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# RESIDUAL EFFECT OF ORGANIC AND INORGANIC NITROGEN FERTILIZERS ON WHEAT YIELD PRODUCTION AND SANDY SOIL FERTILITY

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## ABSTRACT

A field experiment was conducted during winter season of 2002/2003 at the experimental Farm, Faculty of Agriculture, Zagazig University, El-Khattara region. Sharkia Governorate, to study the residual effect of organic manure "Rabbit and Farmyard manure" which was added to a sandy soil for a pearl millet crop, and the effect was assessed for a succeeding wheat crop. The sandy soil was treated before growing the pearl millet in summer season with the following treatments: no manure, rabbit manure, and farmyard manure FYM both at 10 metric ton/fed. Inorganic N as ammonium sulphate, 20.5% N was added at the rate 0, 20, 40 and 60 kg / fed to the wheat crop.

**The obtained results could be summarized as follows:**

The results revealed that the nitrogen fertilizer "organic and inorganic" was very important to wheat in such soil regardless the form of added nitrogen. Rabbit manure (RM) alone or combined with mineral-N showed more residual effect in all parameters than farmyard manure.

Generally, the obtained results revealed that the residues of organic manure increased grain yield, straw yields biological yield, harvest index, N, P, K uptake in straw and grain, nitrogen use efficiency and biomass nitrogen recovery % compared to the control. Efficiency of added mineral-N expressed as N-use efficiency (NUE) or N-utilization efficiency (NUTE) decreased with increased mineral N fertilization level, and increased with rabbit and farmyard manure application.

Results indicate that N, P, K uptake by wheat plants were increased with increasing nitrogen levels addition, also RM alone or combined with mineral N caused an increase in nutrient uptake in wheat than FYM alone or with added N. The highest value was obtained by using organic manure combined with 60 kg N/ fed.

Agronomic and physiological efficiencies for wheat yield was increased with RM than FYM. There was interaction between nitrogen levels and organic manure and significantly affected protein contents. The highest values of 293.4 kg / fed were obtained with (RM + 60 kg N / fed). The residual effect of RM was much greater than FYM particularly under conditions of no N addition.

Residual effect of organic manure caused a decrease in soil pH, and an increase in organic matter content. Soil salinities and total nitrogen content of soil increased compared to manuring.

The results indicate that application of organic manures (RM & FYM) increased the soil content of organic carbon. The C/N ratio, in studied soil was generally decreased by addition of the organic manures, the decrease was more pronounced with RM treatment as compared with FYM treatments.

It can be concluded that the residual effect of 10 ton organic manure/ fed resulted in an increase in wheat yield, improving sandy soil properties and considered more safe and fusible for a long period from the agronomic and economic point.

## INTRODUCTION

Wheat crop is considered one of the most important cereal crops in Egypt. The wheat yield is a function of many factors including nitrogen, production of wheat in the sandy soils is facing many problems including low

nitrogen, low organic matter, and poor physical properties. Application of mineral fertilizers to sandy soils may not be fully effective, unless organic manuring is done to increase availability of plant nutrients and to improve the physical properties. Organic manuring provides means for stabilizing soil fertility (specially in newly reclaimed sandy soils).

Organic substances play a direct role in sustaining soil fertility, as they are sources of plant nutrients which are liberated during mineralization. (Smith and Sharply, 1990). Khater *et al.*., (2002) proved that nutrient uptake by plants was increased with organic amendment application. El-Fachrani, (1999); Hanna and El-Awag, (2000) and El-Maddah (2000), stated that farmyard manure is one of the natural soil amendments which make physical properties soil more suitable to healthy plant growth. The concept of organic agriculture technique (clean agriculture) means using organic manures and biofertilizers rather than mineral fertilizers in plant nutrition.

Strategies for eco-compatible agricultural systems in Egypt for maximizing utilization of natural agricultural resources, empathize the importance of organic farming and minimizing consumption of inorganic fertilizers. Metwally and Khamis, (1998) reported that the addition of half the N requirement for wheat in organic forms and the other half in a mineral form produced a yield rather than the yield produced by applying all N in a mineral form.

Manure is a valuable resource for increasing and maintaining soil fertility. It supplies nutrients for plant growth and organic matter for improving and maintaining soil physical properties. In fresh manure a considerable portion of N and P occurs in organic form and must be mineralized to be absorbed by plants. Azevedo and Staout (1974) stated that, considering the complexity of factors affecting the availability of organic manure-N in soil, estimation of N availability from manure can only be expressed in terms of recoverable-N.

Kesler (1966) states average estimation of poultry manure-N as follows: 40% of the N is available the 1$^{st}$ year, 30 % in the 2$^{nd}$, 20% in the 3$^{rd}$ and 10% the 4$^{th}$ year, Robertson and Walford , (1970) estimated 50% of manure N as being utilized by crops in the 1$^{st}$ year. Eno (1966) estimated 30 to 60 % of the N in poultry manure as being available within 6 weeks of application to soil. Martin, (1972) reported an that 50% of the N in steer, dairy and poultry manures as available to plants within 6 months of application.

Azevedo and Staout (1974) gave the following estimation of N-release from the corral organic manure N series 0.40, 0.25, 0.06 means that the first year release of mineralized N is 40% in the 1$^{st}$ year, 15%, and 2.7% in the 2$^{nd}$ and 3$^{rd}$ years respectively. They concluded that to achieve a constant release of N to crops each year, enough organic N must be added in 1$^{st}$ year, in successive years, decreasing amounts are required.

The objective of the present work was to study the residual effect of organic and inorganic nitrogen fertilizer and their interactions on yield and yield components of wheat and some chemical properties of sandy soils.

## MATERIALS AND METHODS

A field experiment was conducted at the experimental farm, of the Faculty of Agriculture, Zagazig University at Khattara region Sharkia Governorate, Egypt during the winter season of 2002 – 2003 to study the residual effect of organic manure-N and mineral fertilizer-N. Two manures were studied: farmyard and rabbit manures. Inorganic-N fertilizer was ammonium sulphate (20.5% N). The soil is sand, the crop was wheat (*Triticum aestivum c.v. Gemmeiza* 3) production where as the above yield in summer was pearl millet yield. The sowing date was 28 Nov. 2002 and the harvest date was 18-5-2003. Particle-size distribution was done by the pipette method (Piper 1950). Physical and chemical properties of the soil and manures were done according to Chapman and Pratt (1961). Data of soil and organic manure analyses are presented in Tables 1 and 2. The experimental design was a randomized complete block, factorial, with three replicates. The 2 factors of the experiment were (a): manure (non – rabbit manure and farmyard manure FYM), (b): mineral- N rates (0, 20, 40 and 60 kg/fed). The plot area was 6 $m^2$ (2 x 3 m). The organic manures were added one season (a summer pearl millet season) before the wheat (winter) season. Addition was done before cultivation of pearl millet at rate of 10 metric ton/ fed during land preparation. The inorganic N-fertilizer was added to the wheat crop.

All plots of wheat crop were fertilized with 13 kg P and 24 kg K/fed. as super calcium phosphate (6.8% P) and potassium sulphate (40% K) respectively . Wheat was planted in the plots of the preceeding pearl millet which had received the organic manure treatments. The purpose of the wheat experiment was to evaluate the residual effect of manure which had been applied to the pearl millet. Normal agricultural practices for growing wheat crop in the region were followed . At harvest, grain and straw samples were taken for analyses of N by the kjeldahl method, and other nutrients of P and K were determined in a sulphuric / perchloric concentrated acid mixture (Chapman and Pratt 1961). Measurement of P was done calorimetrically and K was measured by flame photometer (Jackson, 1967 and Hesse, 1971). Protein content = N x 6.25. Nitrogen use efficiency (NUE) and nitrogen utilization efficiency (NUTE) were calculated according to Nova and Loomis (1981). Nitrogen recovery % was calculated as follows: N- recovery % = [N-uptake by fertilized plants (kg/fed) – N-uptake by non fertilized plants(kg/fed) ] × 100 ÷ amount of applied N (kg/fed).

Nitrogen use efficiency was as follows: NUE = (kg yield/fed) ÷ kg N-applied/fed; i.e. the amount of yield (in kg) produced by one kg of applied N.

Nitrogen utilization efficiency was calculated as follows: NUTE = (kg yield/fed.) ÷ (kg N-uptake/fed). ; i.e. the amount of yield (in kg) produced by one kg of N taken-up by plant.

After wheat harvest soil samples were taken at 30 cm, depth from each plot, air dried, ground to pass through a 2 mm sieve and analyzed for, pH, electrical conductivity and organic matter (Walkley and Black) according to Hesse (1971); and total N, P and K according to Chapman and Pratt (1961). The data were statistically analyzed according to Gomez and Gomez (1984).

**Table (1): Physical and chemical properties of the soil**

| Particle size distribution | | | | | pH* | EC** dS/m | OM% | Total (mg/100g) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cause sand | Fine sand | Silt | Clay | Texture class | | | | N | P | K |
| 71.32 | 24.06 | 1.78 | 2.84 | Sandy | 8.39 | 0.38 | 0.25 | 21.5 | 44.5 | 61.4 |
| Soluble ions (1:2.5) soil extract | | | | | | | | | | |
| Cations Meg/100 g soil | | | | Anions Meg/100 g soil | | | | | | |
| Ca | Mg | Na | K | Co3 | $HCO_3$ | CL | SO4 | | | |
| 0.42 | 0.35 | 0.54 | 0.11 | --- | 0.60 | 0.50 | 0.32 | | | |

*** 1:2.5 soil water suspension** **** In soil extract**

**Table (2): Chemical analysis of the organic manures**

| Organic | pH* | OM% | Total (g/ kg) | | | Available**(g / kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | | N | P | K | N | P | K |
| Rabbit manure | 7.71 | 35.5 | 17.6 | 12.0 | 10.9 | 2.24 | 1.52 | 1.89 |
| Farmyard manure | 7.44 | 24.6 | 8.3 | 6.2 | 7.6 | 1.54 | 0.79 | 1.09 |

*** 1:5 organic manure water suspension.**
**** : extracts are Kcl (for N); NaHCO□3(for P) ; NH4-acetate (for K).**

## RESULTS AND DISCUSSION

Data show a positive effect of applied manure and fertilizers on the yield and the uptake of macro nutrients (N, P and K) by wheat plants at maturity stage (straw and grain), as well as in available nutrients residual in the soil.

**1. Effect on straw, grain, biological yield (grains +straw yield), 1000 grain weight and harvest index of wheat plant:**

**1.1. Response to application of mineral N:**

**1.1.1. Straw yield (STY), grain yield (G.Y), biological yield (straw + grains) (BY), 1000 grain weight (GW) and harvest index (HI):**

There was a positive response to applied mineral N as well as residual positive effect to manures applied either separately or together in increasing the yield components of wheat plant. Data in Table (3) reveal that GT, STY, BY and GW increased significantly by applying mineral N, progressing with increased N level. The highest N level gave lower GW when compared to be 40 kg N /fed. The GW increased from an average of 50.59 to 56.21 gm as increasing N from zero to 40 kg /fed. The HI decreased by using 40 and 60 kg N/fed. but increased by using 20 kg N/fed. The highest value of HI was obtained when 40 kg N / fed was applied and it decreased with increasing N level. The superiority of 60 kg-N over 40-kg N was not significant in plots which received rabbit manure (RM). These results agree with those, obtained by Fredrich and Comberato (1995) and Hamissa and Moustafa (1998) who showed that wheat grains, were responded significantly to nitrogen fertilization.

**1.1.2. N, P, and K in straw and grains:**

There was a decrease in N content by application of mineral N (apparently due to the dilution effect i.e. greater yield by N-application causing a decrease in content of N in plant). This is occurred to K, but for P there was an increase, particularly at the high N rates (Tables 4 and 5).

**Table (3): Residual effect of organic and inorganic nitrogen on wheat yield components and nitrogen use efficiency**

| Mineral: (N) / Organic: (F) | 0 | 20 | 40 | 60 | Mean | 0 | 20 | 40 | 60 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Straw yield metric ton /fed.** | | | | | **Grain yield metric ton/ fed.** | | | | |
| Non | 0.505 | 1.005 | 1.378 | 1.794 | 1.170 | 0.351 | 0.748 | 1.013 | 1.301 | 0.853 |
| Rabbit | 0.704 | 1.512 | 2.584 | 2.541 | 1.835 | 0.518 | 1.137 | 1.518 | 1.746 | 1.230 |
| FYM | 0.476 | 1.150 | 1.789 | 2.457 | 1.468 | 0.331 | 0.841 | 1.255 | 1.709 | 1.034 |
| Mean | 0.562 | 1.222 | 1.917 | 2.264 | - | 0.400 | 0.909 | 1.262 | 1.585 | - |
| LSD at 0.5 | N=0.038 F= 0.033 NF=0.066 | | | | | N= 0.44 F= 0.038 NF=0.076 | | | | |
| | **Biological yield metric ton/ fed** | | | | | **1000 grain weight (g)** | | | | |
| Non | 0.857 | 1.754 | 2.390 | 3.094 | 2.024 | 50.59 | 52.22 | 56.21 | 54.61 | 53.41 |
| Rabbit | 1.22 | 2.648 | 4.102 | 4.287 | 3.065 | 53.81 | 54.57 | 60.61 | 55.66 | 56.16 |
| FYM | 0.808 | 1.991 | 3.043 | 4.166 | 2.502 | 49.11 | 52.99 | 59.81 | 55.55 | 54.36 |
| Mean | 0.962 | 2.131 | 3.179 | 3.849 | - | 51.17 | 53.26 | 58.88 | 55.27 | - |
| LSD at 0.5 | N= 0.67 F=0.058 NF= 0.117 | | | | | N=0.733 F= 0.634 NF = 1. 27 | | | | |
| | **Harvest index %** | | | | | **Nitrogen utilization efficiency** | | | | |
| Non | 41.0 | 42.7 | 42.4 | 42.0 | 42.0 | 18.84 | 22.58 | 22.12 | 20.29 | 20.96 |
| Rabbit | 42.3 | 42.9 | 37.0 | 40.7 | 40.7 | 18.85 | 25.84 | 20.98 | 21.21 | 21.72 |
| FYM | 41.0 | 42.2 | 41.2 | 41.0 | 41.4 | 18.42 | 21.22 | 19.43 | 22.31 | 20.35 |
| Mean | 41.4 | 42.6 | 40.2 | 41.3 | - | 18.70 | 23.21 | 20.84 | 20.27 | - |
| LSD at 0.5 | N = 0.014 F= n.s. NF = 0.024 | | | | | N= 1.404 F= n.s. NF= 2.432 | | | | |
| | **Nitrogen use efficiency** | | | | | **Nitrogen harvest index** | | | | |
| Non | - | 37.42 | 25.33 | 21.68 | 28.14 | 0.66 | 0.63 | 0.67 | 0.67 | 0.66 |
| Rabbit | - | 56.84 | 37.95 | 29.10 | 41.30 | 0.65 | 0.61 | 0.58 | 0.62 | 0.62 |
| FYM | - | 42.06 | 31.37 | 28.49 | 33.97 | 0.64 | 0.67 | 0.68 | 0.62 | 0.64 |
| Mean | - | 45.44 | 31.55 | 26.42 | - | 0.65 | 0.63 | 0.63 | 0.64 | - |
| LSD at 0.5 | N=1.354 F= 1.354 NF=2.346 | | | | | N=n.s. F=0.023 NF= 0.046 | | | | |

**Organic manures (rabbit manure) and farmyard manure (FYM) were applied at 10 metric tons/ fed only for the crop which preceded wheat (pearl millet) to assess residual effect on wheat mineral N was applied as ammonium sulphate to the wheat crop.**
**Harvest index % = grain yield / biological (grains + straw) yield (both in metric ton /fed)**
**Nitrogen utilization efficiency = grain yield / total N uptake (kg /fed)**
**Nitrogen harvest index = N in grains uptake / N – uptake (in grains + straw)**

Data also show that the concentration of N as well as P in the grains of wheat is approximately double its concentration in the straw, while the concentration of K in wheat straw is approximately three times that in the grains. Uptake of N, P and K in straw as well as in grains responded positively significantly to N and the increase was excessive with increasing N fertilizer level (Tables 4 and 5). The wheat which received no mineral N fertilizer gave the lowest uptake values of all NPK nutrients in grain, straw. Applying N fertilizer increased such uptake particularly with rate of 60 kg N/fed which increased significantly all uptake values.

The plants which were grown in plots not received organic amendment but received 60 kg mineral N/fed showed uptake of N amounting to 21.46, 42.70 and 64.15 kg N/fed in straw, grain and (straw + grains), respectively. Comparable values for P-uptake reached 2.7, 4.8 and 7.5 kg P / fed. These results for K uptake were the highest values 27.1, 7.7 and 34.8 kg K/fed, respectively.Increasing N fertilization must, activated the root system

and rate of nutrient uptake, which accelerated plant growth, yield and nutrient accumulation in wheat plants. These result are in agreement with those reported by Metwally and Khamis (1998) and Mohamed *et al.*. (2001).

**1.1.3. N-use efficiency (NUE), N-utilization efficiency (NUTE), and N-harvest index (NHI):**

Data for NUE, NUTE and NHI are presented in Table (4). The results show that applying mineral N at increasing rate resulted in a decrease in NUE. On the other hand, NUTE was increased by applying mineral N. The increase did not progress with increasing the rate of N. It was of lower magnitude with the increase in N-rate. The NHI was not affected by N-application. These results agree with those reported by El-Awag *et al.*. (1996) and Hamissa and Moustafa (1998).

**1.2. Response to residual effect of organic manure applied to the preceeding pearl millet crop**

**1.2.1. Response regarding yields (GY, STR and BY), grain weight (GW) and harvest index (HI):**

Means of STY, GY, BY, GW and HI as affected by organic manures of rabbit manure (RM) and farmyard manure (FYM) are shown in Table (3). It is noticed that organic manure had significantly increased BY, GY, STY and GW over the non manure treatment. Therefore, both manures showed residual effect on wheat, although they were applied to the preceding crop of pearl millet. Rabbit manure (RM) surpassed farmyard manure (FYM) in respect of the response to residual effect of manure shown regarding, STY, GY, and BY; as well as the 1000-grain weight. There was an interaction caused by N rate affecting residual effect of manures. This is shown when superiority of RM over FYM occurred in absence of mineral N or in presence of the N levels of only up to 40 kg N/fed. ;in presence of the highest 60 kg N/fed. , there was no difference between RM and FYM. This indicates that superiority of RM over FYM occurred only when soil did not receive mineral N or when applied N was not very high.

In plots which had not received organic manure, means of BY, GY, STY and GW were 2.024, 0.853, and 1.170 metric ton/fed. and 53.41g respectively. Residual effect due to RM caused increases of 51.1, 44.2, 50.8, and 5.1% respectively for each of these attributes. Comparable increases due to FYM were 23.6, 21.2, 25.5, and 1.8 % respectively. Thus the maximum values were obtained from RM. This illustrates the importance of organic manure in improving soil properties, and causing a residual of plant nutrients to be available for more than one season. The results agree with those obtained by El-Naggar, (1996), Singh *et al.*. (1997) and El-Ghamry and El-Naggar (2001).

The highest yields occurred with RM + application of N fertilizer at 60 kg N/ fed. Other hand with level 60 kg N / fed. decreased the GW under all treatments. The highest values of BY, GY, and STY, and for GW were 4.287, 1.746 and 2.541 metric ton/fed. and 60.61 / gm, respectively under RM + 60 kg N/fed treatment. The obtained results all in agreement with those obtained by Awad (1994) Mohamed *et al.*. (2001) and El-Naggar *et al.*. (2005). The results show that the highest value of HI was obtained when 20 kg N/fed was

applied and it decreased in lower and higher N fertilizer levels under RM and FYM. The results suggest that perhaps the most appropriate prospects for enhancing the long term fertility and productivity can be achieved by proper management of soil fertilization (Cole *et al.*. 1987).

**1.2.2. Response regarding NPK in plant:**

Data presented in Tables 4 and 5 show that there was a residual positive effect caused by manures. The positive effect was reflected in the contents as the uptake of N for P, in most cases there was an increase in its contents, but in all cases, there was an increase in uptake due to manuring. For K the positive effect was mainly in terries of K uptake. Residual effect due to RM was greater than due to FYM. Uptake of N due to manuring was greater than in non mineral plots by 67.2, and 31.4 % in straw of plants receiving RM and FYM respectively; comparable values for FYM are 35.4 and 18.7 % respectively. For uptake of P values are 155% and 54.4% in straw and 139% and 52.1% in grains respectively. Those for K were 49.2% and 22.7% in straw and 32.0 and 17.8% in grains. However, there was an interaction caused by status of mineral N application. Where no mineral N was applied, RM showed residual effect regarding the uptake of all nutrients in straw as well as grains, but FYM did not show such residual effect neither for N uptake or P uptake or K uptake whether by straw or by grains.

**Table (4): Residual effect of organic and inorganic nitrogen fertilizer on the nitrogen, phosphor content and uptake of wheat**

| Mineral:(N) / Organic: (F) | 0 | 20 | 40 | 60 | Mean | 0 | 20 | 40 | 60 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | **N% in straw** | | | | | **N uptake in straw (kg / fed)** | | | | |
| Non | 1.27 | 1.24 | 1.10 | 1.20 | 1.20 | 6.39 | 12.50 | 15.15 | 21.46 | 13.87 |
| Rabbit | 1.37 | 1.15 | 1.34 | 1.22 | 1.27 | 9.62 | 17.40 | 34.73 | 31.01 | 23.19 |
| FYM | 1.56 | 1.15 | 1.34 | 1.19 | 1.26 | 6.47 | 13.26 | 24.02 | 29.15 | 18.22 |
| Mean | 1.33 | 1.18 | 1.26 | 1.20 | - | 7.49 | 14.39 | 24.63 | 27.21 | - |
| LSD at 0.5 | N= 0.101 F= 0.087 NF = 0.174 | | | | | N=0.174 F= 0.150 NF= 0.301 | | | | |
| | **N% In grain** | | | | | **N uptake in grains (kg / fed)** | | | | |
| Non | 3.42 | 2.83 | 3.05 | 3.29 | 3.15 | 12.03 | 21.16 | 30.81 | 42.70 | 26.67 |
| Rabbit | 3.49 | 2.36 | 3.16 | 2.96 | 2.99 | 17.97 | 26.88 | 48.04 | 51.53 | 36.11 |
| FYM | 3.51 | 3.16 | 3.25 | 2.80 | 3.18 | 11.52 | 26.59 | 40.78 | 47.78 | 31.67 |
| Mean | 3.47 | 2.78 | 3.15 | 3.01 | - | 13.84 | 24.88 | 39.88 | 47.34 | - |
| LSD at 0.5 | N= 0.250 F= n.s. NF= 0.434 | | | | | N=2.439 F= 2.112 NF =4.225 | | | | |
| | **P % in straw** | | | | | **P. uptake in straw (kg / fed.)** | | | | |
| Non | 0.11 | 0.13 | 0.14 | 0.15 | 0.13 | 0.55 | 1.29 | 1.88 | 2.67 | 1.60 |
| Rabbit | 0.21 | 0.22 | 0.21 | 0.24 | 0.22 | 1.47 | 3.27 | 5.43 | 6.17 | 4.08 |
| FYM | 0.18 | 0.15 | 0.17 | 0.18 | 0.18 | 0.84 | 1.70 | 3.00 | 4.33 | 2.47 |
| Mean | 0.17 | 0.16 | 0.17 | 0.19 | - | 0.96 | 2.09 | 3.44 | 4.39 | - |
| LSD at 0.5 | N=0.006 F= 0.005 NF=0.011 | | | | | N=0.169 F= 0.146 NF=0.293 | | | | |
| | **P % in grains** | | | | | **P uptake in grains (kg / fed)** | | | | |
| Non | 0.25 | 0.26 | 0.26 | 0.37 | 0.88 | 0.87 | 1.92 | 2.65 | 4.84 | 2.57 |
| Rabbit | 0.43 | 0.46 | 0.47 | 0.57 | 0.48 | 2.23 | 5.26 | 7.15 | 10.01 | 6.16 |
| FYM | 0.37 | 0.37 | 0.38 | 0.38 | 0.38 | 1.21 | 3.13 | 4.75 | 6.56 | 3.91 |
| Mean | 0.35 | 0.36 | 0.37 | 0.44 | - | 1.44 | 3.44 | 4.85 | 7.14 | - |
| LSD at 0.5 | N= 0.008 F= 0.007 NF = 0.0134 | | | | | N= 0.204 F= 0.177 NF = 354 | | | | |

*** See footnotes of Table 3 for treatment data**

This shows the superiority of RM over FYM in growing residual nutrients for 2 seasons. Under conditions of application of mineral N, FYM showed a residual effect. This indicates that for FYM to release more nutrients to last 2 successive seasons, application of mineral N is necessary, particularly in sandy soils, as the case with the current study.

**Table (5): Residual effect of organic and inorganic nitrogen fertilizer on the K content and uptake of NPK in wheat**

| Mineral:(N) / Organic: (F) | 0 | 20 | 40 | 60 | Mean | 0 | 20 | 40 | 60 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | **K% in straw** | | | | | **K-uptake in straw (kg / fed)** | | | | |
| Non | 1.70 | 1.41 | 1.52 | 1.51 | 1.54 | 8.56 | 14.16 | 20.88 | 27.08 | 17.68 |
| Rabbit | 1.69 | 1.45 | 1.27 | 1.63 | 1.49 | 11.91 | 21.90 | 30.31 | 41.39 | 26.38 |
| FYM | 1.73 | 1.42 | 1.37 | 1.53 | 1.52 | 8.21 | 16.34 | 24.53 | 37.67 | 21.69 |
| Mean | 1.71 | 1.43 | 1.35 | 1.56 | - | 9.57 | 17.47 | 25.24 | 35.38 | - |
| LSD at 0.5 | N = 0.081 F = n.s. NF= 0.141 | | | | | N= 0.595 F= 0.515 NF =1.031 | | | | |
| | **K% in grains** | | | | | **K-uptake in grains (kg / fed)** | | | | |
| Non | 0.49 | 0.50 | 0.54 | 0.59 | 0.53 | 1.70 | 3.74 | 5.49 | 7.67 | 4.65 |
| Rabbit | 0.53 | 0.49 | 0.55 | 0.51 | 0.52 | 2.75 | 5.52 | 8.38 | 8.85 | 6.37 |
| FYM | 0.56 | 0.54 | 0.55 | 0.51 | 0.54 | 1.86 | 4.50 | 6.85 | 8.72 | 5.48 |
| Mean | 0.53 | 0.51 | 0.55 | 0.54 | - | 2.10 | 4.59 | 6.91 | 8.41 | - |
| LSD at 0.5 | n.s. | | | | | N=0.151 F=0.186 NF=0.372 | | | | |
| | **N uptake in ( grains + straw)** | | | | | **P uptake in ( grains + straw)** | | | | |
| Non | 18.41 | 33.66 | 45.96 | 64.15 | 40.54 | 1.42 | 3.21 | 4.53 | 7.50 | 4.17 |
| Rabbit | 27.59 | 44.28 | 82.77 | 82.54 | 59.29 | 3.70 | 8.53 | 12.57 | 16.18 | 10.24 |
| FYM | 18.00 | 39.85 | 64.80 | 76.93 | 49.89 | 2.05 | 4.83 | 7.75 | 10.89 | 6.38 |
| Mean | 21.33 | 39.26 | 64.51 | 74.54 | - | 2.39 | 5.52 | 8.28 | 11.53 | - |
| LSD at 0.5 | N=2.121 F=1.837 NF=3.670 | | | | | N=0.323 F=0.280 NF=0.561 | | | | |
| | **K uptake in ( grains + straw)** | | | | | | | | | |
| Non | 10.29 | 17.90 | 26.37 | 34.75 | 22.33 | | | | | |
| Rabbit | 14.66 | 27.42 | 38.70 | 50.23 | 32.75 | | | | | |
| FYM | 10.06 | 20.83 | 31.39 | 46.39 | 27.17 | | | | | |
| Mean | 11.67 | 22.05 | 32.15 | 43.79 | - | | | | | |
| LSD at 0.5 | N=0.685 F=0.593 NF=1.186 | | | | | | | | | |

*** See footnotes of Table 3 for treatment data**

Thus combining organic manure with mineral N fertilizer to sandy soils is of marked effect for residual nutrients increasing their available contents. These results are in agreement those of Aly (1999) and Ewais, Magda *et al.*. (2004). Treatment receiving RM and 60 kg N/fed had the highest NPK uptake, giving N-uptake of 51.55, 31.01 and 82.54 kg/fed in grains, straw and (grains + straw) respectively. Values for P uptake reached to 10.01, 6.17 and 16.18 kg/ fed respectively. These for K-uptake were 8.85, 41.39 and 50.24 kg/ fed respectively. These results are in agreement with those obtained by Sakr *et al.*. (1992), Metwally and Khamis (1998) and Mohamed *et al.*. (2001). It was could be concluded that application of rabbit manure or farmyard manure (particularly rabbit manure) as organic material to sandy soils increases the efficiency of mineral fertilizers. Organic material improves the physical and chemical properties of sand soil through its ability to adsorb nutrients on active groups or colloidal surfaces. Increased efficiency of

nutrient uptake by plants is reflected on plant growth and productivity. Organic amendments are sources of nutrients and also main sources of the soil bacteria (El-Akabawy , 2000). These results added more support to the findings reported by Sharma and Namdeo (1992).

**1.2.3. Nitrogen use efficiency (NUE) and nitrogen utilization efficiency (NUTE):**

Nitrogen use efficiency for RM was greater than for FYM (Table 3). Regarding NUE values under the different N rates, there was a decrease as N-rate increased. The value are 37.42, 26.57 and 21.68 kg grains / kg N applied under 20, 40 and 60 kg N/fed rates respectively. There results are similar to those reported by El-Awag *et al.*. (1996) and El-Naggar *et al.*. (2005). The response of NUE to the combined effect of applied N fertilizer levels and different organic manure reflects the importance of managing fertilizers operations (Table 3). Highest NUE occurred with RM under conditions of no mineral N addition. These results are in agreement with those obtained by Huggins and Pan (1993).

Nitrogen utilization efficiency NUTE, was greater in treatments which received mineral N; and was greater in treatments which received organic manure but only under conditions of mineral N application. Highest NUTE was caused by RM + 20 kg N/fed. This trend suggest that under low N conditions, nitrogen uptake efficiency of addition of N was high where manure was used.

**1.2.4. Fertilizer N recovery:**

Data in Table (6) reveal that percent of fertilizer N recovery by RM was more than that under FYM one. Data also reveal that the highest figures for fertilizer N recovery by (grains + straw) were obtained due to the combination of RM+ 40kg N/fed. These results agree with those reported by El-Awag *et al.*. (1996); Othman, Sanaa (1995) and El-Naggar *et al.*. (2005). The different behavior in N- recovery % for crops, may be attributed to different crop growth type and N-requirements beside different irrigation practices and prevailing climate conditions.

**1.2.5. Agronomic and physiological efficiency of nitrogen harvest index and protein in grain content:**

Table 6 show that agronomic and physiological efficiencies, nitrogen harvest index and protein contact can be affected by applying mineral N alone or combination with a residual effect organic manure. Results reveal that with the increase in N fertilizer rate there was decrease in agronomic and physiological efficiencies. It is clear from the results that increasing mineral N rate to more than 20 kgN/fed decreased agronomic and physiological efficiencies. Also application of organic manure had significant effect of agronomic and physiological efficiencies for the wheat yield. Generally the agronomic and physiological efficiencies for wheat yield was greater with RM than the FM. There results are similar to those obtained by Atia and Aly (1998).

**1.2.6. Protein yield:**

Data presented in Table 6 show that mineral N high significant effected at wheat protein yield. Generally increasing mineral N-addition caused increases in protein yield under no manure the highest value was

243.3 kg / fed with 60 kg N / fed and the lowest was 68.6 kg /fed, with zero kg N/fed. where manure was used, the highest values of 293.4 kg / fed, occurred with (RM + 60 kg N/ fed) and the lowest one was 65.7 kg/fed which was obtained by with FYM at zero nitrogen level. RM + N 60 kg /fed increased grain yield and nitrogen content in the grains more than any other treatment. These results agree with those of Ewais , Magda *et al.*. (2004) .

**Table (6): Residual effect of organic and inorganic nitrogen protein yield in grains, agronomic efficiency (AE) , biomass recovery % (BNR) and physiological efficiency (PE)**

| Mineral(N) / Organic(F) | 0 | 20 | 40 | 60 | Mean | 0 | 20 | 40 | 60 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | Protein yield in grains | | | | | (AE) | | | | |
| Non | 68.6 | 120.6 | 175.2 | 243.3 | 151.9 | - | 44.83 | 38.36 | 37.30 | 40.18 |
| Rabbit | 10.24 | 152.7 | 273.8 | 293.4 | 205.6 | - | 89.60 | 81.14 | 57.18 | 75.97 |
| FYM | 68.7 | 151.4 | 232.3 | 272.2 | 180.4 | - | 56.73 | 57.68 | 55.16 | 56.52 |
| Mean | 78.9 | 141.6 | 227.1 | 269.6 | - | - | 63.74 | 59.06 | 49.88 | - |
| LSD at 0.5 | N=0.139 F=0.120 NF=0.024 | | | | | N=3317 F=3.317 NF=5.745 | | | | |
| | (BNR) | | | | | (PE) | | | | |
| Non | - | 74.67 | 67.98 | 75.77 | 72.81 | - | 61.53 | 56.60 | 48.28 | 55.80 |
| Rabbit | - | 127.38 | 133.99 | 106.17 | 122.51 | 41.01 | 70.56 | 60.64 | 53.35 | 56.39 |
| FYM | - | 105.55 | 115.07 | 95.40 | 105.34 | 10.80 | 53.82 | 47.61 | 57.17 | 42.35 |
| Mean | | 102.53 | 105.68 | 92.45 | - | 25.91 | 61.97 | 54.95 | 53.27 | - |
| LSD at 0.5 | N=7.988 F=7.988 NF=13.836 | | | | | N=5.248 F=4.595 NF=9.09 | | | | |

**- See footnotes of Table 3 for treatment data**

**Agronomic efficiency (AE)=wheat yield (fertilized)-wheat yield (non- fertilized) /N (added).**

**Biomass N- Recovery % (BNR)=Total N- uptake (fertilized) – total N- uptake ( non-fertilized) / N ( added).**

**Physiological efficiency (PE)=wheat yield (fertilized) – what yield (non fertilized / N-uptake (fertilized.) – N uptake (non fertilized).**

## 2. Residual effect of organic manure (RM and FYM) on some soil properties:

Changes in soil chemical properties due to organic manure and N fertilizer are shown in Table (7).

### 2.1. Soil pH:

Application of RM or FYM to soil decreased the pH values of the studied soil. This decrease in soil pH would be attributed to the organic acids and $CO_2$ produced during the decomposition processes of organic materials. There was more decrease in soil pH values as a result of application organic manures combined addition of mineral N due to the presence of sulphate ions which can be converted to $H_2S0_4$ (strong acid) beside the production of organic acids from manures during decomposition processes by soil microbes. These results are similar to those obtained by Tester (1990) and Abdel Nasser and Harhash (2000).

### 2.2. Soil salinity:

Data in Table (7) show a slight increase electrical conductivity (EC) values with RM and FYM application either alone or with N fertilizer . The EC mean value for non-manured treatments was 0.38, increased to 0.42 and

0.39 for those treated with RM and FYM respectively. Mean values for the mineral N treatments were 0.39, 0.37, 0.46 and 0.37 for the no-N, 20, 40 and 60 kg N/fed respectively. The effect of such materials can be attributed to the increased moisture retention and hence the possibility of accumulating higher amounts of salts from irrigation water. These results agree with those reported by Badawi (1976). The effect of organic manure on increasing EC values may be due to its contents of soluble salts, in addition to the release of soluble salts during the decomposition of organic manure. These results are in good agreement with those obtained by El-Fakhrani (1999), Abdel-Nasser and Harhash (2000) and Ahmed (2003).

**Table (7): Residual effect of organic and inorganic nitrogen on the some chemical properties of sandy soil.**

| Mineral: (N) / Organic: (F) | 0 | 20 | 40 | 60 | Mean | 0 | 20 | 40 | 60 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | pH* | | | | | EC** | | | | |
| Non | 8.33 | 8.26 | 8.37 | 8.38 | 8.34 | 0.38 | 0.36 | 0.47 | 0.34 | 0.38 |
| Rabbit | 8.34 | 7.98 | 7.90 | 8.01 | 8.06 | 0.39 | 0.39 | 0.47 | 0.44 | 0.42 |
| FYM | 8.16 | 7.04 | 7.96 | 7.93 | 8.02 | 0.41 | 0.63 | 0.46 | 0.32 | 0.39 |
| Mean | 8.28 | 8.09 | 8.08 | 8.18 | - | 0.39 | 0.37 | 0.46 | 0.37 | - |
| LSD at 0.5 | N=0.053 F=0.046 NF=0.092 | | | | | N=0.007 F=0.006 NF=0.012 | | | | |
| | Total N % | | | | | Organic matter content % | | | | |
| Non | 0.017 | 0.021 | 0.019 | 0.021 | 0.020 | 0.121 | 0.328 | 0.368 | 0.304 | 0.280 |
| Rabbit | 0.018 | 0.021 | 0.021 | 0.027 | 0.022 | 0.320 | 0.376 | 0.447 | 0.647 | 0.448 |
| FYM | 0.019 | 0.021 | 0.017 | 0.026 | 0.3021 | 0.337 | 0.488 | 0.369 | 0.491 | 0.407 |
| Mean | 0.018 | 0.021 | 0.019 | 0.025 | - | 0.226 | 0.400 | 0.395 | 0.407 | - |
| LSD at 0.5 | N=0.002 F=n.s. NF=0.035 | | | | | N=0.0296 F=0.0258 NF=0.0513 | | | | |
| | Organic carbon content % | | | | | C/N ratio | | | | |
| Non | 0.071 | 0.191 | 0.214 | 0.177 | 0.163 | 4.18 | 9.10 | 11.26 | 8.43 | 8.24 |
| Rabbit | 0.187 | 0.219 | 0.376 | 0.376 | 0.289 | 10.39 | 10.43 | 17.90 | 13.14 | 12.98 |
| FYM | 0.159 | 0.289 | 0.214 | 0.286 | 0.237 | 8.37 | 13.76 | 12.59 | 11.00 | 11.43 |
| Mean | 0.139 | 0.233 | 0.268 | 0.280 | - | 7.65 | 11.10 | 13.92 | 11.20 | - |
| LSD at 0.5 | N=0.017 F=0.0146 NF=0.0296 | | | | | | | | | |

**- See footnotes of Table 3 for treatment data**
*** 1: 2.5 soil and water suspension**
**** in soil extract**

### 2.3. Total nitrogen content %:

Data presented in Table (7) indicate that RM and FYM and nitrogen levels application individually or in combination increased total nitrogen content in soil. The applied organic manure alone increased total N in soil to 0.02% while with combination increased to 0.024% compared with 0.017% at the control. These results are compatible with the higher contents of N in both organic manures than in the soil. Also, the increase in N content were mostly in line with the rate of application thus the maximum values of total nitrogen content obtained at with adding 60 kg N/fed with or without organic manure. These results agree with those reported by Atia and Aly (1998), Boadran *et al.*. (2000) and Negm *et al.*. (2002).

**2.4. Organic matter content (OM):**

Data in Table (7) show a significant increase in the soil organic matter content especially with organic manure alone or mixed with mineral fertilizer. Data also reveal that RM was more effective of increasing organic matter content than that of FYM.

Applied RM and FYM alone increased total organic matter content in soil to 0.322 and 0.339% while with mineral N, the mean was 0.274% compared with 0.154% at control. Such results were found by many workers (Clark *et al.*. 1998 and Ahmed 2003).

**2.5. Organic C and C/N ratio:**

Data in Table (7) reveal that application of organic manures (RM, FYM) increased the soil content of organic carbon. At the end of experiment the rate of decomposition was higher for RM than FYM. The rate of manure decomposition must have been high in such a sand soil. Applied RM and FYM alone increased the soil content of organic carbon to 0.187 and 0.197 while with minerals N to mean 0.159% compared with 0.089% at control. Some of the factors affecting the rate of decomposition of applied manure to a soil are the resistance of the material to microbial attack (a function of the amount of lignins, waxes and fats present) temperature and moisture levels in the soil (Tisdale *et al.*. 1985). these results agree with those obtained by Ismail *et al.*. (1988) and Abdel Malek *et al.*. (1997) who found that the decomposition of organic matter is high in sandy soil. Physicochemical properties of sandy soils allow high oxygen tension to penetrate in a sandy soil, enhancing a rapid decomposition of the added organic materials. Rasmussen and Collins (1991) reported that soil organic levels typically increased at rate of 10 to 25 of the amount of carbon added.

The response of soil organic carbon and total nitrogen to the different treatments is reflected on the C/N ratio (Table 7). The results indicate that the C/N ratios were generally decreased by the addition of manure. The decline in C/N ratio was more pronounced with RM treatment as compared with FYM treatment .The C/N ratio was more wider in RM, than in FYM due to nitrogen consumption by plants and a probable higher loss higher and faster carbon mineralization. These results agree with those obtained by Hassan *et al.*. (2002) and Negm *et al.*. (2002).

It can be concluded that the residual effect of applying 10 metric tons of organic manure /fed is high with application of mineral N-fertilizer the residual effect is more pronounced and increases wheat yield and improve soil properties. Such effects may be due to the organic manure high content of plant nutrients and to their efficiency in improving soil chemical and physical properties thus leading to higher plant growth and productivity. This positive effect may be due to the simulating biocomposite on soil microbial population both N – fixation and P- dissolving ones as well as the fact that of organic manure are main source of the soil bacteria (El-Akabawy, 2000). These results add more support to the findings reported by Sharma and Namdea (1999). Thus application of mineral N to soil which had received organic manure a preceding crop increase the residual effect of manure.

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# دراسة الأثر المتبقى للتسميد النيتروجينى العضوى والمعدنى على محصول القمح وخصوبة الأراضى الرملية

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أقيمت تجربة حقلية بمزرعة كلية الزراعة – جامعة الزقازيق بمنطقة الخطارة بمحافظة الشرقية خلال الموسم الشتوى لعام 2003/2002 وذلك لدراسة الأثر المتبقى للأسمدة العضوية ( مخلفات الماشية والأرانب) كمصدر للنيتروجين العضوى والتى أضيفت للتربة قبل زراعة المحصول الصيفى السابق (حشيشة الدخن) بمعدل 10 طن للفدان منفرداً أو مع إضافة سماد سلفات النشادر بمعدلات صفر ، 20، 40، 60كجم نيتروجين / فدان على إنتاج القمح صنف جميزة 3 وعلى التغير الحادث فى خصوبة التربة الرملية حديثة الاستزراع من أجراء ذلك ويمكن تلخيص النتائج المتحصل عليها فيما يلى :

أوضحت النتائج المتحصل عليها أهمية التسميد النيتروجينى ( عضوى كان أو معدنى) لنبات القمح فى مثل هذه الأراضى الرملية الفقيرة فى إمدادها للنبات بالنيتروجين0

أظهرالأثر المتبقى لإضافة سماد مخلفات ألأرانب سواء كان بمفرده أو مع إضافة سماد سلفات الأمونيوم إلى زيادة معنوية أكبر فى كل الصفات المدروسة عن الزيادة بإضافة السماد البلدى وكذلك المعدنى0

أوضحت النتائج المتحصل عليها بصفة عامه أن الأثر المتبقى لإضافة التسميد العضوى أدى إلى زيادة معنوية فى محصول القش والحبوب للقمح وكذلك المحصول الكلى وكذلك زيادة دليل الحصاد وامتصاص كل من النيتروجين والفوسفور والبوتاسيوم وكفاءة استخدام ونسبة امتصاص النيتروجين بالمقارنة بالكنترول0

أظهرت النتائج أن الكفاءة الاستعمالية للنيتروجين قلت مع زيادة التسميد النيتروجينى المعدنى لكن زادت مع إضافة مخلفات الأرانب ومخلفات الماشية أى زادت بإضافة التسميد العضوى 0

أدى زيادة معدل التسميد النيتروجينى على زيادة معنوية فى كمية النيتروجين والفوسفور والبوتاسيوم الممتصة فى الحبوب والقش والكمية الممتصة الكلية بالقمح وأيضاً زيادة المحتوى من البروتين فى الحبوب كما أدى إضافة سماد مخلفات الأرانب منفردة أو مع السماد المعدنى إلى زيادة معنوية فى امتصاص الكمية الكلية من العناصر الغذائية عنه فى حالة إضافة مخلفات السماد البلدى مع سماد سلفات الأمونيوم وكانت أعلى قيم متحصل عليها مع أضافة السماد العضوى بمعدل 10 طن للفدان مع إضافة نصف الكمية الموصى بها من التسميد النيتروجينى وهى 60 كجم نيتروجين للفدان 0

كما أوضحت النتائج أن التأثير المتبقى لاضافة السماد العضوى أدى إلى انخفاض قيم الرقم الهيدروجينى بينما أدى ذلك إلى زيادة معنوية فى محتوى التربة من المادة العضوية وكذلك المحتوى من النيتروجين وأيضاً زيادة درجة التوصيل الكهربى أى زيادة محتوى الأراض من الأملاح الكلية الذائبة وذلك بسبب تحسن خواص الأرض مما يزيد من قدرتها على الأحتفاظ بالماء مما أدى إلى تراكم الأملاح الموجودة فى ماء الرى بها 0 وأيضا نتيجة الزيادة محتوى المادة العضوية للأملاح 0 كما تشير ايضاً النتائج إلى زيادة الكربون العضوى بالتربة وخاصة مع أضافة مخلفات الأرانب أيضاً وكان معدل تحلل المادة العضوية عاليا بإضافة المخلفات السابقة وأيضا زادت معدنة الكربون العضوى بالتربة مع إستهلاك النيتروجين بالطرق المختلفة مما أدى الى انخفاض نسبة C/N بالتربة وخصوصاً مع إضافة مخلفات الأرانب عليه و إضافة سماد المزرعة0

مما سبق يمكن القول بأن التأثير المتبقى لإضافة التسميد العضوى مع المعدنى أدى إلى تحسين إنتاجية القمح فى الأراضى الرملية وأيضا إلى تحسين خواص التربة الرملية وبالتالى تحسين خصوبتها مما ينعكس على إنتاجيتها ويعتبر إضافة التسميد العضوى أكثر أماناً على المدى الطويل لإنتاجية التربة من المحاصيل المختلفة مما يقلل من الأعتماد على الأسمدة المعدنية ومايترتب عليها من أضرار0