83-97	97-111	Mean	Kg/fed
Gimiza 9	1.75	1.69	1.74	1.46	2.19	2.93	1.64	2.02	1.93	1765.1
Sakha 61	1.66	1.77	1.95	1.65	2.05	2.32	1.81	1.70	1.86	1628.6
Sakha 93	1.51	2.11	2.06	1.61	2.04	2.95	1.41	2.07	1.97	1286.3
Giza 168	1.51	1.79	2.10	1.87	2.29	2.74	1.60	2.20	2.01	1596.0
Mean	1.61	1.84	1.96	1.65	2.14	2.74	1.62	2.00	1.94	1569.0
F. test	---	**	**	**	**	**	**	**		
L.S.D.0.5	---	0.038	0.046	0.060	0.071	0.075	0.057	0.088		

Data presented in Table (9) show that increasing nitrogen fertilizer levels led to decrease K/N ratio, where the mean values decreased from 2.04 to 1.91, 1.97 and 1.86 as N levels increased from N_0 to N_{30}, N_{60} and N_{90} respectively. At (0-30) period there were no differences between the N levels. All other periods were highly significant. Increasing the nitrogen levels from 0 to 30, 60 and 90 kg N $fed.^{-1}$ led to decrease the K/N ratio in the periods of (30-40), (40-50), (50-61), (61-69) and (69-83).These results show that increasing N fertilizer levels encouraged the vegetative growth of plant and dilution effect of potassium was occurred. At the period of (97-111) the increase of N levels led to increase the K/N ratio. This may be to accumulate potassium ion in plant tissue.

Table 9: Effect of N levels on K/N ratio in the plant tissue during growth periods (day).

Treatments	K/N ratio during growth periods (day)									Yield
	0-30	30-40	40-50	50-61	61-69	69-83	83-97	97-111	Mean	Kg/fed
N_0	1.61	1.96	2.05	2.03	2.67	2.75	1.57	1.66	2.04	911.4
N_{30}	1.61	1.81	1.82	1.43	2.29	2.60	1.60	2.08	1.91	1738.8
N_{60}	1.61	1.80	2.00	1.58	1.94	2.95	1.73	2.18	1.97	1755.6
N_{90}	1.61	1.80	1.98	1.55	1.68	2.66	1.56	2.07	1.86	1870.1
Mean	1.61	1.84	1.96	1.65	2.14	2.74	1.62	2.00	1.94	1569.0
F. test	---	**	**	**	**	**	**	**		
L.S.D.0.5	---	0.038	0.046	0.060	0.071	0.075	0.057	0.088		

It can be said that the soil supply for potassium ion increased as plant grows to maturity except two periods (50-61 and 83-97 days). In respect to wheat yield, it is clear that decreasing K/N ratio was associated with increasing the yield of wheat varieties.

Data presented in Table (10) reveal that the differences between the used wheat varieties in K/N ratio were highly significant in all periods except the period (0-30) where it was insignificant. The head development stage had the highest K/N ratio values in the all varieties comparing to the other stages. The highest K/N values of Gimiza 9 (3.37), Sakha 61 (2.34), and Sakha 93 (3.52) were at (69-83) period as N_{60} level used but Giza 168 was at (69-83) period as N_0 used. Results in Table (10) show that Giza 168 had the highest K/N ratio (2.01) followed by Sakha 93 (1.97), Gimiza 9(1.93) and Sakha 61 (1.86). This means that Giza 168 has high response to the nitrogen fertilization compared to the others varieties.

Table 10: Effect N levels on K/N ratio of wheat varieties in the plant tissue during growth periods (day).

Treatments		K/N ratio during growth periods (day)									Yield Kg/fed.
		0-30	30 -40	40-50	50-61	61-69	69-83	83-97	97-111	Mean	
Gimiz 9	N_0	1.75	1.69	1.65	1.39	2.79	2.79	1.68	1.69	1.93	1117.2
	N_1	1.75	1.69	1.75	1.55	2.17	2.84	1.45	2.30	1.94	1927.8
	N_2	1.75	1.72	1.77	1.49	1.92	3.37	1.75	1.95	1.97	1999.2
	N_3	1.75	1.65	1.77	1.40	1.88	2.71	1.68	2.12	1.87	2016.0
Mean		1.75	1.69	1.74	1.46	2.19	2.93	1.64	2.02	1.93	1765.1
Sakha61	N_0	1.66	2.05	1.76	2.06	2.28	2.28	1.82	1.43	1.92	911.4
	N_1	1.66	1.79	1.88	1.37	2.31	2.33	1.92	2.06	1.92	1881.6
	N_2	1.66	1.67	2.00	1.57	1.99	2.34	2.01	1.96	1.90	1953.0
	N_3	1.66	1.58	2.17	1.58	1.61	2.34	1.47	1.34	1.72	1768.2
Mean		1.66	1.77	1.95	1.65	2.05	2.32	1.81	1.70	1.86	1628.6
Sakha93	N_0	1.51	2.42	2.35	1.79	2.47	2.50	1.29	1.96	2.04	802.2
	N_1	1.51	1.99	1.50	1.35	2.04	2.70	1.38	1.76	1.78	1230.6
	N_2	1.51	2.12	2.18	1.73	1.92	3.52	1.49	2.06	2.07	1289.4
	N_3	1.51	1.91	2.20	1.57	1.74	3.09	1.47	2.51	2.00	1822.8
Mean		1.51	2.11	2.06	1.61	2.04	2.95	1.41	2.07	1.97	1286.3
Giza168	N_0	1.51	1.69	2.44	2.86	3.13	3.43	1.49	1.56	2.26	814.8
	N_1	1.51	1.76	2.15	1.42	2.64	2.51	1.63	2.20	1.98	1915.2
	N_2	1.51	1.68	2.06	1.54	1.93	2.55	1.65	2.75	1.96	1780.8
	N_3	1.51	2.04	1.76	1.65	1.47	2.48	1.62	2.29	1.85	1873.2
Mean		1.51	1.79	2.10	1.87	2.29	2.74	1.60	2.20	2.01	1596.0
Average		1.61	1.84	1.96	1.65	2.14	2.74	1.62	2.00	1.94	1569.0
F. test		**	**	**	**	**	**	**	**		
L.S.D.0.05		0.10	0.075	0.11	0.12	0.13	0.14	0.12	0.18		

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وزارة الزراعة(2009). مساحة القمح في مصر قطاع الشئون الاقتصادية التابع لوزارة الزراعة المصرية.

تأثير مستويات التسميد النتروجيني علي امتصاص بعض أصناف القمح لعنصر البوتاسيوم في منطقة شمال الدلتا

رجب حجازى عطية

معهد بحوث الأراضى والمياه والبيئة ـ مركز البحوث الزراعية ـ مصر

أقيمت تجربة حقلية بمزرعة محطة البحوث الزراعية بسخا ـ محافظة كفرالشيخ ـ مصر خلال الموسم الشتوي لعامي 2008-2009م لدراسة تأثير مستويات التسميد النتروجيني علي امتصاص بعض أصناف القمح للبوتاسيوم حيث تم تقدير النسبة المئوية لتركيز البوتاسيوم والكمية الممتصة ونسبة البوتاسيوم إلي النتروجين خلال فترات النمو المتتالية للنبات. استخدم تصميم القطع المنشقة فى أربع مكررات. شغلت القطع الرئيسية بأربعة أصناف قمح هى: جميزه 9 ، سخا 61 ، سخا93 وجيزة 168 كما شغلت القطع الشقية بأربعة مستويات نيتروجين هى: صفر ، 30 ، 60 و 90كجم ن/فدان (هكتار = 2.4 فدان). تم جمع ثمان عينات نباتية خلال فترات النمو المتتالية لتقدير الصفات السابقة

ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

- تناقصت النسبة المئوية للبوتاسيوم داخل النبات بقيمة عالية المعنوية علي امتداد فترات النمو حتى 111 يوما.
- أوضحت النتائج أن امتصاص عنصر البوتاسيوم كان سريعا في مرحلة تكوين الأشطاء ثم كان متوسط السرعة في مرحلة الاستطالة ثم كان بطيئا نسبيا في مرحلة طرد السنابل ثم بطيئا في مرحلة التزهير.
- كانت هناك اختلافات عالية المعنوية بين الأصناف في النسبة المئوية للبوتاسيوم بعد أربعين يوما من الإنبات.
- ازدادت النسبة المئوية للبوتاسيوم بقيمة عالية المعنوية بزيادة مستويات النتروجين حتى 90 كجم/فدان.
- يمكن ترتيب متوسطات النسبة المئوية لتركيز البوتاسيوم لأصناف القمح كما يلي: جيزة 168> سخا61 > سخا93 > جميزة9 .
- يمكن ترتيب متوسطات البوتاسيوم الممتص لأصناف القمح كما يلي: جيزة 168> سخا61 > جميزة 9 > سخا93.
- كانت أعلي ثلاث متوسطات لقيم البوتاسيوم الممتص 3.697, 4.042, 3.087 بو/نبات/يوم في الفترات (50-61),(61-69),(69-83) يوما من الإنبات.
- ازداد البوتاسيوم الممتص بزيادة مستويات النتروجين من صفر/ فدان إلى 30كجم ,60كجم, 90كجم ن / فدان على التوالي.
- كانت أعلى قيم للبوتاسيوم الممتص خلال الفترات التالية:(50-61), (61-69),(69-83) من الإنبات ,فترة طرد السنابل.
- كانت أعلي نسبة بين البوتاسيوم والنتروجين لأصناف القمح المستخدمة 2.93 , 2.32, 2.95, 2.74 خلال الفترة (69-83) يوما من الإنبات.
- أدت الزيادة في مستويات النتروجين المضاف من صفر إلى 30, 60, 90 كجم ن/ فدان إلى نقص النسبة بين البوتاسيوم والنتروجين من 2.04 إلى1.91, 1.97, 1.97 علي التوالي.
- بلغت النسبة بين البوتاسوم والنتروجين أعلي قيمة لكل الأصناف المدروسة في مرحلة الاستطالة.
- أوضحت النتائج أن زيادة المحصول كانت مصاحبة لنقص النسبة بين البوتاسيوم والنتروجين.

قام بتحكيم البحث

أ.د / محمد وجدي العجرودي	**كلية الزراعة – جامعة المنصورة**
أ.د / عبد الله همام عبد الهادي	**مركز البحوث الزراعية**