

EFFECT OF NITROGEN APPLICATION METHODS ON GROWTH, YIELD AND SOME NUTRIENT CONTENTS OF WHEAT

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Accepted 8 / 6 / 2004

ABSTRACT: Two field experiments were carried out in 2002 and 2003 seasons at Mansoura, Dakahlia Governorate to study the effect of either the 75kg N fed⁻¹ as soil application or three nitrogen levels as foliar application (2, 3 and 4% N) with and without activated dose (15 kg N fed⁻¹ as soil application) on growth, yield and some nutrient contents of wheat. The most important findings could be summarized as follows:

- 1- The level of nitrogen (3% N) as foliar application with 15 kg N fed⁻¹ activated dose increased plant height, leaf area, spike length, grain and straw yield. On the other hand these treatment (3% N+15 kg N fed⁻¹) gave a high increase in comparison with soil application (75 kg N fed⁻¹).
- 2- Using the level of nitrogen (3% N with 15 kg N fed⁻¹) increased the grain and straw yield by (16.89 and 8.44%, respectively) over the recommended dose and at the same time saved the quantity of soil application N by 40.5 kg N fed⁻¹.
- 3- The contents of N, P, Zn and Fe in grains of wheat were increased also, with this treatment (3% N+ 15 kg N fed⁻¹) in comparison with either soil application (75 kg N fed⁻¹) or N foliar application without activated dose while decreased the contents of K and Mn.

INTRODUCTION

Nitrogen application is considered one of the key factors

for obtaining higher grain yield. Because of the shortage of locally produced fertilizer nitrogen, high cost of the nitrogen unit and low

nitrogen use efficiency, the development of practices to improve the efficiency of fertilizer nitrogen. Recent attempts have been made to foliar application essential nutrients in the proportions needs during reproductive stage of wheat. The theoretical basis for this being that it minimizes nutrient depletion from the leaves and results in a decrease in photosynthesis during this period.

Rao and Padmanabhan (1971) reported that the highest grain yield was obtained when 100 kg N ha⁻¹ was applied as 25 % before sowing, 50 % in four foliar sprays at seven days intervals beginning from 28 days after sowing and 25 % as top dressing at panicle initiation. Stafan and Stefan (1990), revealed that the rice yield increased with increasing liquid N fertilizer through foliage. Mandal *et al.* (1991), applied up to 200 kg N ha⁻¹ as 100 % soil application, 50 % soil plus 25 % foliar. They reported that the plant height, straw yield and grain yield were greatest when 75 % of N was applied to soil and the rest through foliage. Also, Taha *et al.* (1992), found that the foliar nutrition of urea significantly increased rice grain and straw yields as well as

their attributes as compared with the control. Rajpal Singh *et al.* (2001), found that the N and Zn content in leaves increased with increasing concentration of urea (1, 2 and 3 % urea). Foliar application of nitrogen is needed to increase the nitrogen use efficiency and to save fertilizer nitrogen. Ishag (1985), proved that the foliar fertilizers greatly increased the uptake of N, P and K.

The present work aimed to study the effect of either the 75kg N fed⁻¹ as field application or three nitrogen levels as foliar application under with or without soil activated dose of nitrogen on growth, yield and some nutrients uptake of wheat plant.

MATERIALS AND METHODS

Two field experiments were established to fulfill the objectives of the present work as follow:

Location: At Mansoura, Dakahlia Governorate.

Soil: Representative surface soil samples (0 – 30 cm) were taken performance of the experiment where some characteristics of the soil samples, were determined according to Black (1965) and Page (1982), as indicated in Table (1).

Table 1: Particle size distribution (%) and chemical properties of the soil in the experimental site.

Soil physical properties %		Soil chemical properties (meq/100 g soil)										Available nutrients (ppm)	
		Cations					Anions						
		Ca ⁺⁺	Mg ⁺⁺	Na ⁺	K ⁺	CO ₃ ⁻	HCO ₃ ⁻	CL ⁻	SO ₄ ⁻				
Sand	10.72	EC dsm ⁻¹	0.84	1	2	5.1	0.5	--	1.4	5	2.2	N ⁽³⁾	15
Silt	41.2	pH	8.1									P ⁽⁴⁾	11.3
Clay	43.88	SAR	4.2									K ⁽⁵⁾	7.2
		ESP	8.4									Ca	58.0
Soil texture	Silty clay			Mg	47.2								

1- 1 : 2.5 suspension

2- 1 : 5 Extract

3- Extracted by 1% K₂SO₄

4- Extracted by 1M sodium bicarbonate

5- Extracted by 1M ammonium acetate

Studied crop: Wheat (*Triticum aestivum*, L.) "Gemmeza 9" from Agric. Res. Center was used. The planting dates were 25th and 28th of October in the two seasons (2002 and 2003), respectively.

Experimental plot: 3 x 4 m.

Experimental treatments: The experiment was carried out a randomized complete block design involving 7 treatments. Each treatment was replicated three times. The detailed experimental treatments were the follows:

- 1- The recommended N-soil application dose i.e. 75 kg N fed⁻¹ in the form of ammonium nitrate 33.5 % N.
- 2- The foliar application, 2% N with or without 15 kg N fed⁻¹ activated dose (20% N from recommended dose).
- 3- The foliar application, 3% N with or without activated dose.

4- The foliar application, 4% N with or without activated dose.

Foliar application after at 15 days for three times. All the experimental plots fertilized with 100 kg calcium superphosphate (15.5 % P₂O₅).

Growth measurements were recorded and all samples were dried, ground and kept for element analysis (N, P, K, Zn, Mn and Fe) according to Page (1982).

All data were statistically analyzed according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth and yield of wheat:

The effect of the tested variables (nitrogen levels as foliar application with and without activated dose) of wheat plant growth, grain and straw yield is presented in Table 2.

Data revealed that, there were a significant increases by the studied parameters. Also, the data showed that, the treatments with the activated dose were higher than those without activated one under nitrogen foliar application for plant height (cm), leaf area (cm²), spike length (cm), grain and straw yield in the two seasons these increase rate were (4.08 and 5.21 %), (2.72 and 6.84%), (7.77 and 2.2%), (17.77 and 19.42%) and (14.39 and 9.1%), respectively for the studied parameters.

Data stated that nitrogen spray (3%) with activated dose using ammonium nitrate gave the highest percentage over the recommended dose than without activated dose these increase were (8.80 and 11.29 %), (7.8 and 7.54 %), (6.53 and 9.94 %), (15.4 and 18.7 %) and (15.5 and 11.1 %) respectively in the two seasons for the studied parameters. These findings might be due to activated dose (20 % from recommended dose) under foliary that increasing the population of micro-organisms on rhizosphere thus increase the root exudate, growth hormones thus increasing growth and yield of wheat plants. Abd El-Rahman (1997), Awad *et al.* (1999) and Oko *et al.* (2003) found similar results.

Macronutrients concentration and uptake of wheat plant:

Macronutrient concentrations were positively increased by all the nitrogen foliary levels with and without activated dose (Table 3). The positive effect of foliar application with activated dose increased the concentrations of N, P and K and resulted an increases than without activated dose, with (10.14 and 5.84%), (3.85 and 3.85 %) and (0.78 and 2.78%), respectively in the two seasons for N, P and K. These results confirmed with the work of Awad *et al.* (1999) and Rajpal Singh *et al.* (2001).

The best nitrogen foliar application (3%) with activated dose, which gave the highest percentage over the recommended dose treatment i.e. (11.6 and 7.53 %) and (15.4 and 14.8 %) for concentration of N and P, respectively, while K application was decreased. Also, the uptake of N and P increased over the recommended dose treatment with (28.98 and 22.54 %) and (31.78 and 34.99 %), respectively.

It is obvious, that the activated dose increased the number of micro-organisms in soil thus the pH decreased in rhizosphere zone so increasing the availability of macronutrients and uptake of plants.

Table 2: Effect of N-application methods on yield components, straw and grain yields of wheat.

Treatments	Plant height (cm)		Leaf area (cm ²)		Spike length (cm)		Grain yield (ard fed ⁻¹)		Straw yield (ton fed ⁻¹)		
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	
75 kg N fed ⁻¹	94.23	91.65	30.19	30.47	16.88	16.79	17.48	17.1	4.54	4.45	
With activated dose	2% N	94.88	96.38	26.95	25.94	15.07	15.99	19.01	19.2	4.79	4.79
	3% N	102.52	102.0	32.51	32.76	17.95	17.65	20.15	20.27	5.16	4.60
	4% N	98.77	100.37	30.13	28.97	16.65	16.45	19.11	19.57	4.60	5.02
Means	98.72	99.58	29.86	29.22	16.56	16.70	19.42	19.68	4.85	4.80	
Without activated dose	2% N	92.50	91.91	28.94	26.71	16.89	16.85	17.20	16.10	4.25	4.31
	3% N	98.12	96.80	28.82	29.56	16.32	16.50	16.40	16.95	4.14	4.25
	4% N	95.22	95.25	29.44	25.78	16.07	15.67	15.87	16.39	4.32	4.53
Means	94.85	94.65	29.07	27.35	16.43	16.34	16.49	16.48	4.24	4.40	
F-test	**	**	**	**	**	**	**	**	**	NS	
LSD at 5%	0.74	0.84	0.98	1.28	0.67	0.49	0.65	0.58	0.38	---	
	1.03	1.18	1.38	1.80	0.95	0.68	0.91	0.81	0.53	---	

Table 3: Effect of N-application methods on N, P and K concentration and uptake by wheat grain yield.

Treatments	N				P				K				
	%		Uptake (kg fed ⁻¹)		%		Uptake (kg fed ⁻¹)		%		Uptake (kg fed ⁻¹)		
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	
75 kg N fed ⁻¹	1.46	1.46	27.88	27.33	0.26	0.27	4.94	5.03	0.326	0.316	7.687	7.297	
With activated dose	2% N	1.47	1.41	30.52	29.71	0.21	0.19	4.18	4.08	0.266	0.267	6.827	6.920
	3% N	1.63	1.57	35.96	33.49	0.30	0.31	6.51	6.79	0.254	0.248	6.633	6.793
	4% N	1.47	1.42	30.83	30.37	0.31	0.32	6.40	6.80	0.260	0.261	6.707	6.897
Means	1.52	1.47	32.44	31.19	0.27	0.27	5.7	5.89	0.260	0.259	6.72	6.87	
Without activated dose	2% N	1.34	1.34	25.24	23.68	0.17	0.17	3.17	3.08	0.232	0.233	5.383	5.070
	3% N	1.41	1.41	25.38	26.23	0.29	0.28	4.66	5.23	0.269	0.261	5.953	5.950
	4% N	1.38	1.37	23.92	24.53	0.32	0.33	5.47	5.07	0.272	0.263	5.627	5.810
Means	1.38	1.37	24.85	24.81	0.265	0.261	4.43	4.46	0.258	0.252	5.65	5.61	
F-test	**	**	**	**	**	**	**	**	**	**	**	**	
LSD at 5%	0.06	0.04	1.24	1.45	0.006	0.009	0.64	0.81	0.024	0.017	0.611	0.500	
	0.08	0.06	1.74	2.04	0.009	0.012	0.90	1.31	0.034	0.025	0.858	0.701	

Micronutrients concentration and uptake of wheat plant:

The effect of nitrogen levels as spray on the concentration of micronutrients in wheat plant are presented in Table 4. The micronutrients (Fe, Mn and Zn) concentrations in plants significantly increased by nitrogen foliary under with and without activated dose. Whereas the percentages increased under means of activated dose than means of without one, were (6.87 % and 9.84 %), (6.1 and 2.8 %) and (19.2 and 17.6 %), respectively in the two seasons.

Table 4 shows that the uptake of Zn, Mn and Fe was significantly by nitrogen foliar application. The increase percentage of (with activated dose treatments) than without one in two seasons, were (26.28 and 33.16%), (25.06 and 22.7 %) and (40.9 and 37.3 %), respectively for Zn, Mn and Fe uptake. This result agreed with the work of Rajpal Singh *et al.* (2001) who studied the effects of urea (1, 2 and 3 %) on Zn content in leaves which increased significantly with urea. The best level of nitrogen spray was (3 %) using ammonium nitrate with 20 % N from recommended dose. The increase percentage of micronutrients over

the control were (10.3 and 11.1 %), (7.62 and 8.52 %) and (8.9 and 7.6 %), respectively for Zn and Fe but Mn decreased in the two seasons. While, the uptake of micronutrients was (24.77 and 28.60 %), (12.9 and 15.2 %) and (25.8 and 26.6 %), respectively for the previous parameters (Zn and Fe) in two seasons.

Micronutrients uptake depends on its concentration in the grains, also the weight of grains and both were positively affected by activated dose of nitrogen spray level (3 %) which is the best level. These results confirmed with Awad *et al.* (1999) and Rajpal Singh *et al.* (2001).

Data in Table 5 showed that the yield of wheat increased with 3% N (spray) + 15 kg N fed⁻¹ (20% N activated dose). The foliar (3 % N) gave a high increase in comparison with soil application (75 kg N fed⁻¹). So the increase percentage of grain and straw yields was more by (16.89 and 8.44%) respectively over recommended dose. The interpretation can be summarized as follows: (3 % N + 15 kg N activated dose) saved 40.5 kg N fed⁻¹ than 75 kg N fed⁻¹ recommended dose. These results confirmed with Awad *et al.* (1999).

Table 4: Effect of N-application methods on Zn, Mn and Fe concentration and uptake by wheat grains.

Treatments		Zn				Mn				Fe			
		ppm		Uptake (gm fed ⁻¹)		ppm		Uptake (gm fed ⁻¹)		ppm		Uptake (gm fed ⁻¹)	
		2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
75 kg N fed ⁻¹		34.10	32.53	83.17	77.60	49.03	46.13	119.53	110.03	92.93	88.27	226.6	212.1
With activated dose	2% N	33.10	32.40	87.77	86.77	44.67	41.80	118.40	111.97	78.20	73.17	207.4	195.97
	3% N	36.70	35.30	103.77	99.83	48.00	44.87	134.93	126.73	101.20	95.00	284.97	268.6
	4% N	37.60	36.10	100.23	98.57	46.10	44.43	122.90	121.30	98.43	91.70	262.30	250.2
Means		35.80	34.60	97.26	95.06	46.26	43.70	125.41	120.0	92.61	86.62	251.56	238.26
Without activated dose	2% N	30.80	28.30	73.97	63.60	42.60	40.67	102.23	91.30	73.60	70.47	176.70	170.27
	3% N	34.03	32.23	77.87	72.90	45.03	43.90	103.03	103.80	80.87	76.07	185.00	179.9
	4% N	35.77	33.97	79.23	77.67	43.17	43.03	95.57	98.40	78.60	74.50	174.00	170.3
Means		33.50	31.50	77.02	71.39	43.6	42.53	100.28	97.83	77.69	73.68	178.57	173.49
F-test		**	**	**	**	**	**	**	**	**	**	**	**
LSD at 5%		1.25	1.87	4.32	5.59	2.05	1.79	5.93	6.39	3.23	2.91	11.84	17.7
1%		1.75	2.63	6.06	7.84	2.88	2.51	8.32	8.97	4.55	4.08	16.61	24.8

It could be concluded the following:

1- The beneficial effect of 3% N (spray) + 15 kg N fed⁻¹ activated dose gave the highest growth, yield and macronutrients uptake.

2- It could be recommended using the technique that save N from loss, hence reduce the economical cost/fed.

3- Using 3% N + 15 kg N fed⁻¹ activated dose reduce the soil fertilizer and yield pollution.

Table 5: Effect of N-application, methods on grain and straw yield of wheat.

Treatment	Quantity of fertilizer	Grain yield ard fed ⁻¹	Straw yield ton fed ⁻¹
Control	75 kg N fed ⁻¹	17.29	4.5
3% N + A.dose	34.5 kg N fed ⁻¹	20.21	4.88

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تأثير طرق إضافة النيتروجين على النمو، المحصول وبعض المغذيات لمحصول القمح

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أجريت تجربتان لموسمى ٢٠٠٢ و ٢٠٠٣ فى المنصورة – محافظة الدقهلية لدراسة تأثير كلا من ٧٥ كجم ن /فدان كإضافة أرضية مع ثلاث مستويات من النيتروجين كإضافة رشا (٢،٣،٤% ن) فى وجود أو غياب جرعة تنشيطية (١٥ كجم نيتروجين/فدان) كإضافة أرضية وأثرها على النمو، المحصول ومحتوى بعض العناصر الغذائية لنبات القمح. أهم النتائج المتحصل عليها كما يلى:-

١- أدى المستوى النيتروجينى (٣% نيتروجين) رشا مع إضافة ١٥ كجم ن/فدان كجرعة منشطة إلى زيادة طول النبات، مساحة الورقة ، طول السنبلة، ومحصول الحبوب والقش، كما أعطت أعلى قيم بالمقارنة بالإضافة الأرضية (٧٥ كجم ن /فدان).

٢- أعطى المستوى النيتروجينى (٣% ن) مع ١٥ كجم ن/فدان زيادة فى محصول الحبوب والقش بنسبة (١٦،٨٩ ، ٨،٤٤%) عن الموصى به وانخفضت كمية النيتروجين المضافة إلى التربة بمعدل ٤٠،٥ كجم ن/فدان.

٣- ازداد المحتوى العنصرى من ن، فو، زنك والحديد فى حبوب القمح باستخدام ٣% ن + ١٥ كجم ن/فدان بالمقارنة بالإضافة الأرضية (٧٥ كجم ن/فدان) أو بدون جرعة تنشيطية بينما انخفض محتوى البوتاسيوم والمنجنيز.