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RESPONSE OF SOME WHEAT CULTIVARS TO DIFFERENT LEVELS OF NITROGEN

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ABSTRACT

Increasing wheat productivity under Egyptian conditions is one of the main targets of wheat agronomists. The yield of wheat is a function of many factors among them the cultivars and nitrogen fertilization being the most important ones. A filed experiment was carried out at Agricultural Research Station , Faculty of Agriculture , Cairo University during 2005/2006 season to evaluate the effect of nitrogen levels (0 , 50 , 75 Kg N fed^{-1}) in the form of urea on the yield , N content , harvest index% (HI%) and nitrogen use efficiency (NUE) of nine wheat cultivars (Giza 168, Sids 1, Sakha 93, Sakha 61, Gemmiza 9, Gemmiza 7, Sohag 3, Beni-Suif 1 and Beni-Suif 3). At harvest grain and straw yields were measured. Nitrogen content of grain and straw was determined. Harvest index% (HI%) and nitrogen use efficiency (NUE) were calculated.

Wheat cultivars were differed significantly in all characters , where Beni-Suif 1 gave the highest values of grain and straw yield , nitrogen content of grain and straw, HI and NUE. Meanwhile Sakha 93 recorded the lowest values.

Significant differences among the tested nitrogen levels were observed among characters studied. In this respect, the highest N level compared to without N supply, on average, increased grain yield by 43 % and straw yield by 55 %, but decreased HI % by 4 % and NUE by 28 %. Nitrogen content of grain and straw increased significantly with increasing N levels.

Keywords: Wheat cultivars , N levels , NUE.

INTRODUCTION

The importance of wheat in human main food is the well known fact allover the world as well as in Egypt**.** Raising wheat production through increasing unit land area productivity and increasing the cultivated area is the most important national target to minimize the gap between the Egyptian production and consumption. Increasing wheat yield per unit area can be achieved by breeding high yielding cultivars. Plant breeders need to develop cultivars that can absorb N more efficiently from the soil and partition most of the absorbed N into the grain. Such cultivars would minimize loss of N from the soil and make more economic use of the absorbed N (Gafaar, 2007).

Nitrogen is the most important plant nutrient needed to obtain high wheat yield in Egypt.

Several investigators reported a beneficial effect of nitrogen application on wheat (Sobh *et al.,* 2000 ; Mowafy, 2002 and Saleh, 2002). They reported that numbers of tillers and spikes m^{-2} , plant height, spike length and grains/spike, grain and straw yields of wheat increased with increasing N level.

Nitrogen use efficiency (NUE) is an important topic when discussing fertilizer applications and plant growth. Nitrogen use efficiency is defined as grain production per unit of N available in the soil (Moll *et al*., 1982; Van Sanford and Mackown, 1986). A recent review of nitrogen use efficiency (NUE) in cereal production identified worldwid efficiencies of only 33% for fertilizer-N. The unaccounted 67% represents a $15.9 billion annual loss of N fertilizer (assuming fertilizer-soil equilibrium) (Raun and Johnson , 1999). Loss of fertilizer N results from gaseous plant emission, soil denitrification, surface runoff, volatilization, and leaching (Raun and Johnson, 1999; Granstedt, 2000 and Cassman *et al*., 2003).

The early study of NUE was facilitated by identifying individual components that explained both uptake and utilization efficiency (Moll *et al.,* 1982). Genotypic variation in N efficiency could generally be attributed to high N uptake and/or high N utilization (Sattelmacher et al., 1994). Wheat cultivars with a high harvest index (HI) (grain produced divided by the total dry biomass) and low forage yield have low plant N loss and increased NUE (Kanampiu et al., 1997). Wheat cultivars differed in NUE (Kanampiu *et al.,* 1997 ; Le Gouis *et al.,* 2000 ; Guarda *et al*., 2004 and Lo´pez-Bellido *et al.*, 2008). The objective of this study was to evaluate the effects of nitrogen levels on yield , NUE and HI % of some wheat cultivars.

MATERIALS AND METHODS

A filed experiment was carried out at Agricultural Research Station , Faculty of Agriculture , Cairo University during 2005/2006 season to study the effect of nitrogen levels on the yield of wheat. The soil of the experimental area is sandy clay loam and had the following characteristics: pH 7.5 (1:1 soil-water ratio) after Richards (1954), EC 0.66 dS m^{-1} (1:1 soil-water ratio) after Jackson (1973), organic matter 1.53 % determined by oxidizing with chromic acid according to Jackson (1973), Olsen's extractable P 12.45 ppm determined after Olsen *et al.,* (1954) , available nitrogen 35.40 ppm determined using microkjeldahl apparatus, after extracting with 1N KCl solution as outlined by Jackson (1973).

The experiment included 27 treatments which were the combination of nine wheat cultivars , i.e. Giza 168, Sids 1, Sakha 93, Sakha 61, Gemmiza 9, Gemmiza 7, Sohag 3, Beni-Suif 1 and Beni-Suif 3 and three nitrogen levels i.e. 0 , 50 and 75 Kg N / fed. The treatments were arranged in a split plot design with three replications. The plot size was 9 m^2 (3.0 m length and 3.0 m width). Pre-sowing calcium supperphosphate and potassium sulphate were added at rates of 6.55 Kg P fed^{-1} and 19.90 Kg K fed^{-1} , respectively. Nitrogen fertilizer was applied in the form of urea (46.5 % N) in two equal dose at 21 and 42 days after sowing. The proceeding crop was maize. The plots were irrigated six times and irrigation was held three weeks before harvesting .

At harvest grain and straw yield per feddan were measured. Nitrogen content in the dry matter of grain and straw (Kg fed^{-1}) was determined after Jackson (1973). Nitrogen use efficiency (NUE) = (grain weight / nitrogen supply) (Gw/Ns) (Moll *et al*., 1982) and harvest index% (HI) = (dry weight of grain yield)/(dry weight for above ground plant parts)*100 (Kanampiu et al., 1997) were calculated.

RESULTS AND DISCUSSION

1-Grain and straw yield

Data in Table 1 show that there were significant differences in grain and straw yield of the wheat cultivars. Nitrogen levels also significantly affected grain and straw yield. Interaction among wheat cultivars and nitrogen levels was found to be significant.

Significant differences were observed in grain and straw yield amongst wheat cultivars, regardless N levels. Beni-Suif 1, Beni-Suif 3, Gemmiza 9, Sids 1 and Sohag 3 are cultivars superior to, Sakha 61, Gemmiza 7, Giza 168 and Sakha 93 in grain and straw yield. Both superior and inferior cultivars differ significantly from each other. Beni-Suif 1, Beni-Suif 3, Gemmiza 9, Sids 1 and Sohag 3 had a higher grain and straw yield than the other cultivars, and so , were superior cultivars. Beni-Suif 1 recorded the highest grain and straw yield , while Sakha 93 recorded the lowest. These results are supported by several researchers (Kanampiu *et al.,* 1997; Mowafy, 2002 ; Ali *et al*., 2004; Amal *et al.,* 2006 ; Alam *et al.,* 2007 and Gafaar, 2007). BARI (2006) reported that the reasons for differences in producing growth and yield characters might be due to genetic make up of the varieties primarily influenced by heredity.

Table 1: Effect of different nitrogen levels on grain and straw yield of various wheat cultivars .

Cultivars (c)	Grain yield (Kg/ fed)				Straw yield ((Kg/ fed)			
	N-levels (L) (Kg/fed)							
	0 (without N-application)	50	75	Mean	0 (without N-application)	50	75	Mean
BENI-SUIF1	3244.44	3977.78	4118.67	**3780.30**	4045.78	5368.00	5800.89	**5071.56**
BENI-SUIF3	3198.67	3955.56	4108.00	**3754.08**	4000.00	5333.33	5777.78	**5037.04**
GEMMEIZA 9	3022.22	3825.33	3896.44	**3581.33**	3960.00	5377.78	5728.89	**5022.22**
SIDS 1	2928.89	3721.33	3890.22	**3513.48**	3947.56	5332.89	5732.00	**5004.15**
SOHAG 3	2796.89	3555.56	3840.00	**3397.48**	3788.89	5275.56	5720.00	**4928.15**
SAKHA 61	2622.22	3471.11	3783.56	**3292.30**	3645.33	5244.44	5702.22	**4864.00**
GEMMEIZA 7	2417.78	3336.44	3764.44	**3172.89**	3640.00	5044.44	5688.89	**4791.11**
GIZA 168	2281.33	3321.33	3693.33	**3098.66**	3422.22	5013.33	5622.22	**4685.92**
SAKHA 93	1794.22	3191.11	3635.56	**2873.63**	2711.11	4841.33	5577.78	**4376.74**
Mean	**2700.74**	**3595.06**	**3858.91**		**3684.54**	**5203.46**	**5705.63**	
LSD at 0.05 for	**(C) 104.27**	**(L) 60.89**	**C*L 182.84**		**(C) 308.53**	**(L) 174.40**	**C*L 523.73**	

The results presented in Table 1 reveal that low to high nitrogen application significantly increased the grain and straw yield over the control. Wheat grain and straw yield resulting from application of 50 Kg N fed^{-1} differing significantly from the application of 75 Kg N f ed^{-1} . This result is in accordance with numerous studies (Sobh *et al.,* 2000 ; Mowafy, 2002 ; Saleh, 2002 ; Ali *et al.,* 2004 ; Yadav *et al.,* 2005 ; El-Sirafy *et al.,* 2006 ; Alam *et al.,* 2007 ; Gafaar, 2007 ; Limon-Ortega *et al.*, 2008 and Montemurro, 2009).

Increasing nitrogen levels up to 50 Kg N fed^{-1} significantly increased grain yield of all cultivars, the relative increases by adding 50 Kg N fed^{-1} ranged from 23 to 27 % and from 32 to 78% in superior and inferior cultivars over unfertilized plants , respectively. Increasing N levels from 50 to 75 Kg N fed^{-1} significantly increased grain yield of Sohag 3, Sakha 61, Gemmiza 7, Giza 168 and Sakha 93. This result is in accordance with (Guarda *et al.,* 2004) who found that the nitrogen levels interacted positively with wheat cultivars.

Increasing nitrogen levels up to 50 Kg N/fed significantly increased straw yield of all cultivars, while increasing N levels from 50 to 75 Kg N/fed significantly increased straw yield of Gemmiza 7, Giza 168 and Sakha 93.

2-Harvest index % (HI)

Data in Table 2 show that there were significant differences in harvest index of the wheat cultivars under study. Nitrogen levels also significantly affected harvest index. Interaction among wheat cultivars and nitrogen levels was found to be significant.

In general, the data presented in Table 2 show that there were significant differences in harvest index (HI%) between wheat cultivars. Both Beni-Suif 1 and Beni-Suif 3 had the higher harvest index (HI%) than the other cultivars. This result is supported by (Kanampiu *et al.,* 1997 and Gafaar, 2007).

Table 2: Effect of different nitrogen levels on harvest index % (HI %) of various wheat cultivars.

Cultivars (c)	Harvest index %			
	N-levels (L) (Kg/fed)			
	0 (without N-application)	50	75	Mean
BENI-SUIF1	44.50	42.50	41.50	**42.80**
BENI-SUIF3	44.40	42.60	41.60	**42.90**
GEMMEIZA 9	43.30	41.60	40.50	**41.80**
SIDS 1	42.60	41.10	40.40	**41.40**
SOHAG 3	42.50	40.30	40.20	**41.00**
SAKHA 61	41.80	39.80	39.90	**40.50**
GEMMEIZA 7	39.90	39.80	39.80	**39.80**
GIZA 168	39.90	39.80	39.60	**39.80**
SAKHA 93	39.80	39.70	39.50	**39.70**
Mean	**42.08**	**40.80**	**40.33**	
LSD at 0.05 for	(C) 0.16	(L) 0.08	C*L 0.23	

The results presented in Table 2 indicate also that the highest value of HI % was recorded for the control treatment (0 N level).However, high N fertilizer rate (75 Kg N fed^{-1}) reduce HI% significantly from the application of 50 Kg N fed^{-1} . This result is in accordance with (Ehdaie *et al.,* 2001 and Lo´ pez-Bellido *et al.,* 2006).

Generally, increasing nitrogen levels up to 50 Kg N fed^{-1} significantly decreased the harvest index of all cultivars, while increasing N levels from 50 to 75 Kg N fed^{-1} significantly decreased only the harvest index of Beni-Suif 1, Beni-Suif 3, Gemmiza 9 and Sids 1. This result is supported by (Ehdaie *et al.,* 2001 and Alam *et al.,* 2007).

3-Nitrogen content in grain and straw

Data in Table 3 show that there were significant differences in nitrogen content in grain and straw of the wheat cultivars. Nitrogen levels also significantly affected nitrogen content in grain and straw. Interaction among wheat cultivars and nitrogen levels was found to be significant.

In general, the data presented in Table 3 show that there were significant differences in nitrogen content in grain and straw between wheat cultivars. Both Beni-Suif 1 and Beni-Suif 3 had the higher nitrogen content in grain and straw than the other cultivars. Beni-Suif 1 recorded the highest nitrogen content in grain and straw, while Sakha 93 recorded the lowest. This result is supported by (Kanampiu *et al.,* 1997 and Le Gouis *et al.,*2000).

Table 3: Effect of different nitrogen levels on nitrogen content in grain and straw of various wheat cultivars.

Cultivars (c)	Nitrogen content in grain (Kg/ fed)				Nitrogen content in straw (Kg/ fed)			
	N-levels (L) (Kg/fed)							
	0 (without N-application)	50	75	Mean	0 (without N-application	50	75	Mean
BENI-SUIF1	32.444	69.611	74.136	**58.730**	10.114	16.104	20.303	**15.507**
BENI-SUIF3	31.987	69.222	73.944	**58.384**	10.000	16.000	20.222	**15.407**
GEMMEIZA 9	30.222	67.708	70.915	**56.282**	9.900	16.133	20.051	**15.361**
SIDS 1	29.289	65.868	70.802	**55.320**	9.869	15.999	20.062	**15.310**
SOHAG 3	29.367	64.000	69.504	**54.290**	9.855	15.827	20.020	**15.234**
SAKHA 61	28.844	61.786	68.104	**52.911**	9.700	15.733	19.390	**14.941**
GEMMEIZA 7	27.804	59.722	67.760	**51.762**	9.433	15.133	19.340	**14.635**
GIZA 168	27.376	59.120	67.588	**51.361**	8.898	15.040	19.120	**14.353**
SAKHA 93	23.325	57.120	66.531	**48.992**	7.591	14.524	18.960	**13.692**
Mean	**28.962**	**63.795**	**69.920**		**9.484**	**15.610**	**19.719**	
LSD at 0.05 for	(C) 0.9951	(L) 0.4964	C*L 1.4905		(C) 0.218	(L) 0.1341	C*L 0.4026	

The results presented in Table 3 reveal that low to high nitrogen application significantly increased the nitrogen content in grain and straw over the control. Nitrogen content in grain and straw resulting from application of 50 Kg N fed^{-1} differing significantly from the application of 75 Kg N fed^{-1} . This result is in accordance with (Kanampiu *et al.,* 1997; Le

Gouis *et al.,* 2000 ; Ehdaie *et al.*, 2001; Guarda *et al.,* 2004 and Montemurro, 2009). Increasing nitrogen levels up to 50 and 75 Kg N fed^{-1} significantly increased nitrogen content in grain and straw of all cultivars. This result is supported by Le Gouis *et al.,*(2000).

4-Nitrogen use efficiency (NUE)

Data in Table 4 show that there were significant differences in NUE of the wheat cultivars. Nitrogen levels also significantly affected NUE. Interaction among wheat cultivars and nitrogen levels was found to be significant.

The results presented in Table 4 indicate that significant differences were observed in NUE amongst wheat cultivars, regardless N levels. Beni-Suif 1, Beni-Suif 3 , Gemmiza 9 and Sids 1 are the cultivars recorded the highest values of NUE, while Sohag 3, Sakha 61, Gemmiza 7 ,Giza 168 and Sakha 93 recorded the lowest values. This result is supported by (Kanampiu *et al.,* 1997 ; Le Gouis *et al.,* 2000 ; Guarda *et al.*, 2004 and Lo´pez-Bellido *et al.*, 2008). Moll *et al.,* (1982) observed that, differences among corn hybrids for NUE were largely due to variation in utilization of accumulated N and N uptake efficiency. Kanampiu *et al..,* (1997) reported that wheat cultivars with high harvest index (grain yield/total biomass) and low forage yield had low plant N loss and high NUE. Genotypic differences in the early uptake of nitrogen have been shown in wheat genotypes differing in vigour and they have been associated with differences in early root biomass (Liao *et al.*, 2004 and Liao *et al*., 2006). Vigour wheat genotypes have larger leaf area, larger shoot biomass (Richards and Lukacs, 2002), and larger root biomass (Liao *et al.,* 2004) than current cultivars. While Cox *et al*., (1985) reported that wheat cultivars that accumulate large amounts of N early in the growing season do not necessarily have high NUE. Plants must convert this accumulated N to grain nitrogen and must assimilate N after anthesis to produce high NUE.

Table 4: Effect of different nitrogen levels on nitrogen use efficiency (NUE) of various wheat cultivars.

Cultivars (c)	NUE		
	N-levels (L) (Kg/fed)		
	50	75	Mean
BENI-SUIF1	79.56	54.92	**67.24**
BENI-SUIF3	79.11	54.77	**66.94**
GEMMEIZA 9	76.51	51.95	**64.23**
SIDS 1	74.43	51.87	**63.15**
SOHAG 3	71.11	51.20	**61.16**
SAKHA 61	69.42	50.45	**59.93**
GEMMEIZA 7	66.73	50.19	**58.46**
GIZA 168	66.43	49.24	**57.84**
SAKHA 93	63.82	48.47	**56.15**
Mean	**71.902**	**51.451**	
LSD at 0.05 for	**(C) 6.5735**	**(L) 0.973**	**C * L 2.918**

NUE=G_W /N_S whears Gw = grain yield (kg/fed). Ns = N supply (kg/fed).

The results presented in Table 4 reveal that NUE decreased significantly with increasing nitrogen application. Increasing nitrogen levels from 50 Kg N fed^{-1} to 75 Kg N fed^{-1} significantly decreased NUE. This result is supported by (Le Gouis *et al.,* 2000 ; Ehdaie *et al.,* 2001 and Limon-Ortega *et al.,* 2008). Kanampiu *et al.,* (1997) found that avoiding excess N application would reduce N loss and increase NUE in winter wheat cultivars.

Increasing nitrogen levels from 50 Kg N fed^{-1} to 75 Kg N fed^{-1} significantly decreased NUE of all cultivars . This result is supported by Le Gouis *et al.,* (2000).

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أستجابة بعض أصناف القمح لمستويات مختلفة من النيتروجين

محمدى ابراهيم الخرباوى ، يوسف على عبد العال و منى فوزى عبد الغنى
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ان زيادة انتاجية القمح تحت الظروف المصرية تعتبر هدف من الأهداف الرئيسية لمزارعى القمح و محصول القمح هو محصلة للعديد من العوامل وتعتبر الأصناف و التسميد النيتروجينى من اهم هذه العوامل . لذلك أقيمت تجربة حقلية بمحطة البحوث الزراعية بكلية الزراعة- جامعة القاهرة خلال موسم ٢٠٠٥ /٢٠٠٦ لتقييم تأثير مستويات التسميد النيتروجينى (صفر ، ٥٠ ، ٧٥ كجم نيتروجين/ فدان) فى صورة اليوريا على المحصول ، المحتوى النيتروجينى ، دليل الحصاد و كفاءة أستخدام النيتروجين وذلك لتسعة أصناف من القمح (جيزة ١٦٨، سدس ١ ، سخا ٩٣ ، سخا ٦١ ، جميزة ٩ ، جميزة ٧ ، سوهاج ٣ ، بنى سويف ١ و بنى سويف ٣) و عند الحصاد تم قياس محصول الحبوب والقش ، وتم تقدير محتوى الحبوب والقش من النيتروجين ، وحساب دليل الحصاد وكفاءة استخدام النيتروجين.

أظهرت الأصناف إختلافات معنوية فى كل الصفات المدروسة ، حيث سجل الصنف بنى سويف ١ أعلى قيم فى محصول الحبوب و القش ، محتوى الحبوب والقش من النيتروجين ، دليل الحصاد و كفاءة استخدام النيتروجين، بينما سجل الصنف سخا ٩٣ اقل القيم .

لوحظ وجود إختلافات معنوية بين مستويات النيتروجين فى كل الصفات المدروسة . حيث ادى اضافة المستوى الاعلى من النيتروجين بالمقارنة بمعاملة عدم اضافة النيتروجين الى زيادة كل من محصول الحبوب والقش بنسبة ٤٣% و ٥٥% على التوالى بينما ادى لانخفاض كل من دليل الحصاد و كفاءة استخدام النيتروجين بنسبة ٤% و ٢٨% على الترتيب بينما زاد محتوى الحبوب و القش من النيتروجين معنويا بزيادة مستويات النيتروجين.