J.Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 8 (12): 693 - 702, 2017

Effect of Nitrogen and Potassium Fertilization on Yield and Nitrogen Use Efficiency of Two Wheat Cultivars Grown under Sprinkler Irrigation in Sandy Soil.

Abd El-All, A. E. A. [1]**; E. Ghalab** [2] **and Asal M. Wali** [3]

[1] **Soils& Water and Environment Res. Inst. Agric. Res. Center, Giza, Egypt**

[2] **Wheat Res. Department ,Field Crops Institute, Agric. Res. Center, Giza, Egypt**

[3] **Plant Production Department, Arid Lands Cultivation Res. Inst. City of scientific Res. and Technological Applications (SRTA-City),New Borg El-Arab, Alexandria, Egypt.**

ABSTRACT

Two field experiments were conducted at El-Bostan area at Aly Mubarak experimental farm south Tahrir region, El-Beheira governorate, Egypt, during 2013/2014 and 2014/2015 to investigate the validity of two wheat cultivars (Sakha 93 and Giza 168) for growing under sprinkler irrigation in sandy soil at El-Bostan area, Also to study the effect of different nitrogen and potassium rates on the productivity of the studied wheat cultivars and their effect on nitrogen use efficiency. A split-split plot design in three replicate were used, where wheat cultivars (Giza 168 and Sakha 93) were lay in the main plots and three nitrogen fertilization levels (60, 90 and 120 kg N/fed "0.42 ha^{-1}) were lay in sub-plot and three potassium levels (24, 36 and 48 kg K_2O/fed) were distributed randomly in the sub-sub plots. Data showed that wheat cultivars Giza 168 have the highest biological, grain and straw yield than Sakha 93 as a mean values of the two growing seasons grain and straw yield for wheat cultivars Giza 168 and Sakha 93 were 2.25 and 3.64 ton/fed, and were 1.73 and 3.04 ton/fed, respectively. Total nitrogen uptake for Giza 168 was higher than Sakha 93 by 27.88 % as a mean values of the two growing seasons. Nitrogen uptake significantly affected by wheat cultivars and was higher for Giza 168 than Sakha 93 indicating that Giza 168 has higher ability to absorb nitrogen which resulted in increasing the growth (biological yield). Rising nitrogen and potassium application significantly increase nitrogen and potassium uptake by wheat cultivars for the two growing seasons 2013/2014 and 2014/2015. Nitrogen use efficiency (NUE) was significantly higher for Giza 168 than Sakha 93 and decreasing with increasing nitrogen application rates during the two growing seasons. Potassium application has significant positive effect on NUE. Nitrogen utilization efficiency (NUtE) was significantly higher for Giza 168 (48.16) than Sakha 93 (43.92) during the two growing seasons indicating that Giza 168 has a good ability to utilize their absorbed nitrogen than Sakha 93. Nitrogen application significantly increase NUtE and the relative increase as a mean values of the two growing seasons were 4.09 and 11.27 % for 90 kg N/fed and 120 kg N/fed, respectively compared to 60 kg N/fed. Increasing potassium application rate significantly increase NUtE during the two growing seasons. The interaction effect between the studied variable are not significant for the most measured and calculated parameters in the two growing seasons except for the interaction between nitrogen and potassium applications, the treatment 120 kg N/fed+48 kg K/fed with Giza 168 was higher than other treatments in the most valuable parameters (biological, grain, straw yield, harvest index, nitrogen utilization efficiency (NUtE)). The previous results conclude that under sprinkler irrigation in sandy soil at El-Bostan region, El-Behiera governorate, Egypt , wheat cultivar Giza 168 is more valuable than Sakha 93 with 120 kg N/fed and 48 kg K/fed during the growing season based on grain yield and the associated NUtE .

INTRODUCTION

Al most of people in Egypt depend on wheat grain in their food and there is a great gap between consumption and production, hence scientific institutes search how to increase wheat productivity under marginal and low fertile soils for that the good strategy to increase wheat productivity in these soil, firstly is cultivated the suitable wheat cultivar to the area conditions, secondly were the cultivation practices such as soil preparation, fertilization (organic, biofertilizer and mineral), irrigation. Weed, pest and diseases managements.

Wheat cultivars genetically differ in their ability to grow under a certain environmental conditions, nitrogen and potassium application rates. Many studies reported that wheat cultivars significantly differed in the most growth characteristics .These differences may be due to the genetic differences among the three cultivars in photosynthesis translocation rate from leaves to the storing sites i.e. the grain (Abd ElMonem 2000, Hafez 2007, Abdel-Razik 2002, Tabl *et al.,* 2005, Abu-Grab *et al.,*2006, Koriem 2008 and Radwan *et al.,* 2014).

Radwan *et al.,* (2014) reported that Sakha 94 cultivar gave higher number of tillers/m2, number of spike/m2, number of spikelet's/spike, 1000-grain weight, grain, straw and biological yields tons/fed., than Misr 1 and Giza 168 cultivars in both seasons. Also, Sakha 94 cultivar significantly surpassed Giza 168 and Misr 1cultivars or crude protein percentage, nitrogen content (%), phosphorus (%) and potassium content (%) in both seasons. Also, increasing nitrogen and potassium rates increased nitrogen and potassium content. Badawy, *et al.,* (2011) reported that application of organic matter, elemental Sulphur application, and increasing rates of mineral N-fertilization significantly affected wheat growth characteristics and increased nitrogen and phosphorous uptake. The optimum economic rate of mineral N-fertilization for wheat grown on this sandy calcareous soil is 90 kg N/fed on the other hand Atta Allah and Mohamed, 2003 authorized that the optimum nitrogen fertilization level for different wheat varieties varies widely depending on soil type and fertility level and may be ranging between 80 up to 160 kg N/fed. Abd El-Hameed, 2012 investigate the response of four wheat cultivars (Egypt 1, Sakha 94, Sids 12 and Sids 13) to different nitrogen fertilizer rates (50, 75 and 100 kg N/fed) under sprinkler irrigation system in sandy soils and reported that there were significant differences among the four wheat cultivars in all studied characters and wheat cultivar Sids 13 followed by Sids12 and Egypt 1 recorded the highest values regarding spike length (cm), number of spikelets per spike, number of grains per spike, grain weight (gm) per spike and grain yield. The increase of N level from 50 to 75 and up to 100 kg N/fed led to significant increase in aforementioned characters in both seasons and their combined analysis.

Many investigators reported that wheat cultivars differ in yield and yield attributes (Gafar (2007), Ramadan and Awaad (2008) and El-Murshedy (2008). Ashmawy and Abo-Warda (2002) showed that wheat cv. Giza-168 was significantly high in grain yield per fed, number of grains per spike and 1000-grain weight than Sids-1 and Gemmeiza-9 cultivars Moreover; Abd El–Hameed (2005) found that, wheat cultivar Giza-168 gave higher values of grain yield than Sakha-93. Zeidan *et.al*., (2009) reported that there were significant differences among three wheat cultivars, where, Sids 1 was superior and gave the highest values for the studied attributes (grains per spike, grain weight per spike, 1000- grain weight and grain yield) followed by Giza 168 ,while Sakha 93 have the lowest values. However, Amin *et al.* (2010) reported that, wheat cultivar Gemmeiza-9 gave the highest number and weight of grains per spike and grain yield followed by Sakha 93 and Giza 168.

Nitrogen is the most important element for several vital functions as it plays an important role in plant life. Shaaban (2006) found significant increase in wheat grain yield grown under sandy soil conditions due to the increase of application rates up to 40 kg per fed with organic nitrogen addition on the other hand, Gafar (2007) reported that there is significant increases in number of spikelets and grains per spike, 1000- grain weight and grain yield to the increase of N level up to 60 kg N per fed. Weber *et al.* (2008) showed that the increase of nitrogen application rates up to 180 kg per hectare significantly increase grain yield. Abou-Amer *et al.,*2012 investigate the application of three nitrogen rates in three application methods (soil, foliar, or combinations of both methods) to approach the goal yield of wheat by using the least possible nitrogen level via either soil, foliar, or both. Data showed that all nitrogen fertilization levels and methods were significantly better than the control treatment regarding wheat grain, straw, and biological yields, growth parameters, and NPK uptake in both plant parts. Antoun, Linda *et al.,* 2010 study the effect of different rates of nitrogen fertilizers 0, 25, 50, 75 and 100kg N/fed. from recommended dose (100kg/fed) with or without composted rice straw and / or humic acid on wheat plants grown in sandy soil and reported that increasing mineral nitrogen fertilizer level from 25 to 50, 75 and 100 kg N/fed resulted in significant increases in grain and straw yields/fed. Also, NPK uptake of grain and straw were significantly increased.

Abdallah, Amany *et al.,* 2013 studied the response of two wheat cultivars via, Sakha 69 and Gemmiza 10 to mineral nitrogen fertilizer with or without biofertilizers and reported that Varieties and bio chemical fertilizers had a significant effect on most of wheat traits and shoot and grain uptake of N, P and K under these certain study where Gemmiza 10 cultivar was superior than Sakha 69. Many investigators found that wheat grain and straw yields, yield components, protein and carbohydrate contents and N,P and K uptake were increased with raising nitrogen application rates Salem *et al.,* 2004, Madiha *et al.,* 2004 .

In general, the amount of N accumulated by the crop is affected by many factors such as type and rate of nitrogen fertilizer, timing of application, the genetic potential of the species or cultivar to absorb N, climate, rooting pattern and soil conditions. Fertilizer N uptake by crop is generally low. The efficiency of N fertilizer is expressed in several ways (Novoa and Loomis, 1981) but the term "nitrogen use efficiency: NUE" has usually referred to the relation between yield and N rate (yield or agronomic efficiency), between N recovered and N rate (N recovery efficiency), or between yield and N recovered (physiological efficiency).

According to Moll *et al.,* (1982) nitrogen use efficiency is Gw/Ns where Gw is grain yield and Ns is the N applied to soil. This definition is a basis for evaluation soil and plant physiological processes including productivity with respect to N use. Moll *et al.* (1982) in their analysis of NUE (Gw/Ns), defined two primary components of NUE: (i) the efficiency of absorption and uptake (Nt/Ns) and (ii) the efficiency with which the N absorbed is utilized to produce grain (Gw/Nt) where Nt is the total N in the plant at maturity (grain+stover), Ns is the N supply or rate of fertilizer N, and Gw is the grain weight, all expressed in the same units.

There are several strategies to improve NUE, among these balanced nutrition, especially balancing N and K nutrition to achieve the synergistic effect between N and K, is important both in irrigated as well as rainfed production systems (Ganeshamurthy and Srinivasarao, 2001). Cassman *et al*., 2002 illustrate that more than 50% of the applied N is not assimilated by plants. Under optimal climate conditions the highest values of nitrogen recover efficiency was about 50%. The N use efficiency for global cereal crops was nearly of 33%, and an increase of 1% NUE was estimated to be worth US$234 million (Megan and Nosov, 2008). Adequate and balanced fertilization with N, P, and K give the highest nitrogen recoveries with an average of 54% compared to the unbalanced fertilization (N was applied alone) which give the lowest nitrogen recoveries of 21% (Fixen and West, 2002).

K application enhance uptake of N hence, helps in increasing the NUE. There are positive interaction between K application in presence of N nutrition on yield which resulted in increasing NUE (Bruns and Ebellhar, 2006), Brennan and Bolland, 2009 on Wheat). When wheat plants fertilized with moderate N level (112.5 kg N ha-1), K application highly increased yield of wheat than when N or K fertilizer was applied singly. Optimum N:K ratios fertilization increment plant to grow and develop healthy on the other hand imbalance fertilization of N and K supply is detrimental to plant growth (Wells and Wood, 2007). Application of K enhances the activities of nitrate assimilating enzymes which facilitate the uptake and transport of nitrate towards aerial parts of the plant, resulting in improving the NUE (Anjana *and Iqbal* 2009).

The objective of this study was to investigate the validity of two wheat cultivars (Sakha 93 and Giza 168) for growing under sprinkler irrigation in sandy soil at El-Bostan area, Also to study the effect of different nitrogen and potassium rates on the productivity of the studied wheat cultivars and their effect on nitrogen use efficiency.

MATERIALS AND METHODS

Two field experiments were conducted in sandy soil in El-Bostan area - Aly Mubarak experimental farm, South El-Tahrir region, (30.570 N latitude and 30.710 E longitude), El-Beheira Governorate, Egypt, during the two growing seasons of 2013/2014 and 2014/2015 to investigate the effect of different application rates of nitrogen and potassium fertilizers on yield of two wheat cultivars (Giza 168 and Sakha 93) and to investigate the validity of these two wheat cultivars to grown under sprinkler irrigation system and sandy soil conditions.

Split-split plot design with three replications was used. The treatments in the main plots (plot area were 12 m^2) were two different wheat cultivars Sakha 93 and Giza 168 whereas the nitrogen levels (60, 90 and 120 kg N/fed) were assigned in the sub-plots and three potassium fertilizer levels (24, 36 and 48 kg K_2O/fed) were distributed randomly in the sub-sub plots.

Wheat grains were sown on the 19th and 25th of November in the first and second seasons, respectively. Grains were drilled in rows at the rate 60 Kg/Fed. Phosphorous in form of super phosphate (15.5 % P_2O_5) at rate of 30 kg P_2O_5/fed was added before sowing and during land preparation. Nitrogen fertilizer was added in form of ammonium nitrate (33.5% N) in 5-equal dose; the 1st one was added at after 15th days of planting and other doses were applied every fifteen days. Potassium in form of potassium sulfate (48 % K_2O) was added in 2-equal doses with the first and the second dose of nitrogen fertilizer application. Soil physical and chemical properties the experimental site were analyzed according to Jackson, 1973 and Page *et. al.,* 1982 and presented in Table 1.

Table 1. Soil physical and chemical characteristics of the experimental site (mean values of the two growing seasons).

Soil depth (cm)	**Particle size %**			**Texture class**	**Available nutrients (mg/kg soil)**			**F.C %**	**W.P %**	**A.W**
	Sand	**Silt**	**Clay**		**N**	**P**	**K**			
0-15	90.5	5.5	4.0	Sandy	10.55	8.1	40.4	12.3	5.3	7.0
15-30	92.6	2.9	4.5	Sandy	6.5	5.8	25.7	11.1	4.3	6.8
Soil depth (cm)	BD, gm/cm^{-3}	pH	EC ds/cm	Soluble cations and anions (meq/l)						
				Ca^{+2}	Mg^{+2}	Na^+	K^+	HCO^{3-}	SO4 $^{-2}$	Cl-
0-15	1..62	8.6	1.11	3.6	1.95	4.8	0.6	3.51	1.86	5.7
15-30	1.71	8.8	1.23	4.2	1.86	5.4	0.9	3.75	1.92	6.6

Agronomic data:

1-Biological yield (ton/fed.) was determined as the total weight of all above ground wheat plants after harvesting of each plot.

2-Grain yield (ton/fed.) was estimated as the weight of grains for each plot and converted to grain yield ton per fed.

3-Straw yield (ton/fed.) was recorded as total above ground dry matter minus grain yield of each plot and converted to (ton/fed.).

4-Harvest index (%): was calculated as a ratio of (grain yield/ biological yield) x100

Sampling and measurements:

1-Soil sampling and analysis:

At harvest stage, disturbed soil samples were collected from each plot for two depths (0-15 and 15-30 cm) to determine chemical analysis. The amount of available nitrogen was extracted by 1M KCl solution (Page *et. al.*, 1982) and soil available potassium in soil was extracted by ammonium acetate (NH_4OAC), 1N, pH=7.00 and measured by flame photometer (Black, 1965).

2-Plant sampling and analysis:

Wheat samples of grains and straw were collected from each plot, each plant sample was washed with tap water several times then by distilled water, dried in an oven at 70 C^0 for 48 hrs,. Oven-dried plant material was ground in a stainless steel mill and stored in polyethylene bags for analysis. Half gram of the oven-dried plant material was subjected to wet digested with H_2SO_4 and H_2O_2 (Chapman and Pratt, 1961). The concentration of nitrogen was measured by macro-Kjeldahl (Jackson, 1973) using automatic Kjeldahl and the concentration of potassium was determined by flame photometer (Chapman and Pratt, 1961).

Nutrients uptake by plant:

Uptakes were calculated according to Westerman (1990):

Grain N and K uptake, kg NK fed-1 = NK concentration, % × grain yield, kg fed-1

Straw N and K uptake, kg NK fed-1 = NK concentration, % × straw yield, kg fed-1

Total N and K uptake, kg NK fed-1 = Grain NK uptake + Straw NK uptake

Nitrogen Use and utilization Efficiencies.

I. Nitrogen Use Efficiency (NUE) was calculated according to Moll *et al.* (1982) as follows:

NUE = Gy / applied Nf

Where:

Gy: grain yield kg/fed

Nf: rate of applied nitrogen kg/fed

II. Nitrogen utilization efficiency (NUtE): is the ratio of Gy to Nt and was calculated as follows:

NUtE = Gy/Nt

Where:

Gy: grain yield kg/fed

Nt : Total N uptake kg/fed

Data were statistically analyzed according to Steel and Torrie (1980) for all studied traits using SAS Program (2007).

RESULTS AND DISCUSSION

1-Effect of nitrogen and potassium fertilization on yield of Sakha93 and Giza 168 wheat cultivars.

Table (2) indicate that there is significant differences for wheat biological yield between the two cultivars Sakha 93 and Giza 168 for the two growing seasons as a mean values for the first growing season biological yield were 4.72 and 5.41 and were 4.81 and 6.35 ton/fed for Sakha 93 and Giza 168 for the two growing seasons, respectively. Many studies reported that there are significant differences between the different wheat cultivars (Abd ElMonem, 2000 on Sakha 69 and Sids 6, Radwan *et al.,* 2014 on Sakha 94 Giza 168 and Misr 1, Zaki, Nabila *et al.,* 2007 on Sakha-93, Gemiza-7 and Gemiza-9, Abdallah, Amany *et al.,* 2013 on Sakha 69 and Gemmiza 10).

Nitrogen application significantly increased biological yield of the two wheat cultivars where biological yield increased from 4.11 to 4.97 and 6.13 ton /fed for the first growing season and increased from 4.48 to 5.40 and 6.86 ton/fed for the second growing season for 60, 90 and 120 kg N/fed, respectively. Also, Potassium fertilizers significantly increased biological yield of Sakha 93 and Giza 168 where it increased from

4.62 to 5.51 ton/fed at the 1st growing season and from 5.10 to 6.07 ton/fed at the 2nd growing season for 24 and 48 potassium levels, respectively. Data in Table 2 also, indicate that nitrogen application have more valuable effect on biological yield than potassium application where the relative increases in biological yield were 49.1% for nitrogen fertilizers application and were 19.26 % for potassium fertilizers application for the 1st growing season and the same trend were found for the 2nd growing season. These data are agree with Badawy, Farida *et al.,* 2011, Abd El-Hameed, 2012.

Data in table (2) also, indicate that there is significant effect in wheat grain yield between the two wheat cultivars Sakha 93 and Giza 168 for the two growing seasons 2013/2014 and 2014/2015. These results are agreed with Abd ElMonem, 2000, Gafar 2007, Ramadan and Awaad 2008, El-Murshedy 2008 and Ashmawy and Abo-Warda 2002. Raising nitrogen fertilizer application from 60 to 120 kg N/fed significantly increase grain yield from 1.46 to 2.37 ton/fed, respectively for the 1st growing season 2013/2014 and from 1.64 to 2.63 ton/fed, respectively for the second growing season 2014/2015. Wheat grain yield significantly increased with increasing potassium application rates where it increased from 1.70 to 2.02 ton/fed with increasing potassium application rates from 24 to 48 kg K/fed., respectively for the first growing season and two wheat cultivars, the same trend was found for the second growing season.

The interaction effects were not significant between the studied variable except for the nitrogen and Potassium interaction effect (B x C) where the grain yield significantly increased from 1.40 ton/fed. to 2.69 ton/fed. at the first growing season and from 1.57 to 2.82 ton/fed. at the second growing season for 24 kg K/fed + 60 kg N/fed and 48 kg K/fed.+ 120 kg N/fed treatments, respectively.

Table 2. Effect of different rates of nitrogen and potassium fertilization on biological and grain yield of Sakha 93 and Giza 168 wheat cultivars under sprinkler irrigation and sandy soil conditions.

Treatments		biological yield (ton/fed)							
		1st season (2013/2014)				2nd season (2014/2015)			
Wheat cultivars	**Potassium levels (kg/fed)**	**Nitrogen levels (kg/fed)**							
		60	**90**	**120**	**Mean**	**60**	**90**	**120**	**Mean**
	24	3.45	4.48	5.39	4.44	3.63	4.17	5.59	4.46
Sakha93	36	3.75	4.70	5.63	4.69	3.89	4.55	5.88	4.77
	48	4.30	4.95	5.87	5.04	4.13	5.16	6.28	5.19
Mean		3.83	4.71	5.63	4.72	3.88	4.63	5.92	4.81
	24	3.99	4.31	6.11	4.80	4.76	5.12	7.32	5.73
Giza168	36	4.24	5.61	6.50	5.45	4.96	6.66	7.51	6.38
	48	4.94	5.77	7.25	5.99	5.51	6.76	8.57	6.95
Mean		4.39	5.23	6.62	5.41	5.08	6.18	7.80	6.35
Potassium	24	3.72	4.40	5.75	4.62	4.20	4.64	6.46	5.10
x	36	4.00	5.15	6.07	5.07	4.43	5.61	6.69	5.57
Nitrogen	48	4.62	5.36	6.56	5.51	4.82	5.96	7.43	6.07
Mean		4.11	4.97	6.13		4.48	5.40	6.86	
LSD at 0.05 level (1st and 2nd seasons) for:									
Wheat cultivars (A)		0.59		A x C	NS	A	1.31	A x C	NS
Nitrogen levels (B)		1.22		B x C	1.79	B	1.30	B x C	1.58
Potassium levels (C)		0.85		AxBxC	NS	C	0.89	AxBxC	NS
A x B		NS				A x B	NS		
		Grain yield ton/fed							
	24	1.32	1.45	1.99	1.58	1.35	1.40	2.04	1.60
Sakha93	36	1.36	1.58	2.11	1.69	1.40	1.67	2.22	1.76
	48	1.40	1.69	2.48	1.86	1.45	1.82	2.34	1.87
Mean		1.36	1.57	2.19	1.71	1.40	1.63	2.20	1.74
	24	1.48	1.72	2.25	1.82	1.78	2.27	2.88	2.31
Giza168	36	1.58	1.98	2.50	2.02	1.84	2.59	3.00	2.48
	48	1.62	2.05	2.90	2.19	2.01	2.71	3.30	2.67
Mean		1.56	1.92	2.55	2.01	1.88	2.52	3.06	2.49
	24	1.40	1.58	2.12	1.70	1.57	1.84	2.46	1.95
Nitrogen x Potassium	36	1.47	1.78	2.31	1.85	1.62	2.13	2.61	2.12
	48	1.51	1.87	2.69	2.02	1.73	2.27	2.82	2.27
Mean		1.46	1.74	2.37		1.64	2.08	2.63	
LSD at 0.05 level (1st and 2nd seasons) for:									
Wheat cultivars (A)		0.23		A x C	NS	A	0.71	A x C	NS
Nitrogen levels (B)		0.90		B x C	1.19	B	0.93	B x C	1.10
Potassium levels (C)		0.30		AxBxC	NS	C	0.31	AxBxC	NS
A x B		NS				A x B	NS		

Table 3 cleared that there is significant effect in the straw yield between the two studied wheat cultivars Sakha 93 and Giza 168 for the two growing seasons. Many investigators indicate that wheat cultivars differ between them yield and some yield attributes (Abd El–Hameed 2005, Zeidan *et al.,* 2009 and Amin *et al.,* 2010). Wheat straw yield significantly increased with increasing nitrogen application rates where it increased from 2.65 to 3.76 ton/fed. at the first growing season and from 2.84 to 4.23 ton/fed. at the second growing season for 60 and 120 kg N/fed. treatments, respectively . Also, there were significant increases in straw yield with potassium application, raising potassium fertilizers rate from 24 to 48 kg K/fed corresponding with increasing straw yield from 2.92 to 3.49 ton/fed for the 1st growing season and from 3.14 to 3.80 ton/fed for the 2nd growing season, respectively.

Table 3. Effect of different rates of nitrogen and potassium fertilization on straw yield and harvest index for Sakha 93 and Giza 168 wheat cultivars under sprinkler irrigation and sandy soil conditions.

Treatments		straw yield (ton/fed)							
		1st season (2013/2014)				2nd season (2014/2015)			
Wheat cultivars	Potassium levels (kg/fed)	Nitrogen levels (kg/fed)							
		60	90	120	Mean	60	90	120	Mean
Sakha93	24	2.13	3.03	3.41	2.86	2.28	2.77	3.55	2.86
	36	2.39	3.12	3.52	3.01	2.49	2.88	3.66	3.01
	48	2.90	3.26	3.39	3.18	2.68	3.34	3.94	3.32
Mean		2.47	3.14	3.44	3.02	2.48	2.99	3.72	3.06
Giza168	24	2.51	2.59	3.86	2.99	2.98	2.85	4.44	3.42
	36	2.66	3.62	4.00	3.43	3.12	4.07	4.51	3.90
	48	3.32	3.72	4.36	3.80	3.50	4.04	5.27	4.27
Mean		2.83	3.31	4.07	3.40	3.20	3.65	4.74	3.87
Potassium x Nitrogen	24	2.32	2.81	3.63	2.92	2.63	2.81	4.00	3.14
	36	2.52	3.37	3.76	3.22	2.81	3.48	4.09	3.46
	48	3.11	3.49	3.87	3.49	3.09	3.69	4.61	3.80
Mean		2.65	3.22	3.76		2.84	3.32	4.23	
LSD at 0.05 level (1st and 2nd seasons) for:									
Wheat cultivars (A)			NS	A x C	NS	A	NS	A x C	NS
Nitrogen levels (B)			0.40	B x C	0.98	B	0.42	B x C	1.01
Potassium levels (C)			0.15	AxBxC	NS	C	0.18	AxBxC	NS
A x B			NS			A x B	NS		
		HI %							
Sakha93	24	38.20	32.36	36.83	35.80	37.23	33.65	36.53	35.80
	36	36.45	33.64	37.51	35.87	35.97	36.68	37.73	36.80
	48	32.53	34.10	42.50	36.38	35.08	35.39	37.32	35.93
Mean		35.73	33.37	38.95	36.01	36.09	35.24	37.19	36.18
Giza168	24	37.14	46.47	36.81	40.14	37.38	51.93	39.38	42.90
	36	37.29	35.38	38.48	37.05	37.17	38.84	39.96	38.66
	48	32.87	35.47	39.96	36.10	36.47	40.14	38.44	38.35
Mean		35.76	39.11	38.42	37.76	37.01	43.64	39.26	39.97
Nitrogen x Potassium	24	32.70	34.79	41.23	36.24	35.77	37.76	37.88	37.14
	36	36.87	34.51	38.00	36.46	36.57	37.76	38.85	37.73
	48	37.67	39.42	36.82	37.97	37.30	42.79	37.96	39.35
Mean		35.75	36.24	38.68		36.55	39.44	38.23	
LSD at 0.05 level (1st and 2nd seasons) for:									
Wheat cultivars (A)			NS	A x C	NS	A	NS	A x C	NS
Nitrogen levels (B)			3.20	B x C	3.25	B	3.15	B x C	3.22
Potassium levels (C)			NS	AxBxC	NS	C	NS	AxBxC	NS
A x B			NS			A x B	NS		

The interaction between wheat cultivars, nitrogen and potassium application showed non-significant effect except the interaction between nitrogen and potassium application showed significant effect where the straw yield increased from 2.32 ton/fed. to 3.87 ton/fed. at the first growing season and from 2.63 to 4.61 ton/fed. at the second growing season for 24 kg K/fed + 60 kg N/fed and 48 kg K/fed.+ 120 kg N/fed treatments, respectively. Data in table (3) also, showed that the highest Nitrogen and potassium application rate achieved the highest significant harvest index (HI) for the two growing seasons. These finding are agree with Shaaban 2006, Gafar 2007, Antoun, Linda *et al.*, 2010, Abou-Amer *et al.,*2012 .

2- Effect of nitrogen and potassium fertilization on total nitrogen and potassium uptake for Sakha93 and Giza 168 wheat cultivars.

Table 4 showed that there were significant differences between the two studies wheat cultivars on nitrogen uptake during the two growing seasons as mean values of the two growing seasons nitrogen uptake for Giza 168 were higher (62.66 kg N/fed) than Sakha93 (49.02 kg N/fed). These results are agreed with Haile *et al.,* 2012. Increasing nitrogen and potassium application rates significantly increased the amount of nitrogen uptake by wheat plants during the two growing seasons. Nitrogen uptake increased from 43.27 to 51.56 and 63.77 kg N/fed for the first growing season with increasing nitrogen application rate from 60 to 90 and 120 kg N/fed, respectively and the same trend were found for the second growing season. The relative increases in total nitrogen uptake as a mean values of the two growing seasons were 22.57 and 46.31 % for 90 and 120 kg N/fed, respectively compared to the lowest nitrogen application rate (60 Kg N/fed) and were 6.45 and 11.36 % for 36 and 48 kg K/fed, respectively compared to the lowest potassium application rate (24 kg K/fed). Table 4 also, showed no significant interaction effect between wheat cultivars, nitrogen and potassium application except the interaction effect between nitrogen and potassium application. The results are agree with Abdallah, Amany *et al.,* 2013 , Novoa and Loomis, 1981 whom emphasis these differences in the amount of N accumulated by the crop is affected by nitrogen application rates and the genetic potential of the species or cultivar to absorb N.

Potassium uptake significantly increased with raising nitrogen and potassium application rates where it increased from 17.18 to 18.62 and 22.41 Kg K/fed with increasing nitrogen application from 60 to 90 and 120 kg N/fed, respectively and with relative increases of 8.38 and 30.44 % for nitrogen application rates 90 and 120 Kg N/fed, respectively compared to the lowest nitrogen application rate (60 kg N/fed) for the first growing season and the same trend were found for the second growing season. Increasing potassium application rates from 24 to 36 and 48 kg K/fed significantly increased potassium uptake from 18.53 to 19.37 and 20.31 kg K/fed, respectively with relative increases of 4.53 and 19.61 % for potassium application rates of 36 and 48 kg K/fed, respectively compared to the lowest potassium application rate (24 kg K/fed) at the first growing season and the same trend were found for the second growing season.

Data in Tables 2, 3 and 4 showed that nitrogen application has the highest valuable effect on total, grain, straw yield, harvest index and potassium and nitrogen uptake compared to the other studied variables (Wheat cultivars and potassium application).

Table 4. Effect of different rates of nitrogen and potassium fertilization on total nitrogen and potassium uptake for Sakha 93 and Giza 168 wheat cultivars under sprinkler irrigation and sandy soil conditions.

Treatments		**Total N uptake kg/fed**							
		1st season (2013/2014)				**2nd season (2014/2015)**			
Wheat cultivars	**Potassium levels (kg/fed)**	**Nitrogen levels (kg/fed)**							
		60	**90**	**120**	**Mean**	**60**	**90**	**120**	**Mean**
	24	38.03	35.17	50.52	41.24	43.11	46.28	56.90	48.76
Sakha93	36	40.33	38.77	59.38	46.16	43.28	50.09	65.43	52.93
	48	47.06	43.03	63.61	51.23	45.28	50.86	65.13	53.76
Mean		41.80	38.99	57.84	46.21	43.89	49.08	62.49	51.82
	24	41.17	61.37	67.90	56.81	49.10	68.63	74.41	64.05
Giza168	36	44.88	64.87	69.21	59.65	51.29	71.67	75.65	66.20
	48	48.19	66.17	72.01	62.12	53.05	71.63	76.57	67.08
Mean		44.75	64.14	69.71	59.53	51.15	70.64	75.54	65.78
Potassium	24	39.60	48.27	59.22	49.03	46.10	57.45	65.66	56.40
x	36	42.60	51.82	64.30	52.91	47.28	60.88	70.54	59.57
Nitrogen	48	47.62	54.60	67.81	56.68	49.17	61.24	70.85	60.42
Mean		43.27	51.56	63.77	52.87	47.52	59.86	69.02	
LSD at 0.05 level (1st and 2nd seasons) for:									
Wheat cultivars (A)		8.48		A x C	NS	A	9.43	A x C	NS
Nitrogen levels (B)		10.66		B x C	9.36	B	9.17	B x C	NS
Potassium levels (C)		5.01		AxBxC	NS	C	3.84	AxBxC	NS
A x B		NS				A x B	NS		
					Total K uptake kg/fed				
	24	15.01	16.00	19.09	16.70	15.54	17.31	20.66	17.83
Sakha93	36	15.39	16.61	19.87	17.29	16.06	18.00	21.44	18.50
	48	15.57	17.30	22.06	18.31	16.67	18.67	23.95	19.77
Mean		15.32	16.63	20.34	17.43	16.09	17.99	22.02	18.70
	24	18.58	19.81	22.72	20.37	18.38	18.80	21.74	19.64
Giza168	36	19.14	20.70	24.50	21.45	18.10	19.74	23.52	20.45
	48	19.42	21.30	26.22	22.31	18.46	20.24	25.58	21.43
Mean		19.05	20.60	24.48	21.38	18.31	19.59	23.62	20.51
	24	16.78	17.90	20.90	18.53	16.96	18.06	21.20	18.74
Nitrogen x Potassium	36	17.26	18.66	22.19	19.37	17.07	18.88	22.48	19.48
	48	17.50	19.30	24.14	20.31	17.57	19.46	24.77	20.60
Mean		17.18	18.62	22.41	19.40	17.20	18.80	22.82	
LSD at 0.05 level (1st and 2nd seasons) for:									
Wheat cultivars (A)		3.84		A x C	NS	A	1.79	A x C	NS
Nitrogen levels (B)		5.04		B x C	6.58	B	5.60	B x C	5.52
Potassium levels (C)		1.84		AxBxC	NS	C	1.84	AxBxC	NS
A x B		NS				A x B	NS		

3-Effect of nitrogen and potassium fertilization on soil available nitrogen and potassium.

Data in Table 5, showed that soil available nitrogen at harvest significantly increased with increasing nitrogen application rate where soil available nitrogen increased from 26.95 to 50.39 and 72.30 mg/100 g soil at the first growing season and from 29.66 to 55.28 and 79.47 mg/100 g soil at the second growing season for 60, 90 120 kg N/fed treatments, respectively. The results also, showed that wheat cultivars, potassium application and other combination treatments didn't have any significant effect on soil available nitrogen. Results in Table (5) also, cleared that the differences between wheat cultivars and nitrogen application rates in their influences on values of soil available potassium were not significant in both the two growing seasons. On the other hand potassium application significantly increased the amount of soil available potassium in both the two growing seasons. There is no significant effect of the other combination treatments on soil available potassium for the two growing seasons.

Table 5. Effect of different rates of nitrogen and potassium fertilization on soil available nitrogen and potassium for sandy soil cultivated with wheat under sprinkler irrigation condition.

Treatments		**Soil N mg/100 kg soil**							
		1st season (2013/2014)				**2nd season (2014/2015)**			
Wheat cultivars	**Potassium levels (kg/fed)**	**Nitrogen levels (kg/fed)**							
		60	**90**	**120**	**Mean**	**60**	**90**	**120**	**Mean**
	24	27.29	42.88	68.85	46.34	29.74	47.05	75.16	50.65
Sakha93	36	25.46	54.24	71.55	50.42	27.95	58.92	77.94	54.94
	48	27.44	52.97	74.55	51.66	29.58	57.37	81.60	56.18
Mean		26.73	50.03	71.65	49.47	30.63	47.05	76.98	51.55
	24	27.58	42.61	69.46	46.55	30.63	47.05	76.98	51.55
Giza168	36	25.18	55.34	72.83	51.11	28.18	61.08	80.65	56.64
	48	28.75	54.31	76.59	53.21	31.90	60.18	84.49	58.86
Mean		27.17	50.75	72.96	50.29	30.24	56.10	80.71	55.68
Potassium	24	27.43	42.75	69.15	46.44	30.19	47.05	76.07	51.10
x	36	25.32	54.79	72.19	50.77	28.07	60.00	79.29	55.79
Nitrogen	48	28.10	53.64	75.57	52.44	30.74	58.78	83.05	57.52
Mean		26.95	50.39	72.30		29.66	55.28	79.47	
LSD at 0.05 level (1st and 2nd seasons) for:									
Wheat cultivars (A)		NS		A x C	NS	A	NS	A x C	NS
Nitrogen levels (B)		20.51		B x C	NS	B	22.25	B x C	NS
Potassium levels (C)		10.20		AxBxC	NS	C	9.50	AxBxC	NS
A x B		NS				A x B	NS		
		Soil K mg/100 kg soil							
	24	62.0	65.8	63.6	63.8	64.80	68.76	70.79	68.12
Sakha93	36	80.2	80.6	81.4	80.7	83.20	84.95	84.31	84.15
	48	100.1	100.9	104.4	101.8	113.8	110.4	105.94	110.1
Mean		80.7	82.4	83.1	82.1	82.1	195.3	88.06	87.01
	24	65.6	66.6	64.0	65.4	70.32	73.10	80.46	74.63
Giza168	36	80.8	80.2	83.4	81.5	86.60	86.20	92.03	88.28
	48	105.6	103.1	104.9	104.5	114.5	111.6	112.50	112.9
Mean		84.0	83.3	84.1	83.8	83.8	90.47	90.30	95.00
Nitrogen x	24	63.8	66.2	63.8	64.6	67.56	70.93	75.63	71.37
Potassium	36	80.5	80.4	82.4	81.1	84.90	85.58	88.17	86.22
	48	102.9	102.0	104.6	103.1	116.2	111.0	109.22	112.4
Mean		82.4	82.9	83.6		89.55	89.17	91.01	
LSD at 0.05 level (1st and 2nd seasons) for:									
Wheat cultivars (A)		NS		A x C	NS	A	NS	A x C	NS
Nitrogen levels (B)		NS		B x C	NS	B	NS	B x C	NS
Potassium levels (C)		22.15		AxBxC	NS	C	25.18	AxBxC	NS
A x B		NS				A x B	NS		

4-Effect of nitrogen and potassium fertilization on nitrogen use efficiency (NUE) and nitrogen utilization efficiency (NUtE) of Sakha93 and Giza 168 wheat cultivars.

Table (6) indicate that there is significant differences in nitrogen use efficiency (NUE) between the two wheat studied cultivars (Shakha 93 and Giza 168) for the two growing seasons 2013/2014 and 2014/2015 this is may be due to that Giza 168 have high ability to absorb and utilize nitrogen compared with Sakha 93. Also, nitrogen application significantly affected NUE, where it decreased from 24.36 to 19.76 and 19.38 at the first growing season for 60, 90 and 120Kg N/fed, respectively and the same trend was found for the second growing season. These results are agreed with Brar *et al.,* 2011.

Results also, showed that NUE significantly increased with increasing potassium application rates, where it increased from 19.52 to 21.18 and 22.79 at the first growing season and from 22.33 to 24.13 and 25.85 at the second growing season for 24, 36 and 48 Kg K2O/fed treatments, respectively. This may be due to that potassium application enhance nitrogen uptake by wheat roots and increase wheat root growth (Brar *et al.,* 2011 and Brennan and Bolland, 2009) and enhances the activities of nitrate assimilating enzymes which facilitate the uptake and transport of nitrate towards aerial parts of the plant (Anjana and Iqbal 2009). Table (6) also, cleared that the interaction effect between the studied variable are not significant for the NUE in the two growing seasons except for the interaction between nitrogen and potassium applications, where it increased from 17.59 for 120kgN/fed+24 kg K/fed to 25.20 for 60 kg N/fed+48 kg K2O /fed treatments at the first growing season and from 20.50 for 120kgN/fed+24 kg K to 28.83 for 60 kgN/fed+48 kg K2O/fed. at the second growing season (Table 6).

Table (6) also, indicate that there were significant differences between the two wheat cultivars in their influences on values of NUtE in the two growing seasons 2013/2014 and 2014/2105. Values of NUtE significantly increased with increasing nitrogen application rate where NUtE increased from 33.74% at 60 kgN/fed to 37.16% at 120 kgN/fed for the first growing season and from 34.51% at 60 kgN/fed to 38.10% at 120 kgN/fed for the second growing season. Data in Table 6 also, showed that potassium application significantly increased the values of NUtE for the two growing seasons 2013/2014 and 2014/2015. The interaction effect between the studied variable are not significant for the calculated NUtE in the two growing seasons except for the interaction between nitrogen and potassium applications, where it increased from 31.71% for 60 kg N/fed+48 kg K/fed to 39.67 for 120 kg N/fed+48 kg K/fed treatments at the first growing season and from 34.06 for 60 kg N/fed+24 kg K/fed to 39.80 for 120kgN/fed+48 kg K/fed treatments at the second growing season. these results are agreed with Brar *et al.,* 2011, and Magen and Nosov, 2008.

Table 6. Effect of different rates of nitrogen and potassium fertilization on nitrogen use efficiency (NUE) and nitrogen utilization efficiency (NUtE) for Sakha 93 and Giza 168 wheat cultivars under sprinkler irrigation and sandy soil conditions.

Treatments		**Nitrogen use efficiency (NUE)**							
		1st season (2013/2014)				**2nd season (2014/2015)**			
Wheat	**Potassium levels**	**Nitrogen levels (kg/fed)**							
cultivars	**(kg/fed)**	**60**	**90**	**120**	**Mean**	**60**	**90**	**120**	**Mean**
	24	21.95	16.11	16.56	18.20	22.50	15.59	17.03	18.37
Sakha93	36	22.72	17.55	17.61	19.30	23.28	18.55	18.47	20.10
	48	23.33	18.74	20.69	20.92	24.17	20.30	19.53	21.33
Mean		22.67	17.47	18.29	19.47	23.31	18.15	18.34	19.93
	24	24.72	19.07	18.72	20.84	29.67	25.22	23.97	26.29
Giza168	36	26.35	22.04	20.83	23.07	30.72	28.74	25.00	28.15
	48	27.07	22.76	24.13	24.65	33.50	30.15	27.47	30.37
Mean		26.05	21.29	21.23	22.86	31.30	28.04	25.48	28.27
Potassium	24	23.33	17.64	17.59	19.52	26.08	20.41	20.50	22.33
x	36	24.54	19.22	19.80	21.18	27.00	23.65	21.74	24.13
Nitrogen	48	25.20	22.41	20.75	22.79	28.83	25.22	23.50	25.85
Mean		24.36	19.76	19.38		27.31	23.09	21.91	
LSD at 0.05 level (1st and 2nd seasons) for:									
Wheat cultivars (A)			2.40	A x C	NS	A	3.10	A x C	NS
Nitrogen levels (B)			4.5	B x C	2.50	B	4.50	B x C	2.45
Potassium levels (C)			3.20	AxBxC	NS	C	3.10	AxBxC	NS
A x B			NS			A x B	NS		
		Nitrogen utilization efficiency (NUtE)							
	24	34.71	41.23	39.39	38.31	31.32	30.25	35.85	32.81
Sakha93	36	33.72	40.75	35.53	36.61	32.35	33.34	33.93	33.25
	48	29.75	39.27	38.99	36.31	32.02	33.05	35.93	34.78
Mean		32.54	40.27	37.86	37.00	31.90	33.21	35.21	33.58
	24	35.95	28.03	33.14	32.04	36.25	33.08	38.70	36.07
Giza168	36	35.20	30.52	36.12	33.86	35.87	36.14	39.66	37.46
	48	33.62	30.98	40.27	35.25	37.89	37.83	43.10	39.80
Mean		34.86	29.93	36.58	33.76	36.75	35.67	40.51	37.85
Nitrogen x	24	35.35	32.73	35.80	34.67	34.06	32.03	37.47	34.57
Potassium	36	34.51	34.35	35.93	34.97	34.26	34.99	37.00	35.59
	48	31.71	34.25	39.67	35.64	35.18	37.07	39.80	37.57
Mean		33.74	33.75	37.16		34.51	34.75	38.10	
LSD at 0.05 level (1st and 2nd seasons) for:									
Wheat cultivars (A)			4.12	A x C	NS	A	4.52	A x C	NS
Nitrogen levels (B)			4.30	B x C	5.12	B	5.25	B x C	8.15
Potassium levels (C)			1.54	AxBxC	NS	C	3.70	AxBxC	NS
A x B			NS			A x B	NS		

CONCLUSION

Under sprinkler irrigation in El-Bostan area, El-Beheira Governorate, based on the highest values of wheat grain yield and highest values of NUE and NUtE wheat cultivar Giza 168 can be recommended with combination of 120 kg N/fed + 48 Kg K/fed.

REFERENCES

Abd El-Hameed, I. M. (2005). Response of two newly released bread wheat cultivars to different nitrogen and phosphorus fertilizer level proceed 1st Sci. Conf. Cereal Crops, June 20-21, Alex J. Agric. Res., 50(2b) 63-77.

Abd El-Hameed, I.M. 2012. Response of Four New Bread Wheat (*Triticum aestivum L.*) Cultivars to Nitrogen Fertilizer Levels under Sprinkler Irrigation System in Sandy Soils. Egypt. J. Agron. Vol. 34, No. 1, pp. 1-17.

Abd ElMonem, M.A.S. 2000. Nitrogen uptake efficiency of irrigated wheat in Egypt. In Optimizing Nitrogen Fertilizer Application To Irrigated Wheat. Soil and water management & crop nutrition section. Vienna, Austria.

Abdallah, Amany M., Mahmoud, Gamalat O., El-Ssadi, Sawsan A. and Hanaa F. Y. Mohamed. 2013. Wheat production and plant chemical composition under different mineral and biofertilizer treatments. J. Plant Production, Mansoura Univ., Vol. 4 (7): 1119 – 1137.

Abdel–Razik, M.A., 2002. Response of some wheat varieties to bio-fertilizer under different nitrogen levels in saline soil. J. Agric. Sci., Mansoura Univ., 21(2): 1061-1071.

Abou-Amer, I. A. ; Attia M. F. and Attia M. A. 2012. Evaluation of nitrogen application methods to wheat plants grown on Siwa oasis, Egypt. J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 3 (6): 669 – 676.

Abu-Grab, O.S., A.M. Mouss and G.A. El-Shaarawy, 2006. Photosynthesis and N-use efficiencies for some wheat cultivars in relation to planting density and nitrogen fertilization levels. Egypt J. Appl. Sci., 2(2B): 475-492.

Amin, E.H.M., Ibrahim, A.A., Saleh, M.E. and Ali, A.G.A. (2010) Response of wheat cultivars to varying time of N-application, planting densities and sowing date. Zagazig, J. Agric. Res. 37 (4), 803 – 828.

Anjana, S. Umar, and M. Iqbal. 2009. Effect of Applied Potassium in Increasing the Potential for N Assimilation in Spinach (*Spinacea oleracea* L). e-ifc No. 20, June 2009.

Antoun, Linda W. ; Sahar M. Zakaria and Hanaa H. Rafla. 2010. Influence of compost, n-mineral and humic acid on yield and chemical composition of wheat plants. J. Soil Sci. and Agric. Engi., Mansoura Univ., Vol.1 (11): 1131- 1143.

Ashmawy, F. and Abo-Warda, A.M.A. (2002) Response of some wheat cultivars to different seeding rates and nitrogen fertilization levels in sandy soil . Egypt. J. Appl. Sci. 17 (10), 136-157.

Atta Allah, S. A., and G. A. Mohamed. 2003. Response of wheat grown in newly reclaimed sandy soil to poultry manure and nitrogen fertilization. J. Agric. Sci. Mansoura Univ. 28 (10): 7531-7538.

Badawy, Farida H., M. M. M. Ahmed, Hamdia M. El-Rewainy and M. M. A. Ali. 2011. Response of wheat grown on sandy calcareous soils to organic manures and sulfur application. Egypt. J. Agric. Res., 89: (3) 785-807.

Black, C.A. (ed.) (1965). Methods of Soil Analysis. Parts 1 and 2, Am. Soc. Agron., Madison, Wisconsin, USA.

Brar, M.S., Bijay-Singh ,S.K. Bansal, and Ch. Srinivasarao. (2011) .Role of Potassium Nutrition in Nitrogen Use Efficiency in Cereals. https://www.researchgate.net/publication/280076966.

Brennan, R.F., and M.D.A. Bolland. 2009. Comparing the Nitrogen and Potassium Requirements of Canola and Wheat for Yield and Grain Quality. J. Plant Nutr. 32(12):2008-2026.

Bruns, H.A., and M.W. Ebellhar. 2006. Nutrient Uptake of Maize Affected by Nitrogen and Potassium Fertility in a Humid Subtropical Environment. Common. Soil. Sci. Plant Anal. 37:275-293.

Cassman, K.G., A. Dobermann, and D. Walters. 2002. Agroecosystems, Nitrogen-Use Efficiency and Nitrogen Management. Ambio 31:132-140.

Chapman, H. D. and P. F. Pratt. (1961). Methods of Analysis for Soil, Plants and Waters. University of California, Riverside, CA.

El-Murshedy, W.A. (2008) Effect of skipping one irrigation at different developmental stages of five bread wheat cultivars. J. Agric. Res., Kafer El-Sheikh Univ. 34 (1), 25-42.

Fixen, F.E., and F.B. West. 2002. Nitrogen Fertilizers: Meeting Contemporary Challenges. Ambio 31(2):169-176.

Gafar, N.A. (2007) Response of some bread wheat varieties grown under different levels of planting density and nitrogen fertilizer. Minufiya J. Agric. Res. 32 (1), 165 – 183.

Ganeshamurthy, A.N., and Ch. Sriniva-sarao. 2001. Interaction of Potassium with Other Nutrients. Special publication "Potassium in Indian Agriculture". International Symposium on Importance of Potassium in Nutrient Management for Sustainable Crop Production in India. International Potash Institute, Switzerland and Potash Research Institute of India, Gurgaon. India. p. 159-174.

Hafez, E.M., 2007. Effect of some agricultural practices on growth and productivity of wheat, M. Sc. Thesis, Kafr El-Sheikh Univ., Egypt.

Haile1, D., D. Nigussie1 and A. Ayana. (2012). Nitrogen use efficiency of bread wheat: Effects of nitrogen rate and time of application. Journal of Soil Science and Plant Nutrition, 12 (3), 389-409.

Jackson, M.L. (1973). Soil Chemical Analysis, Prentice Hall, Inc. Englewood Cliffs, N.J.

Koriem, M.H.M., 2008. Response of some wheat cultivars in nitrogen and biofertilization. Ph. D. Thesis, Fac. Agric., Kafr El-Sheikh Univ.

Madiha, M. Badran; M. O. Easa; M. Abdel-Warth and M. I. Raslan (2004). Effect of N and Mg application on wheat plant grown on calcareous soil. Minufiya J. Agric. Res., 29 (6): 1493-1502.

Megan, H., and V. Nosov.2008. Putting potassium in the picture: Achieving Improved Nitrogen Use Effeciency. In IPI-BFA-BRRI international workshop on Balanced fertilization for increasing and Sustaining Productivity. 30 March- 1 April 2008, Dhaka, Bangaladesh.

Moll, R.H., Kamprath, E.J. and Jakson. W.A. (1982). Analysis and interpretation of factors which contribute to efficiency of nitrogen utilization. Agron. J. 74:562-564.

Novoa, R. and Loomis, R.S., (1981). Nitrogen and plant production. Plant and Soil 58, 177:204

Page, A.L., R.H. Miller, and D.R. Keeny. (1982). Methods of Soil Analysis, Part 2: Chemical and Microbiological properties. Am. Soc. of Agron, Madison, Wisconsin, USA.

Radwan, F.I.., M.A. Gomaa, M.A.A. Naser and I.F. Mussa. (2014). Response of some Wheat Varieties to Humic Acid, Mineral and Biofertilization on Productivity and Quality. Middle East j. Agric. Res., 3(3): 631-637.

Ramadan, A.R. and Awaad, S.S. (2008) Response of yield and yield attributes of some bread wheat varieties to irrigation levels and seeding rate under old land conditions. J. Agric. Sci., Mansoura Univ. 33 (7), 4717 – 4737.

Salem, F.S.; M. Y. Gebrail; M. O. Easa and M. Abdel warth (2004). Raisng the efficiency of nitrogen fertilization for wheat plants under salt affected soils by applying some soil amendments. Minufiya J. Agric. Res., 29 (4): 1059-1073.

SAS (2007). Guide for personal computers. Version 9 ed. SAS end. SAS institute, Cary. N.C, U.S.A.

Shaaban, S.M. (2006) Effect of organic and inorganic nitrogen fertilizer on wheat plant under water regime. Journal of Applied Science Research, 2 (10), 650 – 656.

Steel, R. G. and J.H. Torrie (1980). Principles and Procedures of Statistics. 2nd Edi, New york, McGrew Hill Book company – 196 P.

Tabl, M.A. , Omar, A.M., El-Sheref, E. and Koriem, M.A. (2005) Effect of seeding rates and nitrogen levels on two wheat cultivars. Alex. J. Agric. Res. 50 (2B), 87 – 95.

Weber, E.A., Graff, S., Koller, W.D., Hermann, W., Markt, N. and Claupein, W.b(2008) Impact of nitrogen amount and timing on the potential of acrylamide formation in winter wheat (*Triticum aestivum* L.). Field Crop Research, 106, 44 – 52.

Wells, M.L., and B.W. Wood. 2007. Relationships Between Leaflet Nitrogen: Potassium Ratio and Yield of Pecan. Hort. Technology 17:473-479.

Westerman, R.L. (ed) (1990). Soil Testing and Plant Analysis. 3rd Edition, Soil Sci. Soc. Am. Book Series No.3, Madison, Wisconsin. USA.

Zaki, Nabila, M., M.S. Hassanein and Karima M. Gamal El-Din.(2007). Growth and Yield of Some Wheat Cultivars Irrigated with Saline Water in Newly Cultivated Land as Affected by Biofertilization. J. Appl. Sci. Res. 3(10): 1121-1126

Zeidan, E.M., Abd El- Hameed, I.M., Bassiouny, A.H. and Waly, A.A. (2009) Effect of irrigation intervals, nitrogen and organic fertilization on yield, yield attributes and crude protein content of some wheat cultivars under newly reclaimed saline soil conditions. 4th Conferences on Recent Technologies in Agriculture, Faculty of Agric., Cairo Univ., Egypt.

تأثير التسميد النتروجينى و البوتاسى علي المحصول وكفاءة استخدام النتروجين لصنفين من القمح تحت ظروف الرى بالرش فى الأراضى الرملية

أحمد إسماعيل أحمد عبد العال[1] ، الحسين غلاب جلال[2] و أصال محيى الدين والى[3]

[1] معهد بحوث الأراضي والمياه والبيئة

[2] معهد بحوث المحاصيل الحقلية مركز البحوث الزراعية - الجيزة - مصر

[3] معهد بحوث زراعة الأراضى القاحلة- مدينة الأبحاث العلمية والتطبيقات التكنولوجية - برج العرب - الأسكندريه - مصر

أقيمت تجربتان حقليتان في أرض رملية بمزرعة علي مبارك التجريبية - منطقة البستان - جنوب التحرير- محافظة البحيرة في موسمي 2014/2013 و 2015/2014 لدراسة مدى ملائمة صنفين من القمح سخا 93 و جيزة 168 تحت ثلاث مستويات من النيروجين (60و 90و 120 كجم نيتروجين /فدان) و ثلاث مستويات أخري من البوتاسيوم(24و 36و 48 كجم بوتاسيوم /فدان) تحت ظروف الري بالرش فى الأراضى الرملية و فى تصميم القطع المنشقه مرتين وكانت أصناف القمح موزعة فى القطع الرئيسية ومستويات النيتروجين فى القطع تحت شقية و البوتاسيوم فى القطع تحت -تحت شقية وذلك لتحديد مدي ملائمة صنفى القمح سخا 93 و جيزة 168 وافضل مستويات النيتروجين و البوتاسيوم اللازم إضافتها تحت ظروف الري بالرش فى الأراضي الرملية بمنطقة البستان. وكانت النتائج المتحصل عليها كالأتى: 1- سجل صنف جيزة 168 اعلي محصول لكل من القش والحبوب حيث كان 3.46 و 2.25 طن/فدان على الترتيب مقارنة بالصنف سخا 93 والذي سجل 3.04و 1.73 طن/فدان على الترتيب (متوسط موسمين).2- إذداد كل من محصول القش والحبوب زيادة معنويه بزيادة كمية النتروجين المضافة حيث إزداد محصول الحبوب من 1.46 الى 1.74 و 2.37 فى الموسم الأول وإزداد من 1.64 الى 2.08 و 2.63 طن /فدان لكل من 60 و 90 و 120 كجم نيتروجين للفدان علي التوالى.3- أدي زيادة معدلات التسميد البوتاسى الي حدوث زيادة معنويه فى كل من محصول الحبوب و القش وكانت نسبة الزيادة النسبيه فى محصول الحبوب 18.82 و16.41 للمعاملة 48 كجم بوتاسيوم /فدان مقارنة بالمعاملة 24 كجم بوتاسيوم /فدان للموسم الأول والثانى على الترتيب .4- سجل الصنف جيزة 168 أعلي كميه من النتروجين الكلي الممتص (قش وحبوب) بزيادة قدرها 27.87 % (متوسط موسمين) مقارنة بالصنف سخا 93 .5- أدى زيادة معدلات التسميد النتروجينى إلى زيادة معنويه فى كمية النتروجين الممتص حيث زادت من 43.27 الى 51.56 و 63.77 خلال موسم النمو الأول بينما زادت من 47.52 إلى 59.86و 69.02 خلال موسم النمو الثانى لكل من 60و 90و 120 كجم نتروجين/فدان على الترتيب.6- كانت هناك زيادة معنويه فى كمية النتروجين الممتص بزيادة معدلات البوتاسيوم المضاف حيث إزداد من 49.03 الى 52.91 و 56.68 كجم نتروجين/فدان خلال الموسم الأول بينما إزداد من 56.40 إلى 59.57 و 60.42 خلال موسم النمو الثانى لكل من 60و 90و 120 كجم نتروجين/فدان على الترتيب.7- سجل الصنف 168 أعلى كمية من البوتاسيوم الممتص حيث بلغت 21.38و 20.51 مقارنة بالصنف سخا 93 والذى بلغت 17.43 و 18.70 كجم بوتاسيوم/فدان خلال موسم النمو الأول والثانى على الترتيب.8- أدي زيادة معدلات التسميد النتروجينى و البوتاسي إلى زيادة كمية البوتاسيوم الممتص خلال موسمى النمو وكان هناك تفاعل معنوى بين التسميد النتروجيني و البوتاسي على كل من النتروجين و البوتاسيوم الممتص خلال موسمى النمو.9- سجل الصنف جيزة 168 أعلي كفأة فى أستخدام للنتروجين NUE حيث بلغت 19.47 و19.93% .10- كانت هناك اختلافات معنوية فى كفأة استخدام النتروجين (NUE) حيث كانت اعلى للصنف جيزة 168 مقارنة بالصنف سخا 93 خلال موسمى النمو. توصى الدراسة بزراعة الصنف جيزة 168 مع اضافة 120 وحدة من التسميد النتروجين مقسمة على خمس دفعات متساوية تبدأ من بداية مرحلة التفريع وبفاصل زمنى 15 يوما بين كل دفعة والأخري وإضافة 48 وحدة من التسميد الوتاسى مقسمه على دفعتين متساويتين مع الدفعة الأولى والثانيه للسماد النتروجيني وذلك تحت نظام الرى بالرش فى الأراضى الرمليه.