J. Agric. Sci. Mansoura Univ., 31 (3): 1753 - 1760, 2006

EFFECT OF NITROGEN FERTILIZATION WITH CALCIUM AND MAGNESIUM APLICATION ON GROWTH, YIELD AND NUTRIENTS CONTENT OF WHEAT PLANT

Mohamed, M.R.M; A.A. Haggag, and H.Z. Abd EL-Salam
Plant Nutrition Dept., Soil, Water & Environ. Res. Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT

Two field experiments were conducted at Meet Loza, Mansoura, Dakahlia Governorate during 2003/2004 and 2004/2005 seasons to study the effect of three levels from ammonium nitrate fertilizer with and without Ca + Mg addition on wheat plant characteristics and yield component as well as macro and micronutrients.

Results showed that:

1- Plant height, leaf area, spike length, grain and straw yield were increased with increasing nitrogen rates under Ca + Mb sulphate addition.
2- N, P, K, Ca, Mg, Fe, Zn and Mn content of grains were increases with increasing the rates of nitrogen in presence of Ca + Mg addition and these increase were significant.

Its conclusion that, addition of calcium and magnesium sulphate increased the availability of macro and micronutrients for wheat plants and using 75 kg N fed^{-1} with Ca + Mg were the best treatment for most parameters.

INTRODUCTION

New and high yielding wheat respond to the incremental doses of nitrogen fertilization, which may increases production costs as well as has a negative environmental effect. Nitrogen is the most important element for wheat production as well as for many cereal crops. Hagras (1985), and Abd Elatif et al. (1986) found that increasing N rates resulted in increasing grain yield, number of spikes/m^2 and grain/spike of wheat plants.

EL-Ganbeehy (1993); Sultan et al. (1993) and Zaher (1996) reported that nitrogen levels markedly increased plant height, grain yield and crude protein percentage in grains of wheat plants. EL-Karamity (1998), reported that increasing nitrogen levels from 60 kg to 90 kg N fed^{-1} markedly increased growth and yield of wheat. Ismail et al. (1993) and Wyszkowski, M. (2001) mentioned that gypsum and Mg had favorable effect on growth and yield of some crops (spring barley, oat, spring wheat, yellow lupine (lupinus luteus), maize and spring triricaley). Calcium acts as a regulator of the balance particularly for micro-nutrients such as iron, zinc, manganese and copper in plants (Mohamed et al. (1997).

Akram et al. (1992) found that improvement of soil proprieties (Esp & pH) by application of 100% gypsum requirement was greater than with respective lower doses. On the other hand micro-nutrients such as Fe, Zn, Mn and Cu in sodic soils their availability were influenced by soil pH (Mohamed, 1990). Abd EL-Salam et al. (2003), and Abou Defan et al, (1999) reported that magnesium and calcium had the greatest significant effect on nitrogen and phosphorus uptake by wheat.

The aim of this work to study the effect of nitrogen fertilizer rates with Ca + Mg application on yield, growth and micro-macronutrients contents of wheat plant.

MATERIALS AND METHODS

Two field experiments were conducted at Meet Loza, Mansoura, Dakahlia Governorate during 2003/2004 and 2004/2005 seasons to study the effect of different rates of nitrogen fertilizer under calcium + magnesium application on yield of wheat plants, their growth measurements, and some nutrient contents. Some chemical analysis of the studied soils are shown in Table (1) using methods according to Page et al. (1982). Physical analysis were done according to international method Piper (1950)

Table (1): Mechanical and Chemical analysis of the studied soil.

pH	EC_e dSm^{-1} soil paste	Soluble cations and anions (meq L^{-1})							
		Cations				Anions			
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Co_3	HCO_3	Cl^{-}	SO_4
8.1	0.84	2	1	5.1	0.5	--	1.4	5	2.2

Available mg kg^{-1}							
N	P	K	Ca	Mg	Zn	Fe	Mn
15	10.9	214	48.7	40.3	0.74	2.94	1

Mechanical analysis						
C. sand %	Fine sand %	Silt %	Clay %	texture	O.M. %	Ca Co_3 %
3.6	12.72	25.12	54.84	clayey	1.85	2.85

The experiment was arranged in split plots design. Which the main plots were, with Ca + Mg addition (as calcium and magnesium sulphate with rates of 35 kg fed^{-1} and 20 kg fed^{-1} respectively) and without Ca + Mg fertilizers.

The sub plots were three levels from nitrogen (75, 56.25 and 45 kg N fed^{-1} as ammonium nitrate 33.59% N. All treatments replicated three times, so the total area 20 m^2 (4 × 5 m) for each experimental unit.

Data recorded:

a) Growth: plants were chosen at random from every plot after 90 days from the planting and the following data of growth were recorded.
   1- Plant height (cm).
   2- Leaf area (cm^2)/plant.
   3- Spike length (cm)

b) Field production:
   1- Grain in ard fed^{-1}.
   2- Strwa in ton fed^{-1}

c) Nutrients content:

Macro and micronutrients were determined by wet digestion using H_2SO_4 + $HClO_4$ mixture according to Page et al. (1982). Ca, Mg, Fe, Zn and Mn were determined by the atomic absorption spectrometer (Pirken Elmer – 2380). The statistical analysis methods were carried out according to Gomez and Gomez (1984).

RESULTS AND DISCUSSIONS

1- Plant growth and yield production:

Data of Table (2) show the effect of different nitrogen rates with and without calcium + magnesium application on plant height, leaf area, spike length, grain yield and straw yield of wheat plant in both seasons.

The obtained data from Table (2) show that, the addition of different nitrogen rates with calcium + magnesium application gave the heighest

values compared with that obtained from without calcium + magnesium application. This may be due to the influence of calcium and magnesium as form of sulphate on lowering soil pH and consequently increasing the availability of plant nutrients as mentioned by Shahin et al. (1999) and EL-Fakhrani (2001) as well as improving soil media du to Ca + Mg application.

Data show, the addition of different rates of nitrogen with Ca + Mg application had significant effect on spike length and grain yield in both seasons. The heighest values were obtained at 75 kg N fed^{-1} for plant height, leaf area, grain yield and straw yield in both seasons. These findings are in agreement with those obtained by EL-Fakhrani (1999) on potatoes plants and Abd EL-Gawad et al. (1997), they stated that N fertilization promoted the growth and yield of fodder beet plant.

The maximum straw and grain yields were obtained by using 75 kg N fed^{-1} and also it could be noticed that grain yield was gradually increased with the increasing N rate up to 75 kg N fed^{-1} with the application of calcium and magnesium compared with that not have (without) calcium + magnesium.

These results are in harmony with those reported by Wyszkowski (2001), who mentioned that soil applied with Mg had a more favorable effect on the yield of grain of wheat.

2- Macro nutrients:

Table (3) illustrate the effect of nitrogen application levels with and without addition of Ca + Mg sulphate on concentration and content of some macronutrients (N, P, K, Ca and Mg) of wheat grain in both studied seasons. The results presented in Table (3) show that, the addition of calcium + magnesium with the rates of nitrogen caused a significant increase in the concentrations of Mg and Ca. While showed a significant effect on N, P and K concentrations in both seasons. But the same relationship gave a significant effect for all macronutrients content in both seasons. The N, P, K and Mg concentrations and content increased with increasing N applications rate from 45 kg N fed^{-1} to 75 kg N fed^{-1}. From the results the maximum increases of macronutients content were obtained by addition rate of 75 kg N fed^{-1} with Ca + Mg addition in comparison with those not have Ca + Mg application which their values are: 46.86, 7.68, 8.52 and 9.78 kg fed^{-1} calculated as the arrange of both seasons for N. P. K and Mg respectively. These results are in agreement with that found by Abou EL-Defan et al. (1999) where they stated that N,P and K increased with increasing gypsum in wheat grain and the same results with Darwish et al. (1997) and Sagare et al. (1990) reported that soil Mg application increased N, P and K uptake by sunflower plants.

As well as these results agree with those which found by Nathan et al. (1989); Taondon (1989); EL-Fakharani (2001) and Alromian et al. (2002) and EL-Fakarani (2001). They found that the addition of calcium improved physical and chemical properties of the stated soil, but magnesium sulphate is very important to activate enzymes, energy transfer, maintenance of electro neutrality and production of proteins, metabolism of carbohydrates. So the favorable effects of Mg and Ca sulphate may be due to increasing availability of nutrients.

Table (2): Effect of N-fertilization rates with and without calcium and magnesium application on growth, 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})	
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
With Ca + Mg	75	98.82	98.31	30.98	31.66	14.64	14.39	22.16	22.48	4.35	4.49
	56.25	96.95	96.09	29.42	29.42	15.07	14.99	20.51	20.73	3.87	3.90
	45	95.03	94.94	27.52	28.04	15.16	14.65	16.43	16.39	2.50	2.41
	Means	96.93	96.45	29.31	29.71	14.96	14.68	19.70	19.87	3.58	3.60
Without Ca + Mg	75	93.24	94.27	30.17	30.75	12.16	11.41	17.75	17.72	3.73	3.73
	56.25	89.01	90.63	28.38	28.15	12.39	12.40	16.70	16.64	2.89	2.85
	45	87.16	88.54	26.27	27.08	13.45	13.38	15.61	15.59	2.08	2.05
	Means	89.80	91.15	28.27	28.66	12.67	12.39	16.69	16.65	2.90	2.88
F. test		N.S.	N.S.	N.S.	N.S.	*	*	**	**	N.S.	N.S.
L.S.D. at 5%		--	--	--	--	0.76	0.84	0.68	0.78	--	--

Table (3): Effect of N-fertilization rates with and without calcium and magnesium application on macronutrients concentration and content of wheat grains.

Treatments		N				P				K				Ca				Mg			
		%		Content Kg fed^{-1}		%		Content Kg fed^{-1}		%		Content Kg fed^{-1}		%		Content Kg fed^{-1}		%		Content Kg fed^{-1}	
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
With Ca + Mg	75	1.77	1.87	50.10	43.61	0.28	0.28	7.24	8.12	0.29	0.31	8.87	8.17	0.81	0.76	23.29	21.61	0.36	0.33	10.21	9.35
	56.25	1.59	1.62	41.16	42.71	0.24	0.26	6.82	9.95	0.27	0.27	7.05	7.00	0.87	0.87	23.07	22.68	0.30	0.28	8.01	7.31
	45	1.37	1.37	28.73	28.63	0.23	0.24	4.57	5.08	0.27	0.26	5.36	5.65	0.96	0.93	20.14	19.48	0.21	0.21	4.31	4.11
	Means	1.58	1.61	39.99	38.31	0.25	0.26	6.88	6.72	0.27	0.28	7.09	6.92	0.88	0.85	22.17	21.26	0.29	0.27	7.51	6.92
Without Ca + Mg	75	1.24	1.21	27.99	27.34	0.21	0.20	4.71	4.44	0.23	0.21	4.66	5.20	0.66	0.73	15.05	14.26	0.19	0.18	4.29	4.07
	56.25	1.08	1.10	23.07	23.40	0.18	0.17	3.00	3.60	0.21	0.20	4.17	4.40	0.71	0.72	15.13	15.41	0.18	0.17	3.81	3.55
	45	1.01	0.98	20.04	19.54	0.14	0.14	2.47	2.84	0.19	0.17	3.44	3.78	0.77	0.76	15.17	14.86	0.16	0.16	3.11	3.18
	Means	1.11	1.10	23.69	23.42	0.18	0.17	3.73	3.63	0.21	0.19	4.09	4.46	0.72	0.71	15.18	14.86	0.18	0.17	3.74	3.6
F. test		N.S.	N.S.	**	**	N.S.	N.S.	**	**	N.S.	N.S.	*	*	*	*	**	**	**	**	**	**
L.S.D. at 5%		--	--	3.53	3.35	--	--	0.32	0.43	--	--	0.25	0.34	0.017	0.017	0.73	0.73	0.007	0.037	0.39	0.79

Table (4): Effect of N-fertilization rates with and without calcium and magnesium application on micronutrients concentration and content of wheat grains.

Treatments		Zn				Mn				Fe			
		ppm		Content Gm fed^{-1}		ppm		Content Gm fed^{-1}		%		Content Gm fed^{-1}	
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
With Ca + Mg	75	49.66	48.11	142.76	135.85	36.10	36.56	103.52	103.36	103.77	100.94	297.40	285.04
	56.25	50.79	43.72	126.28	114.63	45.05	43.39	119.14	113.60	105.97	104.53	280.05	273.32
	45	33.64	27.63	70.31	58.01	51.14	50.07	106.84	104.90	118.95	116.10	248.54	243.26
	Means	44.69	39.82	113.12	102.83	44.10	43.34	109.83	107.29	109.56	107.19	275.33	267.21
Wilhout Ca + Mg	75	30.36	25.67	68.57	58.10	26.69	31.11	60.72	70.39	96.70	98.88	218.43	223.77
	56.25	30.88	24.48	65.50	52.36	28.08	33.10	59.57	69.86	93.40	94.75	198.12	201.79
	45	25.78	22.77	51.24	44.93	30.59	36.18	60.81	72.02	102.49	101.78	203.72	202.57
	Means	29.00	24.34	61.77	51.80	28.45	33.48	60.37	70.76	97.53	98.47	206.76	209.38
F. test		**	**	**	**	*	**	**	**	**	**	*	*
L.S.D. at 5%		0.66	3.66	9.81	8.81	1.05	1.15	4.21	4.21	2.04	2.84	13.45	13.95

3- Micro nutrients:

Data reported in Table (4) show that there is a highly significant relationship between nitrogen rates with Ca + Mg application Zn, Mn and Fe concentrations as well as content of them in wheat grain in both studied seasons, compared with that not Ca + Mg additions. The results show that the treatment with 75 kg N fed^{-1} gave the highest values for Zn and Fe (139.31 and 291.22 g. $fed.^{-1}$) content (calculated as the average of both seasons), while the treatment with 56.25 kg N fed^{-1} gave the highest value for Mn (116.37). While the treatments with 45 kg N fed^{-1} gave the highest concentrations value (mg kg^{-1}) for both Mn and Fe (calculated as the average of both seasons). But the heighest value for Zn are obtained from 75 kg N fed^{-1} which was 48.89 mg kg^{-1}.

Conclusion

In conclusion from the above discussion and results, one can concluded that, addition of calcium and magnesium sulphate increased the availability of macro and micronutrients for plants.

As general using 75 kg N fed^{-1} with Ca + Mg application were the best treatment for most parameters.

REFERENCES

Abd EL-Gawad, A.A.; H.M. Abd EL-Aziz; M.Sh. Reiad and S.Th. Ahmed (1997): Effect nitrogen, potassium and organic manure on yield and chemical composition of fodder beet (Beta vulgaris, L.) Ann. Agric. Sci., Ain Shams Univ., Cairo, 42(2): 377-397.

Abd El-Latif, L.I.; M.K. Tuhany and L.I. Latif (1986): Effect of nitrogen fertilization levels and seeding rates on growth and yield of wheat. Ann-of-Agrulture-sci. Ain Shams Univ., 3(1), 265-272.

Abd El-Salam, H.Z.; S.H. Sarhan and Marouah I.A.H (2003): Effect of some macronutrients addition on growth, yield, some element concentration and seed quality of wheat. J. product, and Dev., 8(1): 183-188.

Abou EL-Defan, T.A.; A.S.A. Abdel-Mawgoud; S.A. EL-Gindi and H.E.M. EL-Kholi (1999): The role of soil amendments on soil fertility and the response of wheat grown in saline sodic soil. Egypt. J. Agric. Res., 77(1): 27-39.

Akram, M.; G. Hassan; M. Ashraf and H.C. Ehsan (1992): Effect of gypsum and sulphuric acid and soil properties and dry matter yield of wheat grown on a highly saline soil. J. Agric. Res., Lahore, 27 (2), 113-119.

Alromain, F.M. and Y.M. El-Fakharani (2002): Effect of sulphur on utilization efficiency of nitrogen by wheat on sandy soils of Saudi Arabia. J. Agric. Sci., Mansoura Univ., 27(9): 6477-6491.

Darwish, D.S.; A.Y. Negm and F.A. Zahran (1997): Effect of magnesium application on production and yield of sunflower. J. Agric. Sci. Mansoura Univ., 22(10): 3375-3381.

El-Fakharani, Y.M. (1999): Response of potato plants irrigated with different levels of irrigated saline water to organic manganic and N fertilization. Ann. Agric. Sc. Moshtohor, 37(2): 1553-1564.

El-Fakharani, Y.M. (2001): Effect of sulphur and organic manure on the utilization efficiency of mineral P fertilizers and sugar beet production in sandy soils. Egypt. J. Appl. Aci., 16(7): 686-700.

El-Ganbeehy, M.M. (1993): Wheat response to clipping and nitrogen fertilization Alex., J. Agric. Res., 38: 311-334.

El-Karamity, A.E. (1998): Response of some wheat cultivars to seeding and fertilization rates. J. Agric. Sci. Mansoura Univ., 23(2): 643-655.

Gangiah, B. and Parsad, R. (1999): Effect of fertilizers on the productivity and NPK removal of a rice-wheat cropping system. Acta Agro. Hung, 47(4): 405-412.

Gomez, K.A. and A.A. Gomez (1984): "Statistical Procedures for Agriculture Research". John Willy and Sons Inc., New York, U.S.A.

Hagras, A.M. (1985): Response of wheat to nitrogen, phosphorus and potassium fertilization. Ann. Agric. Sci., Moshtohor, 23(2): 1032-1035.

Ismail, A.S.; A.A. Saker and Radwan (1993): Effect of leaching and amendement on chemical properties of an alluvial soil and the growth barley. 2nd African Soil Sci. Soc., Conf., 153-159.

Mohamed, M.R. (1990): Studies on zinc and manganese status of Dakalia Governorate soils. M.Sc. Thesis, Soil Dept. Fac. Agric. Mansoura Univ.

Mohamed, N.A. (1999): Curve analysis for evaluation of the response of some wheat varieties to different nitrogen fertilization levels. J. Agric. Sci. Mansoura Univ., 24(4): 1559-1571.

Mohamed, S.S.; M.A. Negm and M.G. Rehan (1997): Gypsum amendment against soil alkalinity in relation to Tomato plants. 11. Change in agro-chemical properties and nutrient availability of the soil.

Nathan, H.P.; G.E. Mac. Donaled and A.V. Gargner (1989): Snap bean plant responses to sources and rates of nitrogen and potassium. Hort. Sci., 99: 595-602.

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

Piper, C.S (1950). " Diagnoses and improvement of saline and alkali soils" U.S.A Handbook No.60.

Rogozinska-I (1991): Effect of magnesium fertilizer on quality traits of potatoes. Kartoffelbau. 42: 6, 257-259.

Sagare, B.N.; Y.S. Gahe and A.H. Atre (1990): Yield and nutrient harvest by sunflower (Helian thus annuusl) in response to sulpher and magnesium application in Typi chiomusterts. Ann. of plant physiology, 4:1, 15-21.

Shahin, R.R.; K.N. Al-Redaiman and M.I.D. Helal (1999): Volatilization of ammonia from sulphur-blended nitrogen fertilizers. Zagazig J. Agric. Res., 26(5): 1457-1468.

Sultan, M.S.; A.N. Attia; A.M. Salama and M.M. Abo El-Nagah (1993): Studies on the effect of timing of phosphorus fertilization, nitrogen levels and forms on wheat. J. Agric. Sci. Mansoura Univ., 18(5): 1342-1349.

Tondon, H.L.S. (1989): Secondary and micro nutrient recommended for soils crops. A Guidebook. 110. Greak Kailash, New Delhi, India.

تأثير التسميد النتروجينى مع إضافة الكالسيوم والماغنسيوم على النمو والمحصول والمحتوى الغذائى لنبات القمح

محمد رضا عبد الهادى محمد، أحمد عبد الله حجاج، حمدى زكى عبد السلام
قسم تغذية النبات – معهد بحوث الأراضى والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر

أجريت تجربتان حقليتان فى قرية ميت لوزة مركز المنصورة – محافظة الدقهلية خلال موسمى ٢٠٠٣/٢٠٠٤، ٢٠٠٤/٢٠٠٥ على نبات القمح بغرض دراسة تأثير ثلاث مستويات نتروجين (سماد نترات الأمونيوم ٣٣,٥% ن) مع إضافة سماد سلفات الكالسيوم وسلفات الماغنسيوم على النمو والمحصول والمحتوى المعدنى لنبات القمح.

وقد أظهرت النتائج ما يلى:

١- حدثت زيادة فى كل من ارتفاع النبات ومساحة الورقة وطول السنبلة ومحصول الحبوب والقش مع زيادة مستويات النتروجين تحت إضافة سلفات الكالسيوم والماغنسيوم.

٢- زاد محتوى نبات القمح لكل العناصر الغذائية المدروسة وهى النتروجين والفوسفور – البوتاسيوم – الكالسيوم – الماغنسيوم – الحديد – الزنك – المنجنيز مع زيادة معدلات النتروجين فى حالة إضافة الكالسيوم والماغنسيوم كسماد.

ويمكن الاستنتاج بأن إضافة سلفات الماغنسيوم وسلفات الكالسيوم معا كسماد قد زاد من صلاحية كل عناصر الدراسة وأن استخدام ٧٥ كجم ن/فدان هو أفضل معاملة على معظم عوامل الدراسة.