Effect of Potassium Application Methods on Some Wheat Varieties (*Triticum aestivum* L.) Production Under Middle Egypt Conditions

Sarhan[1], M. G. R. and A. S. Abd El-Hamed[2]
1. Soil, Water and Environment, Res. Inst., Agricultural Research Center, Egypt
2. Field Crops, Res. Inst., Agricultural Research Center, Egypt

ABSTRACT: This investigation was conducted during the two growing successive winter seasons of 2014/2015 and 2015/2016 at the Experimental Farm of Sids Agricultural Research Station, ARC, Beni-Suef Governorate, Egypt to study the response of two bread wheat varieties (Sids 12 and Sids 13) and two durum wheat (Beni-Suef 5 and Beni-Suef 6) to potassium fertilization as soil application and/or foliar spraying. The treatments were: without potassium fertilization (K1), 24 kg K2O/feddan as soil application one time before planting (K2), 12 kg K2O/feddan as soil application before planting + 12 kg K2O/feddan as soil application added after two month later (K3), foliar spraying of 2% potassium sulphate one time (K4), foliar spraying of 2% potassium sulphate twice (K5), 12 kg K2O/feddan as soil application + foliar spraying of 2% potassium sulphate one time (K6) and 12 kg K2O/feddan as soil application + foliar spraying of 2% potassium sulphate twice (K7). The results indicated that Sids 12 variety gave the shortest days for heading and maturity stages and greatest number of spikes/$m^2$and number of grains/spike, while Beni-Suef 5 variety possesed the highest values of plant height, 1000-grain weight, grain yield and straw yields as well as total N, P and K uptake. On the other hand, Sids 13 variety recorded the lowest values of plant height, 1000-grain weight, grain yield, straw yield and total NPK uptake, while Beni-Suef 6 gave the lowest number of spikes/m^2 and number of grains/spike. The highest values of number of days to heading or maturity stages were recorded for Beni-Suef 5 variety. Added K3 or K7 treatments exhibited the greatest period to heading and maturity stages. On the other hand, the wheat plants without potassium application exerted the lowest growth parameters, yield and its components as well as total NPK uptake. In general, Beni-Suef 5 variety when fertilized with K3 or K7 treatments produced the highest values of wheat growth, yield and its components as well as total NPK uptake.

Key words: Wheat, soil fertilization of potassium, foliar fertilization of potassium, growth parameters, yield and its components and total NPK uptake.

INTRODUCTION

World population is envisaged to increase by 34% till 2050 reaching about 9.1 billion, thus necessitating 70% more food production (FAO, 2005). Wheat (*Triticum aestivum*, L.) is considered as the major cereal crop in world in respect of the cultivated area and total production. It provides an almost 20% of food calories for people in the world (Hamouda *et al.,* 2015). In Egypt, wheat provides 37% of the total calories for the people and 40% of protein in Egyptian diet (Abd El-Ghany *et al*., 2013). Also, it is a major source of straw for animal feeding. However, the local production of wheat grain (about million tons) covers only about 60% of the local consumption demand which reflect the need to import about 40% of wheat grains from abroad. Therefore, improving the productivity of this crop consider the national goal.

Potassium is one of major nutrients considered essential for crop growth and yield development, although it is not an integral component of any cellular

organic or structural part of the plant. It is the most abundant cation in plants and is associated or involved with many of the physiological processes supporting plant growth and development. Water relations, photosynthesis, assimilate transport and enzyme activation, all can be impact by potassium (Pettigrew, 2008). Furthermore, potassium plays a key role in the survival of plants under abiotic stress conditions, as stress negatively affects the physiological processes of plants such as root and shoot elongation, enzyme activity, water and assimilate transport, synthesis of protein, photosynthetic transport and chlorophyll content (Gerardeaux *et al*., 2010 and Kanai *et al*., 2011).

In recent years, foliar fertilization for satisfying a part of the major nutrient requirements has gained interest. Foliar spraying may be feasible in cases where plants reach a stage where the supply through roots cannot meet the demand of the crop (Arabia *et al*., 2002). Moreover, the beneficial effects of foliar nutrition of K in mineral form containing K as a supplemental or a partial substitution to soil application were reported by many authors such as Shaaban *et al*. (2009) and Abd El-Ghany *et al*. (2013) on wheat. The foliar application method is usually preferred because very small amounts of fertilizers are applied per unit area and decrease ground water application. In addition exogenous application through foliar application of essential elements like K was found promising to enhance the growth parameters (Mahmoud and Rafiq, 2011). In this concern, Kettlewell *et al*. (2000), Nadin *et al*. (2012) and Hamouda *et al*. (2015) found that foliar application of nutrients on wheat plant had significant positive effects on plant growth and yields and its components.

Therefore, the aims of this investigation is to study the effect of potassium fertilization as soil application and/or foliar spraying for four wheat varities on growth, yield, yield components and nutrients content of grain and straw of wheat.

MATERIAL AND METHODS

Field experiments were conducted during the two growth seasons of 2014/2015 and 2015/2016 in the experimental Farm of Sids Agricultural Research Station, ARC, Beni-Suef Governorate, Egypt to study the response of two bread wheat varieties (Sids 12 and Sids 13) and two durum wheat (Beni-Suef 5 and Beni-Suef 6) to potassium fertilization as soil application and/or foliar spraying; i.e.: without potassium (K1), 24 kg K2O/feddan added before planting (K2), 12 kg K2O/feddan added before planting and 12 kg K2O/feddan added two month later (K3), Foliar spraying of 2% potassium sulphate one time (K4), Foliar spraying of 2% potassium sulphate twice (K5), 12 kg K2O/feddan added before planting + foliar spraying of 2% potassium sulphate one time (K6) and 12 kg K2O/feddan added before planting + foliar spraying of 2% potassium sulphate twice (K7), and its effects on growth, yield components, yields and content of nutrients grains and straw of wheat.

The experimental design was split plot in completely randomized blocks in four replications, where the wheat varieties were located in main plots and potassium treatments were set up in sub plots. The plot area was 2.0 m x 1.4 m (2.8 m^2 = 1/1500 feddan). Wheat varieties were sown in 15 and 16 November in both seasons, respectively. Some physical and chemical properties of surface soil samples collected from plough layer (0.0-30 cm) before planting was done according to the Klute (1986) and Page *et al*. (1982) and listed in Table (1). Foliar spraying on time treatments were performed at one month from sowing, while foliar spraying twice treatments were carried out at one month from sowing and at one month later. The other practices of growing wheat were properly used for the management of the experimental plots throughout the cropping season.

During the growing seasons, days to heading and days to maturity were determined. At harvest time, wheat plants were collected and the following parameters were determined: plant height (cm), number of spikes/m^2, number of grains/spike and 1000-grain weight (g) as well as grain yield (ardab/feddan) and straw yield (ton/feddan). Also, NPK concentration in grains and straw were determined according to the method described by A.O.A.C (1985), and then calculated to NPK uptake (kg/feddan).

The results were submitted to analysis of variance according to Snedecor and Cochran (1980). The means of treatments were compared by L.S.D. at 5% probability level.

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

Soil characteristics	2014/2015	2015/2016
Physical analysis:		
Particle size distribution:		
Clay (%)	51.2	55.8
Silt (%)	30.1	28.3
sand (%)	18.7	15.9
Texture grade	Clay	Clay
Chemical analysis:		
pH (1:2.5 soil-water suspension)	7.92	8.01
EC, soil paste extract (dS m^{-1})	1.11	1.33
Organic matter (%)	1.22	1.26
CaCO3 (%)	3.0	2.8
Available N (mg kg^{-1})	20.5	22.2
Available P (mg kg^{-1})	11.6	12.3
Available K (mg kg^{-1})	160	155

RESULTS AND DISCUSSIONS

1- Growth traits

The data presented in Table 2 show the effect of potassium application as soil and/or foliar application on some growth parameters of four wheat variaties. The results exhibited that Sids 12 variety recorded the shortest period for heading and maturity stages, while Beni-Suef 6 varieties exerted the highest number of days from planting to heading and maturity in both growing seasons. It is obvious to notice that the differences between the effects of Sids 13 and Beni-Suef 5 are not greal enough to reach the 5% level of significant in both growing seasons. These results might be explained according to the fact that crop varieties differed remarkably on the genitical attributs and subsequently on growth characters. These results are in line with those obtained by Mahmoud (1987) and Abd El-Majeed (1990). As for plant height, the data obtained revealed that Beni-Suef 5 variety gaves the tallest plant (112.0 and 111.8 cm during the two growing seasons, respectively), while Sids 13 variety recorded the shortest one (102.9 and 102.0 cm during both growing seasons, respectively). It is obvious to notice that the difference between plant height of Beni-Suef 5 and Sids 12 not reached the significance value. The variation in plant height among the studied varieties may be due to its gentic make up and the mode of utilization of metabolic products (Abd El-Ghany *et al*., 2013). These results are in harmony with those obtained by Ahmed *et al*. (2011) and Abd El-Ghany *et al*. (2012).

Regarding the effect of potassium fertilization, the obtained data revealed that days from planting to heading or maturity stages were significantly affected by methods of potassium fertilization during both growing seasons. The treatments of 12 kg K2O/feddan added before planting + 12 kg K2O/feddan added after one month later (K3) and 12 kg K2O/feddan added before planting + foliar sprying of 2% potassium sulphate twice (K7) recorded the latest heading or maturity stages, while the treatment without potassium application (K1) produced the earliest heading or maturity stages. This may be explained by the fact that plants needs to be supplied with sufficient amount of potassium for plant development, especially in the eritical stage, therefore plants with low potassium fertilization tried to terminate their life cycle earlier and grew more rapidly than those of sufficient potassium (Gul *et al.,* 2011). Similar results were obtained by Pettigrew (2003) who mentioned that potassium difficieny in cotton depress yield by decreasing late season growth and its reportedly more harmful to early maturity cotton genotypes. Concerning the effect of potassium treatments on plant height, the results showed that K3 and K7 treatments produced the tallest wheat plants, while plants without potassium fertilization (control treatment) yielded the shortest plants during both growing seasons. The promoting effect of K3 and K7 treatments than other treatments on wheat plant height may be attributed to the direct effect of potassium on plant growth and development, since those treatments contain higher potassium than others (Jabbar *et al*., 2009). These results are in line with those obtained by Hamouda *et al*. (2015).

Table (2). Effect of potassium fertilization on some growth parameters of four wheat varieties

Varieties (A)	Treatments of potassium (B)	Plant height (cm)		Days to heading stage		Days to maturity	
		2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
Sids 12	K1	108.1	108.3	94.7	93.5	150.3	150.1
	K2	110.2	110.3	99.2	98.6	152.2	152.1
	K3	113.0	113.3	101.3	101.0	153.5	153.3
	K4	110.2	110.8	97.3	96.7	150.6	150.3
	K5	111.2	111.3	98.5	98.1	152.2	152.2
	K6	112.0	111.4	100.1	99.6	153.1	153.0
	K7	113.1	111.7	101.2	101.2	153.4	153.3
Mean		**111.1**	**111.0**	**98.9**	**98.4**	**152.2**	**150.1**
Sids 13	K1	100.1	100.6	96.0	95.4	150.7	150.3
	K2	101.3	101.0	100.1	100.0	152.7	152.5
	K3	106.4	105.0	105.6	105.0	154.0	153.8
	K4	102.3	101.2	97.7	97.0	151.0	150.7
	K5	102.3	101.5	99.2	98.6	152.5	152.1
	K6	103.6	101.7	103.1	102.8	153.5	153.5
	K7	104.2	103.3	105.2	105.7	153.6	153.2
Mean		**102.9**	**102.0**	**100.0**	**100.6**	**152.6**	**152.7**
Beni-Suef 5	K1	108.3	109.3	95.5	95.0	151.0	150.3
	K2	110.1	111.0	99.9	99.1	153.0	152.7
	K3	115.2	115.0	102.4	101.9	154.3	153.8
	K4	110.5	111.2	98.1	97.5	151.2	150.6
	K5	112.3	111.4	99.2	98.7	152.8	152.2
	K6	113.1	111.7	101.2	100.8	153.7	153.6
	K7	114.3	113.3	102.3	101.9	153.9	153.1
Mean		**112.0**	**111.8**	**99.8**	**99.3**	**152.8**	**152.8**
Beni-Suef 6	K1	101.4	103.7	97.2	97.0	151.3	151.4
	K2	103.3	104.0	102.5	102.0	153.7	153.5
	K3	108.2	108.3	107.4	106.8	155.7	155.9
	K4	104.5	104.2	99.2	98.7	151.3	151.5
	K5	105.4	104.6	100.5	100.1	153.0	153.3
	K6	106.6	104.8	104.6	104.1	154.0	154.2
	K7	107.3	105.1	107.3	106.7	154.0	154.2
Mean		**105.2**	**105.0**	**102.7**	**102.2**	**153.3**	**153.4**
Mean of potassium treatments	**K1**	**104.5**	**105.5**	**95.9**	**95.2**	**150.8**	**150.2**
	K2	**106.2**	**106.6**	**100.4**	**99.9**	**152.9**	**152.7**
	K3	**110.7**	**110.4**	**104.2**	**103.7**	**154.4**	**154.2**
	K4	**106.9**	**106.9**	**98.1**	**99.5**	**151.0**	**150.8**
	K5	**107.8**	**107.2**	**99.4**	**98.9**	**152.6**	**152.5**
	K6	**108.8**	**107.4**	**102.3**	**101.8**	**153.6**	**153.6**
	K7	**109.7**	**108.4**	**104.0**	**103.9**	**153.7**	**153.5**
L. S. D. at 0.05							
A		**1.35**	**1.17**	**0.76**	**0.85**	**1.67**	**1.43**
B		**1.10**	**1.07**	**0.96**	**1.02**	**0.99**	**1.00**
A X B		**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Considering the interaction effects, the data revealed that the number of days from planting to heading or maturity stages as well as plant height did not respond to the interaction between treatments. This means that, in general, Sids 12 variety in absence of potassium recorded the earliest heading and maturity stages, while Sids 13 variety under K3 or K7 treatments exerted the latest ones. Moreover, Beni-Suef 6 variety under K3 or K7 treatments showed the tallest plants, while Sids 12 variety with non potassium application produced the shortest plants in both growing seasons.

2- Yield components traits

The effect of different potassium treatments on yield components of four wheat varieties are presented in Table 3. The results revealed that the number of spikes/m^2, the number of grains/spike and 1000-grain weight were significantly affected. Sids 12 variety gave the greatest number of spikes/m^2 and number of grains/spike during both growing seasons (415 and 65.4 during the first growing season and 419 and 66.8 during the second one, respectively). On the other hand, Beni-Suef 6 variety gave the lowest ones (402 and 58.6 during the first growing season and 412 and 60.1 during the second growing season, respectively). Moreover, Beni-Suef 5 variety produced the highest values of 1000-grain weight (55.7 and 56.0 g during both growing seasons, respectively), while Sids 13 gave the lowest 1000-grain weight (48.2 and 48.7 g during both growing seasons, respectively). The differences between varieties may be due to its gentical make up. These results are in harmony with those obtained by Ahmed *et al*. (2006) and El-Habbasha *et al*. (2008).

As for potassium treatments, the obtained data revealed that the yield components of wheat plants were significantly responded to potassium treatments. Added 24 kg K2O/feddan at two equal doses, before planting and two month later (K3) or combined 12 kg K2O/feddan as soil application with foliar spraying of potassium sulphate twice (K7) gave the highest values of number of spikes/m^2, number of grains/spike and 1000-grain weight (416, 416; 66.5, 66.5 and 54.7 and 54.7 g for K3 and K7 in the first growing season, respectively). Whereas, the lowest yield components were recorded under without potassium treatment in both growing seasons (345, 55.8 and 48.0 g in the first growing season and 399, 57.1 and 48.5 g during the second one, respectively).

The promoting effect of K3 and K7 treatments may be support the benifical effect of application of potassium at two equal doses, during land preparation and two month later or combined soil application with foliar spraying on wheat growth as already pointed out above. Similar results were obtained by Thalooth *et al*. (2006) and Zafar *et al*. (2016). Regarding the interaction between wheat varieties and potassium treatments, the results clearly showed that there was no significant effect between wheat varieties and potassium fertilization on yield components of wheat. This means that the Sids 12 variety when fertilized with K3 or K7 treatments yielded the greatest number of

spikes/m^2 and number of grains/spike, while Beni-Suef 5 variety under K3 or K7 treatments produced the heaviest grains.

Table (3). Effect of potassium fertilization for four wheat varieties on yield components

Varieties A	Treatments of potassium B	Number of spikes/m^2		Number of grains/spike		1000-grain weight (g)	
		2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
Sids 12	K1	401	403	60.4	61.2	47.0	47.8
	K2	415	418	63.9	64.4	50.7	51.2
	K3	424	428	71.3	73.4	54.0	54.8
	K4	410	416	62.6	65.2	46.6	47.0
	K5	413	418	63.0	64.0	49.3	49.9
	K6	418	421	65.3	66.3	51.8	52.2
	K7	423	427	71.5	73.3	54.1	54.7
Mean		**415**	**419**	**65.4**	**66.8**	**50.5**	**51.1**
Sids 13	K1	392	398	54.2	54.8	45.3	45.7
	K2	406	414	61.3	62.5	48.3	48.9
	K3	412	422	65.3	66.2	49.8	50.3
	K4	400	411	58.8	59.9	45.0	45.6
	K5	404	413	60.2	61.1	48.6	49.0
	K6	407	416	62.7	63.3	50.6	50.9
	K7	412	423	65.1	66.1	49.7	50.3
Mean		**405**	**414**	**61.1**	**62.0**	**48.2**	**48.7**
Beni-Suef 5	K1	398	399	56.1	57.3	50.9	51.2
	K2	412	416	62.5	63.7	54.4	54.7
	K3	417	425	66.2	67.7	60.1	60.5
	K4	405	414	60.5	61.5	51.8	52.1
	K5	409	415	61.6	62.1	53.1	53.4
	K6	413	418	63.7	63.9	59.6	59.9
	K7	417	425	66.2	67.6	60.0	60.4
Mean		**410**	**416**	**62.4**	**63.4**	**55.7**	**56.0**
Beni-Suef 6	K1	390	395	52.6	55.1	48.8	49.1
	K2	402	412	58.6	60.0	52.5	52.9
	K3	410	420	63.2	64.6	55.0	55.6
	K4	398	410	55.4	56.5	48.0	48.7
	K5	400	411	56.6	58.3	50.2	50.6
	K6	405	415	60.7	61.3	52.6	52.9
	K7	411	420	63.0	64.7	55.1	55.7
Mean		**402**	**412**	**58.6**	**60.1**	**51.7**	**52.2**
Mean of potassium treatments	**K1**	**395**	**399**	**55.8**	**57.1**	**48.0**	**48.5**
	K2	**409**	**415**	**61.6**	**62.7**	**51.5**	**51.9**
	K3	**416**	**424**	**66.5**	**68.0**	**54.7**	**55.3**
	K4	**403**	**413**	**59.3**	**60.8**	**47.9**	**48.4**
	K5	**407**	**414**	**60.4**	**61.4**	**50.3**	**50.7**
	K6	**411**	**418**	**63.1**	**63.7**	**53.7**	**54.0**
	K7	**416**	**424**	**66.5**	**67.9**	**54.7**	**55.3**
L.S.D. at 0.05							
A		**5.12**	**4.82**	**1.61**	**1.43**	**1.05**	**1.13**
B		**3.17**	**4.15**	**1.65**	**1.37**	**1.12**	**1.25**
A X B		**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

3- Yield traits

Data given in Table 4 showed the effect of potassium fertilization as soil and/or foliar spraying on grain and straw yields of four wheat varieties. The results indicated that wheat varieties were significantly varied in its grain and straw yields during both growing seasons. It could be arrange the grain yield of the four varieties of wheat as the following descending order: Beni-Suef 5 > Sids 12 > Beni-Suef 6 > Sids 13 in both growing seasons. The relative increasing of grain yield produced by Beni-Suef 5 comparing by other three wheat varieties were 10.5, 14.9 and 20.3% over Sids 12, Beni-Suef 6 and Sids 13 varieties in the first season, respectively. The same trend was obtained in the second growing season. On the othe hand, Beni-Suef 5 gave the highest straw yield followed by Sids 12 and Beni-Suef 6 varieties, while Sids 13 variety produced the lowest one in both growth seasons. These variations in grain or straw yields to for varieties of wheat may be due to its gentic structure and its tolerance variation to the environmental conditions, which in turn effect the yield components (Table 3) as discussed earlier (Abo-Ward, 2002 and Abd El-Ghany, 2003). These results are in harmony with those obtained by Hassanein (2001) and Mekky *et al.* (2007). With regard to potassium fertilization, the obtained data revealed that both grain and straw yields are significantly affected to potassium fertilization. K3 and K7 treatments gave maximum values in terms of grain and straw yields (23.3 and 23.2 ardab/feddan and 4.2 and 4.2 ton/feddan for grain and straw yields in the first growing season, respectively (Table 4). The promotive effect of K3 and K7 treatments is mainly due to its effect on number of spikes/m^2, number of grains/spike and 1000-grain weight as the above mentioned disucussion. Similar results were obtained by Mousavi (2011) and Zafar *et al*. (2016). Also, there was no significant effect between wheat varieties and potassium fertilization on grain and straw yield of wheat (Table 4). This means that the highest grain and straw yield were obtained for Beni-Suef 5 variety when fertilized with K3 or K7 potassium treatments. On the other hand, Beni-Suef 6 and Sids 13 without potassium fertilization yielded the lowest grain and straw yield, respectively.

3- Total nutrients uptake

The effect of potassium fertilization for four wheat varieties on total N, P and K uptake are given in Table 5. The data revealed that Beni-Suef 5 uptake more N, P and K (60.59, 58.41 and 81.98 kg/feddan in the first growth season, respectively) followed by Sids 12 (56.19, 56.65 and 78.85 kg/feddan). On the other hand, Beni-Suef 6 and Sids 13 gave the lowest values of total NPK uptake.

The variation in NPK uptake among the wheat varieties is mainly explained by the effect of varieties on NPK concentration in grains and straw as well as its effect on grain and straw yields (as shown in bresviously Table 4). Similar results of varietal differences on nutrients uptake were reported by many investigators such as Hassanein (2001) and El-Abady *et al*. (2009).

Table (4). Effect of potassium fertilization for four wheat varieties on grain yield (ardab/ feddan) and straw yield (ton/feddan)

Varieties A	Treatments of potassium B	Grain yield (ardab/feddan)		Straw yield (ton/feddan)	
		2014/2015	2015/2016	2014/2015	2015/2016
Sids 12	K1	15.1	15.5	3.20	3.30
	K2	21.3	21.4	4.00	4.10
	K3	23.9	24.2	4.20	4.30
	K4	19.7	19.9	3.75	3.90
	K5	20.6	20.8	3.85	4.00
	K6	22.1	22.6	4.10	4.15
	K7	23.9	24.1	4.20	4.25
Mean		**20.9**	**21.2**	**3.90**	**4.00**
Sids 13	K1	14.0	14.3	3.00	3.15
	K2	19.5	19.8	3.75	3.90
	K3	21.3	21.5	3.95	4.15
	K4	18.6	18.7	3.50	3.70
	K5	19.0	19.3	3.60	3.75
	K6	20.7	20.9	3..80	4.00
	K7	21.4	21.4	3.90	4.10
Mean		**19.2**	**19.4**	**3.64**	**3.82**
Beni-Suef 5	K1	18.7	19.1	3.25	3.35
	K2	23.6	23.8	3.95	4.00
	K3	25.3	25.9	4.55	4.60
	K4	21.6	21.9	3.70	3.75
	K5	23.0	23.3	3.80	3.85
	K6	24.1	24.6	4.05	4.15
	K7	25.2	25.8	4.53	4.60
Mean		**23.1**	**23.5**	**3.98**	**4.04**
Beni-Suef 6	K1	14.6	14.8	3.10	3.25
	K2	20.3	20.5	4.00	3.90
	K3	22.5	22.8	4.10	4.25
	K4	19.2	19.7	3.60	3.75
	K5	19.9	20.3	3.70	3.80
	K6	21.6	21.9	4.05	4.05
	K7	22.4	22.8	4.15	4.25
Mean		**20.1**	**20.4**	**3.81**	**3.89**
Mean of potassium treatments	**K1**	**15.6**	**15.9**	**3.14**	**3.26**
	K2	**21.2**	**21.4**	**3.93**	**3.98**
	K3	**23.3**	**23.6**	**4.20**	**4.33**
	K4	**19.8**	**20.1**	**3.64**	**3.78**
	K5	**20.6**	**20.9**	**3.74**	**3.85**
	K6	**22.1**	**22.5**	**4.00**	**4.09**
	K7	**23.2**	**23.5**	**4.20**	**4.30**
L. S. D. at 0.05					
A		**2.11**	**2.03**	**0.23**	**0.25**
B		**1.18**	**1.18**	**0.30**	**0.34**
A X B		**N.S.**	**N.S.**	**N.S.**	**N.S.**

Also, (Table, 5) showed that potassium fertilization had significant effect on N, P and K uptake in both growing seasons. (K3) and (K7) gave the highest values of total N, P and K uptake in both growing seasons (67.24, 63.73; 61.33, 61.25 and 98.33, 96.17 kg/feddan in the first growing season, respectively).

The same trends were obtained for the second growing season. On the other hands, wheat plants without potassium fertilization (K1) uptake less N, P and K in both growing seasons (37.13, 44.43 and 52.14 kg/feddan in the first growing season and 38.24, 46.22 and 57.78 kg/feddan in the second one, respectively).

It is obvious to observe that the effect of potassium treatments were parallel to its effect on both grain and straw yields, since nutrients uptake calculated as multiplying grain or straw yield by nutrients content in grains or straw yield. Similar results were obtained by Bahrananyar and Ranjbar (2008) and Mitra *et al.* (2009).

As for interaction effect, the data revealed that N, P and K uptake were not affected by the interaction between treatments.

In general, Beni-Suef 5 variety under K3 or K7 treatments uptake the highest amount of NPK. Whearas, Beni-Suef 6 or Sids 13 varieties without of potassium fertilization K1 recorded the lowest NPK uptake.The previous results exhibited that the interaction between varities and potassium fertilization was not significant for all studied traits. This indicated that the behaviours of these varieties were similar under these conditions.

Thus, the behavious were controlled by gentic affect. These results are in harmony with those obtained by El-Abady *et al.* (2009), Ahmed *et al*. (2011) and Abd El-Ghany *et al*. (2013) who reported that the interaction effect between wheat varity and foliar application of K on wheat productivity were no significant.

CONCLUSION

From the obtained results it can be concluded that, to obtain the best quantity and quality of wheat under these conditions it could be recommended to planting Beni-Suef 5 or Sids 12 variety under the application of 24 kg K_2O/feddan at two equal doses or 12 kg K_2O/feddan + foliar spraying of 2% potassium sulphate twice.

Table (5). Effect of potassium fertilization for four wheat varieties on total N, P and K uptake (kg/feddan)

Varieties A	Treatments of potassium B	Total N uptake (kg/feddan)		Total P uptake (kg/feddan)		Total K uptake (kg/feddan)	
		2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
Sids 12	K1	36.19	37.13	44.76	46.69	54.79	60.58
	K2	56.50	56.57	58.24	58.72	77.88	87.28
	K3	68.83	68.98	61.69	62.92	97.75	102.82
	K4	49.13	49.16	55.35	56.2	68.12	73.60
	K5	53.30	54.26	55.73	57.56	72.78	80.61
	K6	61.35	61.66	59.05	59.92	83.76	94.34
	K7	68.04	67.78	61.71	62.44	96.83	101.93
Mean		**56.19**	**56.51**	**56.65**	**57.77**	**78.85**	**83.38**
Sids 13	K1	33.96	35.01	42.48	44.25	51.34	55.45
	K2	52.41	52.49	53.25	56.12	73.30	80.64
	K3	62.22	63.21	57.71	59.75	90.20	96.55
	K4	46.11	46.36	51.32	53.21	63.85	68.23
	K5	49.67	49.93	52.02	53.84	67.05	73.75
	K6	57.83	57.66	55.60	57.98	77.44	87.75
	K7	61.42	61.70	57.09	58.63	88.84	95.39
Mean		**51.95**	**50.47**	**52.78**	**54.83**	**73.14**	**78.76**
Beni-Suef 5	K1	43.39	44.18	47.3	48.88	58.23	60.88
	K2	61.06	61.32	58.33	59.35	79.29	85.34
	K3	72.83	73.49	66.05	66.97	104.63	107.01
	K4	52.78	53.09	54.68	55.03	68.36	71.07
	K5	57.19	57.14	56.32	57.40	73.62	77.85
	K6	64.79	65.68	60.46	61.82	85.68	94.80
	K7	72.08	72.33	65.66	67.79	104.07	106.93
Mean		**60.59**	**61.04**	**58.41**	**59.61**	**81.98**	**86.26**
Beni-Suef 6	K1	34.96	36.63	43.17	45.04	53.20	56.88
	K2	54.8	54.49	57.25	55.84	77.40	79.97
	K3	65.08	65.99	59.86	61.72	100.74	97.80
	K4	47.58	48.97	51.86	54.09	67.2	69.02
	K5	50.75	52.05	53.57	54.84	70.00	74.79
	K6	60.07	59.96	57.83	58.31	82.94	88.45
	K7	65.4	65.99	60.59	61.45	94.91	97.24
Mean		**54.09**	**54.78**	**54.87**	**55.9**	**77.8**	**81.67**
Mean of potassium treatments	**K1**	**37.13**	**38.24**	**44.43**	**46.22**	**52.14**	**57.78**
	K2	**56.20**	**56.22**	**67.89**	**57.51**	**76.97**	**82.29**
	K3	**67.24**	**67.92**	**61.33**	**62.84**	**98.33**	**100.29**
	K4	**48.91**	**49.40**	**53.30**	**54.63**	**66.44**	**70.12**
	K5	**52.73**	**53.35**	**54.41**	**55.91**	**70.42**	**75.79**
	K6	**61.01**	**61.23**	**58.24**	**59.51**	**82.45**	**90.40**
	K7	**63.73**	**66.95**	**61.25**	**62.58**	**96.17**	**90.27**
L. S. D. at 0.05							
A		**2.33**	**2.66**	**1.87**	**1.95**	**2.15**	**2.36**
B		**2.05**	**2.31**	**1.69**	**1.74**	**2.11**	**2.31**
A X B		**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

APPENDIX

Appendix (1). Effect of potassium fertilization for four wheat varieties on N, P and K concentration (%)

Varieties A	Treatments of potassium B	N%				P%				K%			
		In grain		In straw		In grain		In straw		In grain		In straw	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Sids 12	K1	1.19	1.19	0.29	0.29	0.41	0.42	1.11	1.12	0.47	0.51	1.38	1.40
	K2	1.29	1.28	0.38	0.38	0.42	0.41	1.12	1.11	0.61	0.70	1.46	1.50
	K3	1.39	1.38	0.45	0.44	0.42	0.42	1.11	1.11	0.91	0.92	1.55	1.57
	K4	1.24	1.23	0.32	0.32	0.42	0.42	1.12	1.12	0.52	0.54	1.41	1.44
	K5	1.29	1.25	0.35	0.35	o.41	0.41	1.12	1.12	0.56	0.60	1.44	1.48
	K6	1.33	1.33	0.42	0.40	0.41	0.41	1.11	1.11	0.67	0.83	1.50	1.52
	K7	1.36	1.37	0.46	0.43	0.42	0.41	1.11	1.12	0.90	0.91	1.54	1.56
Mean		**1.29**	**1.30**	**0.38**	**0.37**	**0.42**	**0.41**	**1.11**	**1.12**	**0.66**	**0.71**	**1.47**	**1.50**
Sids 13	K1	1.20	1.19	0.29	0.30	0.42	0.42	1.12	1.12	0.47	0.52	1.38	1.40
	K2	1.29	1.28	0.39	0.37	0.41	0.42	1.10	1.12	0.62	0.71	1.47	1.51
	K3	1.38	1.38	0.46	0.45	0.42	0.41	1.12	1.12	0.92	0.93	1.54	1.57
	K4	1.25	1.23	0.32	0.32	0.42	0.42	1.13	1.12	0.51	0.53	1.40	1.43
	K5	1.29	1.27	0.36	0.35	o.41	0.41	1.12	1.12	0.55	0.60	1.43	1.47
	K6	1.32	1.34	0.41	0.39	0.42	0.42	1.12	1.12	0.65	0.84	1.51	1.52
	K7	1.37	1.36	0.45	0.44	0.42	0.41	1.12	1.11	0.90	0.93	1.54	1.56
Mean		**1.30**	**1.29**	**0.38**	**0.37**	**0.42**	**0.42**	**1.12**	**1.12**	**0.66**	**0.72**	**1.47**	**1.49**
Beni-Suef 5	K1	1.20	1.19	0.30	0.30	0.41	0.41	1.10	1.11	0.48	0.50	1.38	1.39
	K2	1.30	1.30	0.38	0.37	0.42	0.42	1.10	1.11	0.60	0.72	1.47	1.49
	K3	1.38	1.37	0.45	0.44	0.41	0.41	1.11	1.11	0.90	0.91	1.55	1.56
	K4	1.25	1.24	0.33	0.33	0.42	0.41	1.11	1.11	0.51	0.53	1.40	1.43
	K5	1.27	1.26	0.35	0.34	0.41	0.42	1.11	1.11	0.55	0.61	1.44	1.47
	K6	1.32	1.33	0.42	0.40	0.42	0.42	1.12	1.12	0.68	0.85	1.51	1.53
	K7	1.37	1.36	0.45	0.43	0.41	0.42	1.11	1.12	0.91	0.92	1.54	1.55
Mean		**1.30**	**1.29**	**0.38**	**0.37**	**0.41**	**0.42**	**1.11**	**1.11**	**0.66**	**0.72**	**1.47**	**1.49**
Beni-Suef 6	K1	1.19	1.20	0.29	0.31	0.40	0.42	1.10	1.11	0.48	0.51	1.38	1.40
	K2	1.30	1,29	0.38	0.38	0.41	0.41	1.11	1.12	0.61	0.71	1.47	1.49
	K3	1.37	1.37	0.46	0.45	0.41	0.41	1.12	1.12	0.91	0.92	1.54	1.56
	K4	1.25	1.24	0.32	0.33	0.41	0.42	1.11	1.11	0.52	0.52	1.40	1.43
	K5	1.28	1.26	0.34	0.36	0.42	0.42	1.11	1.11	0.56	0.61	1.44	1.48
	K6	1.33	1.32	0.42	0.41	0.40	0.41	1.11	1.11	0.67	0.82	1.51	1.52
	K7	1.38	1.37	0.46	0.45	0.42	0.42	1.11	1.12	0.91	0.92	1.55	1.55
Mean		**1.30**	**1.29**	**0.38**	**0.38**	**0.41**	**0.42**	**1.11**	**1.11**	**0.67**	**0.72**	**1.47**	**1.47**
Mean of potassium treatments B	K1	1.20	1.19	0.29	0.30	0.41	0.42	1.11	1.11	0.48	0.51	1.38	1.40
	K2	1.30	1.29	0.38	0.38	0.41	0.42	1.11	1.11	0.61	0.71	1.47	1.50
	K3	1.38	1.38	0.46	0.45	0.42	0.41	1.12	1.12	0.91	0.92	1.55	1.57
	K4	1.25	1.24	0.32	0.33	0.42	0.42	1.12	1.12	0.52	0.53	1.40	1.43
	K5	1.28	1.26	0.35	0.35	o.41	0.42	1.12	1.12	0.56	0.61	1.40	1.48
	K6	1.33	1.33	0.42	0.40	0.41	0.42	1.12	1.12	0.67	0.84	1.51	1.52
	K7	1.37	1.37	0.45	0.44	0.42	0.42	1.12	1.12	0.91	0.92	1.54	1.56
L. S. D. at 0.05													
A		**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**
B		**0.15**	**0.16**	**0.05**	**0.06**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**0.11**	**0.13**	**0.06**	**0.07**
A X B		**N.S.**	**N. S**	**N.S.**	**N. S**	**N. S**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Appendix (2). Effect of potassium fertilization for four wheat varieties on N, P and K uptake (kg/ feddan)

Varieties A	Treatments of potassium B	N uptake				P uptake				Kuptake			
		By grain		By straw		By grain		By straw		By grain		By straw	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Sids 12	K1	26.92	27.61	9.27	9.52	9.23	9.77	35.53	36.92	10.63	14.31	44.16	46.27
	K2	41.21	41.02	15.29	15.55	13.43	13.13	44.81	45.59	19.47	25.71	58.41	61.57
	K3	49.85	50.08	18.98	18.90	15.07	15.21	46.62	47.71	32.60	35.30	65.15	67.52
	K4	36.61	36.71	12.52	12.45	12.43	12.53	42.92	43.67	15.31	17.43	52.81	56.17
	K5	39.83	39.54	13.47	14.72	12.61	12.73	43.12	44.83	17.35	21.32	55.43	59.29
	K6	44.07	45.05	17.28	16.61	13.55	13.83	45.50	46.09	22.21	31.31	61.55	63.03
	K7	48.71	49.55	19.33	18.23	15.07	14.81	46.64	47.63	32.21	35.60	64.62	66.33
Mean		**41.03**	**41.37**	**15.16**	**15.14**	**13.06**	**13.14**	**43.59**	**44.63**	**21.40**	**23.35**	**57.45**	**60.03**
Sids 13	K1	25.23	25.54	8.73	9.47	8.81	9.02	33.67	35.23	9.87	11.35	41.47	44.10
	K2	37.75	38.06	14.66	14.43	11.97	12.45	41.28	43.67	18.17	21.82	55.13	58.82
	K3	44.06	44.59	18.16	18.62	13.48	13.27	44.23	46.48	29.37	31.43	60.83	65.12
	K4	34.84	34.53	11.27	11.83	11.79	11.75	39.53	41.46	14.29	15.33	49.56	52.90
	K5	36.75	36.76	12.92	13.17	11.69	11.82	40.33	42.02	15.60	18.56	51.45	55.19
	K6	42.32	42.01	15.51	15.65	13.05	13.11	42.55	44.87	20.11	26.92	57.33	60.83
	K7	43.90	43.63	17.52	18.07	13.43	13.11	43.66	45.52	28.82	31.44	60.02	63.95
Mean		**37.84**	**38.59**	**14.11**	**11.88**	**12.03**	**12.08**	**40.75**	**42.75**	**19.46**	**21.49**	**53.68**	**57.27**
Beni-Suef 5	K1	33.62	34.09	9.77	10.09	11.51	11.71	35.79	37.17	13.41	14.31	44.82	46.57
	K2	46.00	46.45	15.06	14.87	14.87	14.90	43.46	44.45	21.20	25.71	58.09	59.63
	K3	52.36	53.21	20.47	20.28	15.51	15.92	50.54	51.05	34.11	35.30	70.52	71.71
	K4	40.51	40.72	12.27	12.37	13.63	13.41	41.05	41.62	16.50	17.43	51.86	53.64
	K5	43.83	44.09	13.36	13.05	14.13	14.63	42.19	42.77	18.91	21.32	54.71	56.53
	K6	47.72	49.04	17.07	16.64	15.10	15.40	45.36	46.42	24.50	31.31	61.18	63.49
	K7	51.75	52.63	20.33	19.70	15.44	16.22	50.22	51.57	34.31	35.60	69.76	71.33
Mean		**45.11**	**45.75**	**15.48**	**15.29**	**14.32**	**14.60**	**44.09**	**45.01**	**23.27**V	**25.85**	**58.71**	**60.41**
Beni-Suef 6	K1	26.03	26.62	8.93	10.01	8.75	9.34	34.42	35.70	10.50	11.35	42.70	45.53
	K2	39.55	39.67	15.25	14.82	12.40	12.61	44.85	43.23	18.52	21.82	58.88	58.15
	K3	46.21	46.82	18.87	19.17	13.89	14.08	45.97	47.64	30.71	31.43	70.03	66.37
	K4	36.02	36.67	11.56	12.30	11.87	12.44	39.99	41.65	14.92	15.33	50.47	53.69
	K5	38.20	38.36	12.55	13.69	12.53	12.71	41.04	42.13	16.73	18.56	53.27	56.23
	K6	43.06	43.33	17.01	16.63	12.92	13.41	44.91	44.90	21.75	26.92	61.19	61.53
	K7	46.33	46.84	19.07	19.15	14.12	14.33	46.47	47.12	30.56	31.44	64.35	65.80
Mean		**39.34**	**39.67**	**14.75**	**15.11**	**12.35**	**12.70**	**42.52**	**43.20**	**20.53**	**22.41**	**57.27**	**59.26**
Mean of potassium treatments B	K1	27.95	28.47	9.18	9.77	9.58	9.96	34.85	36.26	8.85	12.16	43.29	45.62
	K2	41.13	41.30	15.07	14.92	13.17	13.27	54.72	44.24	19.34	22.75	57.63	59.54
	K3	48.12	48.68	19.12	19.24	14.49	14.62	46.84	48.22	31.70	32.61	66.63	67.68
	K4	37.00	37.16	11.91	12.24	12.43	12.53	40.87	42.10	15.26	15.94	51.18	54.18
	K5	39.65	39.69	13.08	13.66	12.74	12.97	41.67	42.94	17.15	18.98	53.27	56.81
	K6	44.29	44.85	16.72	16.38	13.66	13.94	44.58	45.57	22.14	28.18	60.31	62.22
	K7	44.67	48.16	19.06	18.79	14.50	14.62	46.75	47.96	31.48	23.42	64.69	66.85
L. S. D. at 0.05													
A		**2.36**	**2.06**	**1.09**	**1.13**	**0.25**	**0.27**	**1.05**	**1.11**	**1.75**	**1.70**	**2.19**	**2.51**
B		**3.10**	**3.15**	**1.00**	**1.01**	**0.36**	**0.33**	**1.23**	**1.19**	**2.13**	**2.00**	**3.37**	**3.60**
A X B		**N. S.**	**N. S.**	**N. S.**	**N. S.**	**N. S.**	**N. S.**	**N. S.**	**N. S.**	**N. S.**	**N. S.**	**N. S.**	**N. S.**

REFERENCES

Abd El-Ghany, H. M. (2003). Studies on embryo culture in wheat and association with yield and its components. Ph. D. Thesis, Fac. of Agric., Minufiya Univ. Egypt.

Abd El-Ghany, H. M.; A. M. El-Saady and R. Kh. M. Khalifa (2012). Evaluation of some new durum wheat genotypes for growth, yield and micronutrients use efficiency under sandy soil conditions. Australian J. of Basic and Applied Sci., 6(10): 494-499.

Abd El-Ghany, H. M., E. A. El-Housini and M. H. M. Afifi (2013). Effect of certain macronutrients foliar application on growth, yield and nutrients content of grains for two bread wheat varieties in sandy soil. Journal of Applied Sciences Research, 9(2): 1110-1115.

Abd El-Majeed, S. E. A. (1990). Effect of some agricultural practices on growth and yield of wheat. Ph. D. Thesis, Fac. Agric. Minia Univ., Egypt.

Abo-Warda, A. M. A. (2002). Evaluation of some wheat genotypes under different irrigation treatments and nitrogen levels in sandy soil. Minufiya J. Agric. Res., 27(2): 181-196.

Ahmed, A. G., M. S. Hassanein and M. M. El-Gazzar (2006). Growth and yield response of two wheat cultivars to complete foliar fertilizer compound "Dogoplus" Journal of Applied Sciences Research, 2(1): 20-26.

Ahmed, A. I. G., M. M. Tawfik and M. S. Hassanein (2011). Foliar feeding of potassium and urea for maximizing wheat productivity in sandy soil. Australian Journal of Basic and Applied Sciences, 5(5): 1197-1203.

AOAC (1985). Official Methods of Analysis of the Official Analytical Chemists.14 ed. Washington, D.C.

Arabia, M. I. E., B. N. Miralia and M. Jawhara (2002). Effect of foliar and soil potassium fertilisation on wheat yield and severity of Septoria tritici blotch. Australasian Plant Pathology, 31, 359–362

Bahrnanyar, M. A. and G. A. Ranjbar (2008). The role of potassium in improving growth indices and increasing amount of grain nutrient elements of wheat cultivars. .Journal of Applied Sciences 8 (7): 1280-1285.

El- Abady, M., S. Seadh, A. El-Ward; A. Ibrahim and A. M. El-Emam (2009). Irrigation with holding and potassium foliar application effect on wheat yield and quality. Int. J. Sustain. Crop Prod., 4(4): 33-39.

El-Habbasha, S. F., M. M. Tawfik and M. H. Mohamed (2008). Response of two wheat varieties to partial replacement of recommended nitrogen fertilizer by bacterial inoculations. Egypt. J. Agron., 30(2): 187-200.

FAO (2005). Global network on integrated soil management for sustainable use of salt-affected soils. Rome, Italy: FAO Land and Plant Nutrition Management Service. http://www.fao.org/ag/AGL/agll/spush.

Gerardeaux, E., L. Jordan, J. Constantin; S. Pellerin and M. Dingkuhn (2010). Changes in plant morphology and dry matter partitioning caused by potassium deficiency in Gossypium hirsutum (L.). Environ Exp Bot 67: 451–459.

Gul, H., A. Said, B. Saeed, F. Mohammad and I. Ahmad (2011). Effects of foliar application of nitrogen, potassium and zinc on wheat growth. J. Agric. Biol. Sci., 6(4): 56-58.

Hamouda, H. A., M. F. El-Dahshouri, F. M. Manal and A. T. Thalooth (2015). Growth, yield and nutrient status of wheat plants as affected by potassium and iron foliar application in sandy soil. Int.J. ChemTech Res., 8(4): 1473-1481.

Hassanein, M. S. (2001). Effect of variety and nitrogen foliar fertilizer compound under water stress levels on growth, yield and yield components of wheat (*Triticum aestivum* L.) in newly cultivated land. Egypt. J. Agron., 23: 111-131.

Jabbar A., T. Aziz and I. H. Bhatti (2009). Effect of potassium application on yield and protein contents of late sown wheat (*Triticum aestivum* L.) under field conditions. Soil and Environment, 28(2):193–196.

Kanai, S., R. E. Moghaieb, H. A. El-Shemy, R. Panigrahi, P. K. Mohapatra, J. Ito, N. T. Nguyen, H. Saneoka and K. Fujita (2011). Potassium deficiency affects water status and photosynthetic rate of the vegetative sink in greenhouse tomato prior to its effects on source activity. Plant Sci., 180: 368–374.

Kettlewell, P. S., J. W. Cook and D. W. Parry (2000). Evidence for an osmotic mechanism in the control of powdery mildew disease of wheat by foliar applied potassium chloride. European J. Plant Pathol., 106: 297–300.

Klute, A. (1986). Methods of Soil Analysis. Part 1 – Physical and Mineralogical Methods. 2nd ed. SSSA Book Series No. 5. SSSA and ASA, Madison, Wisconsin, USA.

Mahmoud, A. M. (1987). Effect of some agricultural practices of some wheat varieties. M. Sc. Thesis, Fac. Agric. Minia Univ., Egypt.

Mahmoud, A. and A. Rafiq (2011). Foliar application of some essential minerals on tomato (*Solanum lycopersicum* L.) plant grown under two different salinity regimes.Pak. J. Bot., 43(3): 1513-1520, 2011.

Mekky, M. S., A. A. Mostafa and S. A. Abd El-Majeed (2007). Effect of mechanical tillage system, wheat variety and weed control treatments on weeds and wheat (*Triticum aestivum* L.) productivity. Misr J. Agric. Eng., 24(1): 18-41.

Mitra, G. N., S. K. Sahu and R. K. N. Bhubaneswar (2009). The role and benefits of potassium in improving nutrient. International Symposium, 5-7 November, OUAT, Bhubaneswar, Orissa, India.

Mousavi, R. S. (2011). Zinc in crop production and interaction with phosphorus. Australian Journal of Basic and Applied Sciences, 5: 1503-1509.

Nadin, M. A., I. U. Awan, M. S. Baloch, E. A. Khan, K. Naveed and M. A. Khan (2012). Response of wheat (*Triticum aestivum* L.) to different micronutrients and their application methods, J. Anim. Plant Sci. 22 (1): 113-119.

Page, A. L., R. H. Miller and D. R. Keeny (1982). Methods of Soil Analysis. 2nd Edition Part 2: Chemical and Microbiological Properties. American Society of Agronomy, Madisons, Wisconsin, USA.

Pettigrew, W. T. (2003). Relationship between insufficient potassium and crop maturity in cotton. American Society of Agronomy, 95 (5): 1323-1329.

Pettigrew, W. T. (2008). Potassium influences on yield and quality production for maize, wheat, soybean and cotton. Physiol Plantarum 133: 670–681.

Shaaban, S. H. A., F. M. Manal and M. H. M. Afifi (2009). Humic acid foliar application to minimize soil applied fertilization of surface–irrigated wheat.World J. of agricultural Sciences, 5(2): 207-210.

Snedecor, G. W. and W. G. Cochran (1980). "Statistical Methods" 7th Edin. Iowa State Univ., Press, Iowa, USA.

Thalooth, A. T., M .M. Tawfik and H. M. Mohamed (2006). A comparative study on the effect of foliar application of zinc, potassium and magnesium on growth, yield and some chemical constituents of mung bean plants growth under water stress conditions. World J. Agric. Sci , 2 (1): 37-46.

Zafar, S., M. Y. Ashraf, S. Anwar, Q. Ali1 and A. Noman1 (2016). Yield enhancement in wheat by soil and foliar fertilization of K and Zn under saline environment. Soil Environ. 35(1): 46-55.

الملخص العربي

تأثير طرق اضافة البوتاسيوم علي انتاجية بعض اصناف القمح تحت ظروف منطقة مصر الوسطي

محمد جمال رمضان سرحان[١] ، اشرف صلاح عبد الحميد[٢]

١- معهد بحوث الاراضي والمياة والبيئة – مركز البحوث الزراعية- مصر.

٢- معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية- مصر.

أجريت تجربتان حقليتان في محطة البحوث الزراعية بسدس , مركز البحوث الزراعية محافظة بني سويف لدراسة استجابة صنفي من قمح الخبز (سدس١٢ , سدس١٣) وصنفي من قمح المكرونة (بني سويف ٥ , بني سويف ٦) الي اضافة الاسمدة البوتاسية ارضا او رشا وكانت المعاملات كما يلي: بدون تسميد بوتاسي (بو١) , ٢٤ كجم بو٢أ/فدان مرة واحدة ارضي قبل الزراعة (بو٢) , ٢٤ كجم بو٢أ/فدان ارضي تضاف مرتين قبل الزراعة وبعد شهرين (بو ٣) , رش ٢% كبريتات بوتاسيوم مرة واحدة (بو ٤) , رش ٢% كبريتات بوتاسيوم مرتان (بو ٥) , ١٢ كجم بو٢أ/فدان ارضي + رش ٢% كبريتات بوتاسيوم مرة واحدة (بو ٦) , ١٢ كجم بو٢أ/فدان ارضي + رش ٢% كبريتات بوتاسيوم مرتان (بو ٧). ويمكن تلخيص اهم النتائج كما يلي:-

- اظهر صنف سدس ١٢ اقل عدد ايام للوصول الي مرحلة طرد السنابل ومرحلة النضج وكذلك اعلي قيم لعدد السنابل/م٢ , عدد الحبوب/السنبلة.
- اظهر صنف بني سويف ٥ الي اعلي قيم لوزن ١٠٠٠ حبة ومحصول الحبوب والقش.
- سجل صنف سدس ١٣ الي اقل قيم لطول النبات ووزن ١٠٠٠ حبة ومحصول القش وامتصاص العناصر.
- اعطي صنف بني سويف ٦ اقل قيم عدد السنابل/م٢ , عدد الحبوب/السنبلة ومحصول الحبوب.
- اظهر صنف بني سويف ٥ اعلي عدد ايام من الزراعة حتي طرد السنابل او النضج.
- ادت معاملة ٢٤ كجم بو٢أ/فدان علي دفعتان قبل الزراعة وبعد شهرين (بو٣) اواضافة ١٢ كجم بو٢أ/فدان قبل الزراعة + رش محلول كبريتات بوتاسيوم بمعدل ٢% مرتان (بو٧) اعلي قيم لكلا من طول النبات , عدد السنابل/م^{٢} , عدد الحبوب/السنبلة , وزن ١٠٠٠ حبة ومحصول الحبوب والقش وكذلك امتصاص عناصر النيتروجين والفوسفور والبوتاسيوم.
- ادت معامل بو٣ او بو٧ الي اقل عدد ايام من الزراعة حتي مرحلة طرد السنابل والنضج.
- ادي عدم التسميد البوتاسي (بو١) الي اقل قيم لخصائص النمو والمحصول ومكوناتة وامتصاص العناصر.

ويمكن من نتائج الدراسة ان نوصي بزراعة صنف قمح مكرونة بني سويف ٥ اوصنف خبز سدس ١٢ والتسميد بمعدل ١٢ كجم بو٢أ/فدان قبل الزراعة + ١٢ كجم بو٢أ/فدان بعد شهرين من الزراعة أواضافة ١٢ كجم بو٢أ/فدان قبل الزراعة + رش محلول كبريتات بوتاسيوم بمعدل ٢% مرتان للحصول علي اعلي انتاجية لمحصول القمح كما ونوعا تحت ظروف الاراضي الطينية الرسوبية بمصر الوسطي.