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EFFECT OF FYM AND GYPSUM, ON NITROGEN FERTILIZER USE EFFICIENCY, FOR WHEAT PLANT, CULTIVATED IN RECENTLY RECLAIMED SANDY SOILS

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ABSTRACT

A field experiment was conduct at Ismailia Research Station, to study the effect of FYM and gypsum, on nitrogen fertilizer use efficiency, for wheat plant (Sakha 69). Three different rates of N i.e. N_{80}, N_{100} and N_{120} kg/fed were used. FYM and gypsum were added individually or combined along with previous different rates of N.

The obtained results could be summarized as follows:

Wheat yield components were in ascending order as N doses were increased.

1. The absolute highest values 1900 and 3079 kg/fed grains and straw yields, respectively, were obtained from the treatment, having combined FYM and gypsum with N_{120}kg/fed. Thus to promote microorganisms activities and benefit the root media reaction, which in turn increase N fertilizer use efficiency.
2. The results of grain protein % and grain protein yield kg/fed were in harmony with trends of N concentration% and N uptakes kg/fed. However, these values are greatly affected by higher N application rate (N_{120}) and combined FYM + gypsum treatment.
3. The active effect of FYM and gypsum led to increase plant absorption ability of P and K comparing with the other treatments.
4. It could be recommended to take into consideration, that FYM and gypsum are very important together, with N fertilizer, in order to increase nitrogen fertilizer use efficiency.

INTRODUCTION

Wheat is considered the most important cereal crop in Egypt. At present time, increasing wheat production in Egypt is an essential requirement at the national level, to minimize the gap, between wheat production and consumption (accounts for only 57% of the national need (Anonymous, 1998)). Thus, the cultivated area of wheat must be increased in the new reclaimed lands. Many investigators reported that N fertilizer increased grain and straw yield of wheat (Badr *et al.*, 1991; Abdel-Gelil *et al.*, 1997 and El-Sherbeiny *et al.* 1999). Moreover Tulsa *et al.*(2002) found that wheat grain yield increased with increasing N rate up to 120 kgN/ha. They added also that, the highest yield and nutrients uptake, were obtained with FYM + N. It is well known that addition of farmyard manure (FYM) has shown considerable increase in crop yield, and exert significant influences on physical, chemical and biological properties of soil. Smith and Snarply (1990). Math and Trived (2000) found that application of FYM increased the yield of wheat. Ravindra *et al.*(2001) reported that wheat grain yield was increased, by increasing FYM and N fertilizer application rates. On the other hand, El-Koumey (1998) and Vinay *et al.* (2002) concluded, that the addition of FYM, increased concentration and uptake of N, P and K, as well as, grain yield. While Rawat and Pareek (2003) postulated, that the yield and N, P and K

content, and uptake of wheat grain and straw increased with increasing rates of FYM and NPK. El Saadany and Abd El-Rasoul 1999, demonstrated that, application of gypsum significantly increased dry matter yield of seeds and straw of peanut, dry weight of 100 pods and shelling percentage. They also stated that gypsum significantly, increased N, P and K uptake in seeds and straw. El-Sayed (2001) indicated that calcium added with NH_4^+-N, increased plant N use efficiency by more rapid absorption leading to increased tillering, weight per head of grain product and consequently higher grain yields. Bailey (1992) showed that Ca^{++} can be used to enhance NH_4^{++} absorption and increase plant yield. One method of increasing fertilizer N use efficiency is to, minimize loss of fertilizer N from the crop root zone and therby improve the opportunity for plant uptake of applied N, Osman Fatma *et al.*(1998)

The aim of the present work is to study the effect of FYM and gypsum on N fertilizer use efficiency, for wheat plant, in sandy soil under sprinkler irrigation.

MATRIALS AND METHODS

Field experiment was carried out at the experimental farm, Agricultural Research station, Ismailia, Governorate, during the winter season of 2001/2002, to study the effect of FYM and gypsum on N fertilizer use efficiency by wheat (Sakha 69) plants, and their effects on yield components, and quality under sprinkler irrigation system. Three different rates of nitrogen i.e. N_{80}, N_{100} and N_{120} were applied, at six equal doses, before boating stage. FYM and gypsum as $20m^3$/fed and 500 kg/fed respectively, were applied before planting, either individually or together, along with the previous different rates of N. the recommended P and K were added as ordinary superphosphate and potassium sulphate (15.5% and 48% respectively)at rates of 30 kg P_2O_5/fed and 24 kg K_2O/fed. The experimental design was a randomized complete block, by three replicates in plots every one was 3x3.5 m^2.

Soil samples were taken before and after planting, to carry out some physical and chemical analyses according to Jackson 1973 and Piper 1950 presented in Table (1). Chemical analyses of FYM was presented in Table (2).

Plant samples were collected from each plot, after maturity, weighted, oven dried and divided into grains and straw. N, P and K in plant parts were determined according to Chapman and Pratt (1961).

Statistical analysis of data was calculated according to sendecor and Cochran (1982).

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

Soil characteristics	Value
Particle size distribution %:	
Coarse sand	67.11
Fine sand	28.46
Silt	2.90
Clay	1.53
Soil texture	Sandy
Soil chemical analysis:	
pH (1:2.5 soil suspension)	8.17
calcium carbonate %	0.61
Organic matter %	0.30
EC dS/m (1:5 soil:water extract)	0.60
Soluble cations (meq/100g soil)	
Ca^{+++}	1.18
MG^{++}	0.49
Na^{+}	1.37
K^{+}	0.09
Soluble anions (meq/100soil)	
$CO_3^{=}$	--
HCO_3^{-}	0.98
Cl^{-}	1.12
$SO_4^{=}$	1.03
Available nutrients (ppm)	
N	12.20
P	3.50
K	38.30

Table (2): Farmyard manure analysis.

Organic carbon %	Total nitrogen %	Total Phosphorus %	Total potassium %	C/N
6.30	0.43	0.028	0.85	14.65

RESULTS AND DISCUSSION

1-Effect of FYM and gypsum on N fertilizer use efficiency for yield and yield components:-

Table (3) shows that grain and straw yield kg/fed, as well as 1000 grain weight (g) on treatment received 80 kg N /fed only, had less values as compared with all other treatments under study.

Increasing N application rate induced significant increase in grain and straw yield as well as seed index. The relative increase in grain reached 23.8 and 563% by applying 100 and 120 kg N/fed respectively related to the treatment with 80 kg N/fed only. While the corresponding values for straw reached 15.76 and 43.50% respectively, and that of grain index 14.78 and 21.13% respectively. This was in harmony with the findings of Kadry *et al.* (1984); Badr *et al.* (1991), Abdel Galil *et al.*(1997) and El-Sherbieny (1999). Application of gypsum along with N_2 enhanced its beneficial effect on yield components, where the relative increase in grain, straw and seed index reach

(9.74, 12.18, 13.90), (5.93, 7.66. 9.29); (2.81, 4.18, 4.85) respectively, corresponding N_{80}, N_{100} and N_{120} are control of unit of these treatments. Results also revealed that FYM application increased the values of yield components more than gypsum one. These are mainly due to the high N content and C/N ratio of FYM, as shown in Table (2). This was in accordance with the findings of Dahdouh *et al.*(1999) and Tulsa *et al.* (2002), who stated that application of FYM + N increased wheat yield. Moreover, Ravindra *et al.*(2001), stated that wheat grain yield increased with increasing FYM and N fertilizer application rates.

Table (3): Effect of various N rates, FYM and gypsum applications on wheat yield components.

Treatments	Wheat yield (kg/fed)			Weight 1000 grain (gm)	Harvest Index (%)	Grains/ straw
	Grains	Straw	Total yield			
N_{80}	934	1770	2704	35.21	34.54	0.527
N_{80}+ G	1025	1875	2900	36.20	35.34	0.546
N_{80} + FYM	1080	1928	3008	37.23	35.90	0.560
N_{80}+ FYM + G	1136	2005	3141	38.67	36.16	0.566
N_{100}	1157	2049	3206	40.38	36.08	0.564
N_{100}+G	1298	2206	3504	42.07	37.04	0.588
N_{100}+FYM	1361	2297	3658	43.36	37.21	0.592
N_{100} + FYM+G	1448	2430	3878	44.31	37.34	0.595
N_{120}	1460	2540	4000	42.65	36.50	0.574
N_{120}+G	1663	2776	4439	44.72	37.46	0.599
N_{120}+FYM	1741	2860	4601	45.33	37.83	0.608
N_{120+}+FYM+G	1900	3079	4979	47.05	38.16	0.617
LSD at 0.05	86.26	142.66	241.40	0.772	0.902	0.202

The treatments of adding FYM and Gypsum together, raised the efficiency of N doses and gave highest values of wheat components all over the treatments. It is worth to mention here, that all increases obtained, are significant for all treatments under study.

Results of the harvest index (%) and grain /straw ratio recorded slight increases by increasing N application rates as shown in Table (3). However, the highest values for harvest index and grain/straw ratio was obtained by the application of 120 kg N/fed along with gypsum and FYM.

2- Effect of FYM and gypsum application on N fertilizer efficiency for N concentration, uptake and grains protein:

Data illustrated in Table (4) showed that N concentration% in grains and straw were significantly increased with additions of FYM, gypsum and FYM + gypsum associated with N fertilizer, the values are in ascending orders only within each unit of treatments, (I N_{80}, II N_{100} and III N_{120}). Since the highest increase values of N concentration (%), and N-uptake are associated with the treatment of FYM + gypsum additions in the treatment having 120kg N/fed. The values are 2.22 and 0.65% for grains and straw respectively, while they were 42.18 and 20.01 N-uptake/fed. Increases of N-uptake are clearly due to the increases of grain yield, obtained from the treatment under study.

These results are in agreement with those of Abd El-Rasoul *et al.*(2002) and Omer and Bacilious (1998).

The results of grains protein% and grains protein yield kg/fed are in a harmony with trends of N concentration % and N-uptake kg/fed.

Table (4): Effect of various N rates, FYM and gypsum applications on N and protein concentrations (%) and uptake (kg/fed) by wheat plant.

Treatments	Nitrogen				Grain protein	
	Grains		Straw		%	Yield (kg/fed)
	Conc.%	Uptake kg/fed	Conc.%	Uptake kg/fed		
N_{80}	1.42	13.26	0.33	5.84	8.87	82.85
N_{80}+ G	1.59	16.29	0.40	7.50	9.94	101.89
N_{80} + FYM	1.72	18.57	0.49	9.44	10.75	116.10
N_{80}+ FYM + G	1.84	20.90	0.54	10.82	11.50	130.64
N_{100}	1.64	18.97	0.43	8.81	10.25	118.59
N_{100}+G	1.78	23.10	0.45	9.92	11.13	144.47
N_{100}+FYM	1.93	26.27	0.52	11.94	12.06	164.13
N_{100} + FYM+G	2.06	29.82	0.59	14.33	12.88	186.50
N_{120}	1.76	25.69	0.49	12.45	11.00	160.60
N_{120}+G	1.97	32.25	0.51	14.16	12.31	204.71
N_{120}+FYM	2.14	37.25	0.55	15.73	13.38	232.95
N_{120}+FYM+G	2.22	42.18	0.65	20.01	13.88	263.72
LSD at 0.05	0.109	2.47	0.060	2.23	0.682	13.70

3- Effect of FYM and gypsum application on N fertilizer efficiency for P and K concentrations and uptakes by wheat plant:

Phosphorus and K values are significantly increased by all treatments under study. The increases are in ascending order by adding FYM, gypsum individually, and in combination respectively, within each unit of treatments. The enhancing effect of FYM on nutrients uptake was demonstrated also by vinay *et al.*(2002). The absolute increases of P and K were obtained from (N_{120} + FYM + gypsum) for the grains and straw.

From the illustrated results (Table 5), it could be concluded that, the increases values of P and K% and also P and K uptake kg/fed in grains and straw of wheat plant, namely are due to the beneficial effect of FYM and gypsum on the root zone which in courage microorganisms to grow, thus, in turn increases plant absorption ability to P and K, these findings are in agreement with those of El Aggory *et al.*(1996) and Muneshwar *et al.*(2000), who stated that application of N fertilizer and farmyard manure, increased K uptake by the crop. While, Tulsa *et al.*(2002) reported that N and P uptake were increased by FYM + N application, and becomes higher by increasing N application rate up to 120 kg N/ha.

Table (5): Effect of various N rates, FYM and gypsum applications on P and K concentrations (%) and its uptake (kg/fed) by wheat plant.

Treatments	Phosphorus				Potassium			
	Grains		Straw		Grains		Straw	
	%	Uptake	%	Uptake	%	Uptake	%	Uptake
N_{80}	0.345	3.22	0.103	1.82	0.53	4.95	1.28	22.65
N_{80}+ G	0.394	4.03	0.113	2.11	0.59	6.04	1.37	25.68
N_{80} + FYM	0.421	4.54	0.123	2.37	0.64	6.91	1.49	28.72
N_{80}+ FYM + G	0.466	5.29	0.132	2.64	0.65	7.38	1.54	30.87
N_{100}	0.351	4.09	0.110	2.25	0.58	6.71	1.31	26.84
N_{100}+G	0.404	5.24	0.118	2.60	0.61	7.91	1.43	31.84
N_{100}+FYM	0.439	5.97	0.125	2.87	0.63	8.57	1.51	34.68
N_{100} + FYM+G	0.487	7.05	0.133	3.23	0.66	9.55	1.59	38.63
N_{120}	0.358	5.22	0.144	3.65	0.58	8.46	1.36	34.54
N_{120}+G	0.432	7.18	0.120	3.65	0.60	9.97	1.46	40.04
N_{120}+FYM	0.455	7.92	0.131	3.33	0.67	11.66	1.54	44.04
N_{120+}+FYM+G	0.511	9.70	0.140	4.31	0.71	13.49	1.60	49.26
LSD at 0.05	0.024	0.566	0.013	0.425	0.065	0.976	0.976	3.24

4- Nitrogen fertilizer use and yield efficiencies:

Table (6) shows that the results of N, P and K use and yield efficiencies, are greatly affected by the treatments under study. Values of N, P and K use efficiency (expressed by kg grain/fertilizer unit) obtained from the application of N_{80}, N_{100} and N_{120} along with FYM +gypsum were higher than the other treatments.

Table (6): Fertilizer use efficiency (FUE) and yield efficiency as affected by various N fertilization rates, FYM and Gypsum application.

Treatments	Fertilizer use efficiency (FUE) (kg grain/fertilizer unit)			Yield efficiency (kg fertilizer unit/kg grains)		
	NUE	PUE	KUE	N	P	K
N_{80}	11.67	31.13	38.91	0.085	0.032	0.025
N_{80}+ G	12.81	34.16	42.70	0.078	0.029	0.023
N_{80} + FYM	13.50	36.00	45.00	0.074	0.027	0.022
N_{80}+ FYM + G	14.20	37.86	47.33	0.070	0.026	0.021
N_{100}	11.57	38.56	48.21	0.086	0.025	0.020
N_{100}+G	12.98	43.27	54.08	0.077	0.023	0.018
N_{100}+FYM	13.61	45.37	56.70	0.073	0.022	0.017
N_{100} + FYM+G	14.48	48.27	60.33	0.069	0.020	0.016
N_{120}	12.16	48.66	60.83	0.082	0.020	0.016
N_{120}+G	13.85	55.43	69.29	0.072	0.018	0.014
N_{120}+FYM	14.50	58.03	72.54	0.068	0.017	0.013
N_{120+}+FYM+G	15.83	63.33	79.16	0.063	0.015	0.012
LSD at 0.05	1.20	2.87	3.59	0.090	0.001	n.s

It is worthy to notice that, effectiveness of N fertilizer was more higher, when it was associated by the application of FYM + gypsum than without or with individual application of each one. However, it could be noticed that application of FYM was more effective in increasing N, P and K

efficiency compared with the application of gypsum, which was true at all N fertilizer application rates (N_{80}, N_{100} and N_{120}). This was in accordance with Math and Trwed (2000) who demonstrated that application of FYM increased wheat yield and thus increased the fertilizer use efficiency.

Table (6) also illustrate that the treatment of N_{120} + FYM + gypsum gave the absolute greatest value of N, P and K use efficiency (15.83, 63.33 and 79.16 kg grain/fertilizer unit respectively). Indicating that the beneficial effect of each unit of applied fertilizer (nitrogen, phosphate and potassium) was expreaced by the application of FYM +gypsum. This could be attributed to the effect of FYM in reducing the pH of the rhizosphere, thus increased the availability of the applied fertilizer, in addition to the effect of gypsum in improving soil properties, which in turn encourage root growth and allow more nutrients uptake. These results are in accordance with that obtained by Osman Fatma *et al.* (1998).

Concerning the effect of various treatments on yield efficiency (kg fertilizer unit/kg grains), Data presented in Table (6), illustrated that application of FYM and gypsum either individually or in combination reduced the amounts of fertilizer needed to produce 1 kg of wheat grain. This favorable effect becomes more prononnced at higher N fertilizer application rate and also by the application of FYM + gypsum. This indicated that FYM and gypsum improved the opportunity for plant uptake and utilization of applied N, P and K fertilizer to produce more grains. These results are in agreement with those obtained by Awad (1990). Increase N fertilizer use efficiency (as expressed, the percentage recovery of fertilizer N by crop) may be due to minimize loss of N fertilizer from the root zone, as a result of acidic reaction of FYM, and promoting microorganisms activities. (Walters and Malzer (1990) and Sahrawat (1989). More recently, Rowat and Pareek (2003) found that wheat grain yield was increased by the application of FYM along with NPK fertilizer, which increased fertilizer use efficiency and reduced yield efficiency (amounts of fertilizer needed to produce 1 units grain yield).

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تأثير استخدام السماد البلدى والجبس على كفاءة استعمال السماد النيتروجينى لنبات القمح المنزرع فى الاراضى الرملية المستصلحة حديثا

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اجريت تجربة حقلية فى محطة البحوث الزراعية بالاسماعلية خلال الموسم الزراعى ٢٠٠١ / ٢٠٠٢ وذلك لدراسة أثر استخدام السماد البلدى والجبس على كفاءة استعمال السماد النيتروجينى لنبات القمح صنف سخا ٦٩

استخدمت لهذه الدراسة ثلاث معدلات من السماد النيتروجينى سلفات النشادر (٢٠,٦% ن) كانت كالتالى (٨٠ ، ١٠٠، ١٢٠ كجم نتروجين/فدان). كذلك اضيف السماد البلدى والجبس اما منفردا مع السماد النيتروجينى أو معا مع السماد النيتروجينى. وكان التصميم الاحصائى المتبع فى هذه التجربة هو قطاعات كاملة العشوائية فى ثلاث مكررات.

ويمكن تلخيص النتائج المتحصل عليها كالاتى:-

١- ازدادت مكونات انتاج محصول القمح زياده مطردة نتيجة زيادة معدل اضافة السماد النتروجينى.

٢- أوضحت النتائج أن أعلى القيم لانتاج القمح من الحبوب والقش كانت كالتالى ١٩٠٠ و ٣٠٧٩ كجم/فدان على التوالى حيث اعطت من المعاملة المشتركة للسماد البلدى + الجبس مع معدل السماد النيتروجينى ١٢٠ كجم/فدان ويرجع ذلك تشجيع نشاط الكائنات الدقيقة والمفيدة لمنطقة انتشار الجذور التى تزيد من كفاءة استعمال السماد النيتروجينى.

٣- اتفقت نتائج النسبة المئوية للبروتين فى الحبوب وأيضا انتاج الحبوب الكلى من البروتين (كجم/فدان) مع اتجاه تركيز وامتصاص النيتروجين فى الحبوب. من جهة أخرى هذه القيم تأثرت بدرجة كبيرة بمعدل السماد النيتروجينى والمرتبط مع السماد البلدى + الجبس.

٤- أدى التأثير الايجابى للسماد البلدى والجبس الى زيادة قدرة امتصاص الفوسفور-البوتاسيوم لنبات القمح.

٥- توصى الدراسه بأن يجب أن يؤخذ فى الاعتبار أهمية استخدام السماد البلدى + الجبس مع السماد النيتروجينى لكى تزيد من كفاءة استعمال السماد النيتروجينى فى الاراضى الرملية الحديثة الاستصلاح .