Minufiya J. Agric. Res. Vol. 32 No.2: 503 - 524 (2007)

IMPACT OF APPLYING DIFFERENT SOURCES OF N-FERTILIZATION ON SOIL AVAILABILITY OF MACRONUTRIENTS AND WHEAT YIELD

O. F. El-Sedfy, W. M. El-Farghal and A. A. Badawy
Soil, Water and Environ. Res. Inst., Agric. Res. Center, Giza, Egypt

(Received: Jan. 15 , 2007)

ABSTRACT: ***A field experiment was conducted at Ismailia Agric. Exp. Station through the winter season 2004/2005 to study the impact of organic, inorganic, N-fertilization and biofertilizers on NPK availability and wheat grain yield. The experiment was laid out in a split split design with three replications. The treatments were added before sowing as follows: organic fertilization was no compost and 5 ton compost/fed. Nitrogen fertilizers were 50%, 75% and 100% of the recommended nitrogen doses. Four inoculation types were used: 1- no inoculation, 2- inoculation by Bacillus polymyxa; 3-inoculation by Saccharomyces cerevisiae and 4- inoculation by mixture of Bacillus polymyxa and Saccharomyces cerevisiae. Wheat grains (Triticum vulagre) c.v. Giza 168 were sown on 15th November 2004. Six months after sowing plants of each plot were cut and grain yield (kg/fed) was achieved.***

The obtained results indicated that the addition of 5 ton compost to sandy soil exceeded the organic matter concentration from 0.46 to 0.59%. Adversely, this addition markedly decreased the soil hydraulic conductivity value from 2.75 to 1.83 m/day. Available nitrogen and potassium of the studied sandy soil clearly intensified as affected by applying each of 5 ton compost /fed and inoculated by Bacillus polymyxa. While, available phosphorus was clearly heightened as affected by applying each of 5 ton compost/fed and inoculated by mixture of Bacillus polymyxa and Saccharomyces cerevisiae. At the maturity, the highest significant increment of protein concentration in wheat grains and straw were realized by applying 5 ton compost, 100% of the recommended nitrogen dose and inoculated by Bacillus polymyxa. While, the maximum value of phosphorous concentration in wheat grains was attained by applying 5 ton compost, 50% of the recommended nitrogen dose and inoculated by Saccharomyces cerevisiae. The highly significant increment of wheat grain yield was achieved by applying 5 ton compost, 100% of the recommended nitrogen dose and inoculated by Bacillus polymyxa. Although, the lowest one was obtained by applying no compost, 50% of the recommended nitrogen dose and no inoculated.

Key Words: ***Sandy soil, available NPK, compost, Bacillus polymyxa, Saccharomyces cerevisiae, wheat.***

INTRODUCTION

Most of newly reclaimed lands in Egypt are sandy or calcareous soils. Sandy soils are very poor in organic matter and plant nutrients. The importance of organic matter to agriculture on arid soils is second only to that of water. Organic materials can increase soil productivity by providing essential plant nutrients (Sommers, 1977; Fresquez *et al*., 1990) and by improving physical properties (Abu Sharar, 1993).

The improvement for some soil physical parameters were ameliorated as a result of organic manuring referring to control.(El-Sersawy *et al.*(1997). The maximum values of organic matter content, available nitrogen and available phosphorus were resulted in applying compost alone or mixed with biofertilizers to sandy soil (El-Sedfy,2002; Awad *et al*., 2003 and El-Sedfy *et al*., 2005)

On the other hand, the addition of organic manure individual or combined with biofertilizers reduced the values of hydraulic conductivity (El-Sedfy, 2002 and El-Sedfy *et al*., 2005).

A highly significant increase in nitrogen percent in each of grains, straw and whole plant over the control were resulted in nitrogen application. Also, the grain yield significantly increased with nitrogen application (El-Baisary *et al.(*1982).

Inoculation of wheat with diazotrophs resulted in a significant increase in all wheat growth and yield parameters when compared to those uninoculated treatments. The highest straw and grain yield as well as N-content were obtained in plants inoculated with a mixture of *Azospirillum brasilense* and *Bacillus polymyxa* (Al-Kahal *et al*.(2002) and Galal, (2003).

Tajnsek *et al*. (2001) recorded that maximum yield of arable crops were resulted by building up of nitrogen fertilization in organic fertilization systems. However, the high utilization of added N by maize was obtained by nitrogen fertilizers as compared to cattle manure (Chikowo *et al*.(2004), El-Sersawy *et al*. (1997) reported that biofertilization on both seeds and soil under 40 or 60 kg N/fed were the best supporters with organic manurin g in creating suitable soil structure. These treatments show corresponding improvements in microbial counts, azotobacters, azospirilla and phosphate dissolving bacteria and NPK uptake as w

ell, which were reflected on high grain and straw yields.

An objective of the present work is to study the impact of applying different sources of N-fertilization on soil nutrient availability and wheat growth.

MATERIALS AND METHODS

A field experiment was conducted at Ismailia Agric. Exp. Station through the winter season 2004/2005 to study the impact of organic, inorganic N-

fertilization and biofertilizers on NPK availability, some parameters of wheat growth and grain yield. The experiment was laid out in a split split design with three replications. Organic fertilizer was placed in the main plots, while N-fertilizer in the sub plots. Biofertilizers was in the sub sub plots. Some physical and chemical characteristics of the soil surface under investigation as well as compost analyses were determined according to Jackson, 1967 and shown in Tables (1-2).

The treatments were

Organic fertilizers:

1. **No compost**
2. **5 ton compost/fed. added before planting**

Nitrogen fertilizers:

1. **100% of the recommended dose (100 kg N/fed), N1**
2. **75% of the recommended dose (75 kg N/fed), N2**
3. **50% of the recommended dose (50 kg N/fed), N3**

Inoculation:

- **Uninoculated (Bio 1)**
- **Inoculated with Bacillus inoculant (Bio 2):-**

Bacillus polymyxa **(local strain) was cultured on nutrient both media and incubated in incubator at 28 °C. Liquid culture (1 x 10^8 cfu)**

Table (1): Mechanical and chemical analysis of the investigated soil.

Particle size distribution						
Coarse sand%	Fine sand%	Silt %	Clay %	$CaCO_3$ %	O.M %	Texture class
73.61	15.23	0.34	10.82	0.28	0.40	Sand

Chemical analysis											
pH (1:2.5)	EC dSm^{-1}	Sp (%)	Cations (meq/L)				Anions (meq/L)				
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3=	HCO_3^-	Cl-	$SO_4^=$
8.04	0.39	20	0.24	0.32	2.62	0.24	-	0.21	0.32	2.89

Available N (ppm)	Available P (ppm)	Available K (ppm)
15.0	8.0	49.5

Table (2): Compost manure analysis

Analysis	Measurement
Moisture %	33.51
pH (1:10)	6.51
EC (1:10)dS/m	4.58
$N\text{-}NH_4$(ppm)	100
$N\text{-}NO_3$(ppm)	20
Total N %	1.37
O.M.%	37.56
O.C %	21.79
Ash %	62.4
C/N ratio	15.5:1
Total P %	0.24
Total K %	0.61

was added to salied carrier consisting of vermiculite and peat – wheat grains was inoculated by seed dressing by using the Arabic gum as adhesive materials at rate of 400 g/60 kg grains.

- Inoculated with yeast inoculum (Bio 3)

Saccharomyces cerevisiae was cultured on glucose nutrient broth medium and inoculated at 28 °C. Culture (1 x 10^9) was used as liquid at rate of 20 L/fed.

- Inoculated with mixture of *Bacillus polymyxa* and *Saccharomyces cerevisiae* (Bio 4)

The biofertilizers was prepared by adding equal amounts of the microorganisms to a carrier material. Wheat grains were carefully mixed with *Bacillus polymyxa, Saccharomyces cerevisiae* and mixture of them and gum and then spread on a plastic sheet away from direct sun light for a short time before planting.

Wheat grains (*Triticum vulgar*e) c.v. Giza 168 were sown on 15th November 2004. Every two weeks, beginning the second week after sowing, four equal doses of nitrogen fertilizers as ammonium sulphate (20.6 N %) were added to the soil.

At harvest time; 6 months after sowing, plants of each plot were cut, air dried, grain yield (kg/fed) and 1000 grain weight were achieved. Oven dried plant samples were analyzed for N, P and K as described by Chapman and Pratt (1961).

Soil samples were analyzed for available N, P and K according to the described by Dewis and Fraitas(1970). Organic carbon was determined by

modified Walkely-Black method (Jackson, 1967). Soil hydraulic conductivity was determined using undisturbed samples from the cores (Black, 1965).

Analysis of variance was statistically analyzed according to Snedecor and Cochran (1976) using SAS program (SAS Institute, 1982).

RESULTS AND DISCUSSION

1- Organic matter (%) and hydraulic conductivity (m/day) of soil as affected by different N fertilization sources:

Data in Table (3) demonstrate that the addition of 5 ton compost to the sandy soil increased the means value of organic matter concentration from 0.46 % to 0.59%. This increase is due to the high concentration of O.M. in the applied compost (37.56%), Table (2).

Table (3) Organic matter (O.M) and hydraulic conductivity (m/day) of soil as affected by different N-fertilization sources.

Organic fertilizer	N-fertilizers	Bio-fertilizer	K (m/day)	O.M %
No compost	50 %	Bio_1	2.50	0.37
		Bio_2	2.64	0.59
		Bio_3	2.72	0.42
		Bio_4	2.19	0.41
	75%	Bio_1	2.78	0.36
		Bio_2	3.97	0.58
		Bio_3	2.79	0.57
		Bio_4	2.76	0.44
	100%	Bio_1	2.85	0.38
		Bio_2	2.88	0.47
		Bio_3	2.89	0.46
		Bio_4	1.98	0.42
5 ton compost/fed	50 %	Bio_1	1.86	0.50
		Bio_2	2.00	0.67
		Bio_3	2.05	0.64
		Bio_4	1.78	0.57
	75 %	Bio_1	1.86	0.50
		Bio_2	1.93	0.68
		Bio_3	1.86	0.63
		Bio_4	2.00	0.52
	100 %	Bio_1	1.59	0.51
		Bio_2	1.95	0.66
		Bio_3	1.59	0.60
		Bio_4	1.48	0.54

It was noticed that the inoculation by *Bacillus polymyxa* (Bio 2), *Saccharomyces cerevisiae* (Bio 3) raised the means value of organic matter concentration of the studied sandy soil up to 0.61%, 0.55%, respectively, Table (3). This increase could be attributed to the activity of microorganisms of biofertilizer which enhanced the hydrolysis of applied compost and consequently the soil organic matter concentration increased, El-Sedfy (2002). Nitrogen fertilizers had no effect on soil organic matter concentration Table (3).

Data in Table (3) reveal that the high decrease of soil hydraulic conductivity (K) was obtained by applying 5 ton compost/fed. This decrease could be attributed to the creation of soil aggregates which led to increasing micro pores among sand particles. This explanation is in agreement with Moussa *et al*. (2000). Neither nitrogen fertilizers nor Rhizobium inoculation affected on soil hydraulic conductivity values, Table (3).

2- Available NPK of soil (ppm) as affected by different N-fertilization sources:

Data in Table (4) indicate that applying 100% of the recommended dose from nitrogen fertilizers heightened the means value of available N in the studied sandy soil from 21.3 ppm to 25.9 ppm as compared to applying 50% of the recommended N dose. This proves that applying high quantities of nitrogen fertilizers built up the nitrogen availability in soil. Whereas, applying 5 ton compost to sandy soil intensified means value of available N from 22.4 ppm to 24.6 ppm, Table (4). It's worthy to mention that the inoculation by either *Bacillus polymyxa* (Bio 2) or *Saccharomyces cerevisiae* (Bio 3) heightened the value of available N in the studied sandy soil from 20.6 ppm for Bio 1 to 26.2 ppm and 26.0ppm for Bio 2 and Bio 3, respectively, Table (4). This increase may be attributed to the activity of studied microorganisms on mineralization of applied compost. These results are corresponding with the results of El-Sedfy, 2002 and Awad *et al*., 2003.

Data in Table (4) show that applied compost intensified the values of available P for the studied sandy soil from 10.9 ppm to 18.4 ppm. This increase may be ascribed to the phosphorus content of applied compost, Table (2). Whenever, the application of 100% of the recommended dose from nitrogen fertilizers raised the available P values up to 16.3 ppm, Table (4).

This increase may be due to improving the soil fertility resulted from applied fertilizers. It's evident that biofertilizer inoculation of Bacillus polymyxa mixed with Saccharomyces cerevisiae markedly increased available P up to 17.8 ppm, Table (4). This increase may be ascribed to the symbiotic nitrogen fixing role in soil fertility (Neyra and Dobereiner, 1977).

Table (4): Available NPK of soil (ppm) as affected by different N-fertilization sources.

Organic fertilizer	N-fertilizers	Bio-fertilizer	N (ppm)	P (ppm)	K (ppm)
No compost	50 %	Bio_1	17.5	8.0	49.9
		Bio_2	22.9	11.6	68.6
		Bio_3	21.6	13.2	78.0
		Bio_4	18.9	10.0	54.9
	75%	Bio_1	20.2	6.6	52.7
		Bio_2	23.8	6.6	85.8
		Bio_3	25.6	10.0	68.6
		Bio_4	19.3	8.4	58.5
	100%	Bio_1	21.2	8.4	53.2
		Bio_2	28.2	13.2	85.8
		Bio_3	27.0	13.2	78.0
		Bio_4	22.2	21.6	68.6
5 ton compost/fed	50 %	Bio_1	19.3	20.0	54.0
		Bio_2	25.2	15.0	93.6
		Bio_3	23.8	16.6	68.6
		Bio_4	20.8	23.2	68.6
	75 %	Bio_1	22.2	17.7	58.0
		Bio_2	26.2	18.3	93.6
		Bio_3	28.2	12.8	78.0
		Bio_4	21.2	23.8	93.6
	100 %	Bio_1	23.3	19.3	58.5
		Bio_2	31.0	20.0	117.0
		Bio_3	29.7	12.8	109.0
		Bio_4	24.4	21.6	117.0

Data in Table (4) cleared that available K intensified from 66.9ppm to 84.1 ppm as a result of applying 5 ton compost to sandy soil. This increase may be due to the potassium content of the applied compost, Table (2). It was noticed that available K exceeded where the rate of nitrogen fertilizer addition increased from 50% to 100% of recommended dose, Table (4). While, the inoculation by *Bacillus polymyxa* and *Saccharomyces cerevisiae* heightened available K values up to 90.7 ppm and 80.1 ppm, respectively, Table (4).

3- Protein of wheat grains and straw as affected by different N fertilization sources.

The results in Table ($5_{1,2}$) show that the maximum values of protein concentration were resulted in wheat grains and straw receiving 5 ton compost /fed which recorded a significant increment against no compost.

The protein concentration of wheat grains and straw positively responded where the rate of nitrogen fertilizer addition was intensified from 50 to 100% of the recommended dose, Table ($5_{1,2}$). The results indicated that grains and straw of wheat plants receiving 100% of the recommended dose of nitrogen (100 kg N/fed) recorded highly significant increases in protein concentration of wheat grains and straw over that received 50% of the recommended nitrogen dose (50 kg N/fed). These results were corresponding with El-Sedfy *et al.*(2005).

The obtained results clearly revealed that the inoculation with *Bacillus polymyxa* significantly intensified the protein concentration of wheat grains and straw from 11.6, 3.77 to 15.1 and 7.46% in uninoculation and inoculated treatments, respectively, Table ($5_{1,2}$). While, the inoculation with *Saccharomyces cerevisiae* gave the lower values of protein concentration in wheat grains and straw as compared with *Bacillus polymyxa*. So, the inoculation with *Saccharomyces cerevisiae* significantly increased the protein concentration of wheat grains and straw from 11.6, 3.77 to 13.5 and 6.25% in uninoculation and inoculated treatments, respectively. These results may be elucidated by the ability of Azospirillum to fix nitrogen in rhizospher which is reflected by the increasing of available nitrogen in inoculated treatment (26.2 ppm) against the uninoculated one (20.6ppm). Moreover, it can be said that Azospirillum brasilense increases grain protein concentration through an increase in the uptake by the roots of planting. Fallik and Yaacove, 1996 and Saubidet *et al*.(2002).

Concerning the impact of interaction between organic manure and nitrogen fertilizers on protein concentration of wheat grains and straw, it was noticed that the maximum value of protein concentration attained by the interaction between addition of 5 ton compost and 100% of recommended nitrogen dose. However the minimum value of protein concentration obtained by the interaction between no compost and application of 50% of the recommended nitrogen dose.

Regarding the effect of interaction between organic manure and biofertilizer inoculation on protein concentration in wheat grains and straw, the highest value of protein concentration obtained by the interaction between additions of 5 ton compost and inoculated by *Bacillus polymyxa*. Although the lowest one was attained by the interaction between no compost and no inoculated.

Table (5): Protein% of wheat grains and straw as affected by different N-fertilization sources.

1- Protein of grains

Organic fertilizer	N-fertilization levels												Means of organic fert.
	50%				75%				100%				
	Inoculation												
	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	
No compost	10.7	13.4	12.6	11.7	11.0	13.8	12.7	12.0	11.5	15.6	13.3	12.7	12.6
5 ton compost	11.8	14.7	14.0	12.9	12.1	15.2	14.0	13.2	12.7	18.05	14.6	14.0	13.9
Means of N levels	12.7				13.0				14.06				

Means of Bio_1= 11.6, Bio_2=15.1, Bio_3=13.5, Bio_4= 12.8

L.S.D. at 5% for:

Organic fertilizers = 0.053
Inorganic-N = 0.093
Inoculation = 0.047
Organic fertilizer x Inorganic-N = 0.107
Organic fertilizer x Inoculation = 0.054
Inorganic-N x Inoculation = 0.066
Organic fertilizer x Inorganic-N x Inoculation = 0.094

2- Protein of straw

Organic fertilizer	N-fertilization levels												Means of organic fert.
	50%				75%				100%				
	Inoculation												
	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	
No compost	3.32	6.45	4.93	4.47	3.49	7.22	5.90	5.11	3.97	7.65	7.02	6.45	5.50
5 ton compost	3.65	7.10	5.42	4.92	3.84	7.94	6.49	5.62	4.37	8.42	7.72	7.10	6.05
Means of N levels	5.03				5.70				6.59				

Means of Bio_1= 3.77, Bio_2=7.46, Bio_3=6.25, Bio_4=5.61

L.S.D. at 5% for:

Organic fertilizers = 0.032
Inorganic-N = 0.094
Inoculation = 0.070
Organic fertilizer x Inorganic-N = 0.109
Organic fertilizer x Inoculation = 0.080
Inorganic-N x Inoculation = 0.099
Organic fertilizer x Inorganic-N x Inoculation = 0.139

The statistical analysis show that the highest significant effect of the interaction between nitrogen treatments and biofertilizer inoculation on protein concentration in wheat grains and straw obtained by addition of 100% of recommended nitrogen dose and inoculated by *Bacillus polymyxa*. Whenever, the minimum value of protein concentration attained by the interaction between application of 50% of the recommended nitrogen dose and no inoculated.

In regard to the effect of interaction between organic manure, nitrogen fertilizer and biofertilizer inoculation on protein concentration in wheat grains and straw, it was found that highly significant of protein concentration obtained by applying 5 ton compost, 100% of the recommended nitrogen dose and inoculated by *Bacillus polymyxa*.

However, the lowest one obtained by applying no compost, 50% of the recommended nitrogen dose and no inoculated.

4- Phosphorus concentration (%) of wheat grains and straw as affected by different N fertilization sources.

Data in Tables ($6_{1,2}$) cleared that the application of 5 ton compost/fed significantly intensified phosphorus concentration of wheat grains and straw against no compost. This increment may be attributed to high value of available phosphorus in soil treated by 5 ton compost/fed than no compost, Table (4).

Table (6): Phosphorus concentration (%) of wheat grains and straw as affected by different N-fertilization sources.

1- Phosphorus concentration (%) of grains

<table>
<tr><th rowspan="4">Organic fertilizer</th><th colspan="12">N-fertilization levels</th><th rowspan="4">Means of organic fert.</th></tr>
<tr><th colspan="4">50%</th><th colspan="4">75%</th><th colspan="4">100%</th></tr>
<tr><th colspan="12">Inoculation</th></tr>
<tr><th>Bio_1</th><th>Bio_2</th><th>Bio_3</th><th>Bio_4</th><th>Bio_1</th><th>Bio_2</th><th>Bio_3</th><th>Bio_4</th><th>Bio_1</th><th>Bio_2</th><th>Bio_3</th><th>Bio_4</th></tr>
<tr><td>No compost</td><td>0.49</td><td>0.59</td><td>0.62</td><td>0.60</td><td>0.47</td><td>0.63</td><td>0.62</td><td>0.68</td><td>0.44</td><td>0.62</td><td>0.65</td><td>0.61</td><td>0.59</td></tr>
<tr><td>5 ton compost</td><td>0.59</td><td>0.72</td><td>0.77</td><td>0.73</td><td>0.58</td><td>0.71</td><td>0.72</td><td>0.75</td><td>0.57</td><td>0.72</td><td>0.76</td><td>0.75</td><td>0.70</td></tr>
<tr><td>Means of N levels</td><td colspan="4">0.64</td><td colspan="4">0.65</td><td colspan="5">0.64</td></tr>
<tr><td colspan="14">Means of Bio_1= 0.52, Bio_2=0.67, Bio_3=0.69, Bio_4=0.69
L.S.D. at 5% for:
Organic fertilizers = 0.069
Inorganic-N = 0.023
Inoculation = 0.021
Organic fertilizer x Inorganic-N = 0.026
Organic fertilizer x Inoculation = 0.021
N-requirements x Inoculation = 0.029
Organic fertilizer x Inorganic-N x Inoculation = 0.042</td></tr>
</table>

2- Phosphorus concentration (%) of straw

Organic fertilizer	N-fertilization levels												Means of organic fert.
	50%				75%				100%				
	Inoculation												
	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	
No compost	0.43	0.83	0.70	0.82	0.37	0.77	0.76	0.94	0.34	0.56	0.79	0.97	0.69
5 ton compost	0.67	0.96	0.78	0.95	0.68	0.85	0.87	0.93	0.67	0.99	0.96	0.97	0.86
Means of N levels	0.77				0.77				0.78				

Means of Bio_1= 0.53, Bio_2=0.83, Bio_3=0.81, Bio_4= 0.93
L.S.D. at 5% for:
Organic fertilizers = 0.016
Inorganic-N = 0.018
Inoculation = 0.026
Organic fertilizer x Inorganic-N = 0.021
Organic fertilizer x Inoculation = 0.030
N-requirements x Inoculation = 0.037
Organic fertilizer x Inorganic-N x Inoculation = 0.052

It was observed that phosphorus concentration of wheat grains and straw didn't affect where the rate of applied nitrogen fertilizers increased from 50% to 100% of the recommended nitrogen dose, Table ($6_{1,2}$). It's evident that biofertilizer inoculation of *Bacillus polymyxa* mixed with *Saccharomyces cerevisiae* (Bio_4), markedly increased available P from 13.6ppm for no inoculated (Bio_1) to 17.8 ppm for Bio_4. Therefore, the highly significant increment of P concentration of wheat grains and straw were attained by *Bacillus polymyxa* mixed with *Saccharomyces cerevisiae* (Bio_4), Table ($6_{1,2}$).

Regarding the effect of interaction between organic manure and biofertilizer inoculation on P concentration in wheat grains and straw It was observed that the highly significant increment of P concentration in wheat straw was obtained by the interaction between addition of 5 ton compost and inoculated by *Bacillus polymyxa* mixed with *Saccharomyces cerevisiae*. While, the highest values of P concentration in wheat grains were attained by the interaction between additions of 5 ton compost and inoculated with *Saccharomyces cerevisiae* (Bio_3)

The statistical analysis show that the highest significant effect of the interaction between nitrogen treatments and biofertilizer inoculation on P

concentration in wheat grains was attained by addition of 75% of the recommended nitrogen dose and inoculated by *Bacillus polymyxa* mixed with *Saccharomyces cerevisiae*.

In regard to the effect of interaction between organic manure, nitrogen fertilizers and biofertilizer inoculation on P concentration in wheat grains, it was found that highly significant of P concentration of wheat was attained by applying 5 ton compost, 50% of the recommended nitrogen dose and inoculated by *Saccharomyces cerevisiae*.

5- Potassium concentration (%) of wheat grains and straw as affected by different N fertilization sources.

Data in table ($7_{1,2}$) cleared that insignificant increase of potassium concentration of wheat straw was achieved by applying 5 ton compost/fed against no compost. This increment may be elucidated to high value of available potassium in soil treated by 5 ton compost/fed than no compost, Table (4). However, the results in Table (7) appeared that grains of wheat plants receiving 5 ton compost/fed gave the lower value of potassium concentration than no compost.

Data in Table (7) reveal that significant decrease of K was realized where the rate of applied nitrogen fertilizer increased from 50% to 100% of the recommended nitrogen dose. Highly significant increment of potassium concentration in wheat grains and straw were attained by inoculating with *Bacillus polymyxa*, followed by inoculating with *Saccharomyces cerevisiae*, Table ($7_{1,2}$). This increment of potassium concentration may be ascribed to high values of available potassium in inoculated treatments, Table (4).

Table (7): Potassium concentration(%) of wheat grains and straw as affected by different N-fertilization sources.

1- Potassium concentration(%) of grains

Organic fertilizer	N-fertilization levels												Means of organic fert.
	50%				75%				100%				
	Inoculation												
	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	
No compost	0.43	0.59	0.53	0.55	0.41	0.64	0.56	0.49	0.39	0.49	0.39	0.42	0.49
5 ton compost	0.39	0.48	0.53	0.50	0.41	0.50	0.48	0.48	0.42	0.47	0.56	0.50	0.48
Means of N levels	0.50				0.50				0.46				

Means of Bio_1= 0.41, Bio_2=0.53, Bio_3=0.51, Bio_4= 0.49
L.S.D. at 5% for:Organic fertilizers = 0.106
Inorganic-N = 0.015
Inoculation = 0.020
Organic fertilizer x Inorganic-N = 0.017
Organic fertilizer x Inoculation = 0.020
Inorganic-N x Inoculation = 0.028
Organic fertilizer x Inorganic-N x Inoculation = 0.039

2- Potassium concentration (%) of straw

Organic fertilizer	N-fertilization levels												Means of organic fert.
	50%				75%				100%				
	Inoculation												
	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	
No compost	1.00	1.68	1.52	1.16	1.21	1.33	1.56	1.56	1.02	1.44	1.17	1.11	1.31
5 ton compost	1.15	1.54	1.23	1.40	1.13	1.33	1.74	1.48	1.09	1.64	1.39	1.16	1.36
Means of N levels	1.34				1.42				1.25				

Means of Bio_1= 1.1, Bio_2=1.49, Bio_3=1.44, Bio_4= 1.31
L.S.D. at 5% for:Organic fertilizers = 0.143
Inorganic-N = 0.059
Inoculation = 0.042
Organic fertilizer x Inorganic-N = 0.068
Organic fertilizer x Inoculation = 0.048
Inorganic-N x Inoculation = 0.059
Organic fertilizer x Inorganic-N x Inoculation = 0.084

Concerning the impact of interaction between organic manure and nitrogen fertilizer on potassium concentration of wheat straw, applying 5 ton compost and 75% of the recommended nitrogen dose gave the highly significant increment of potassium concentration in wheat straw.

Regarding the effect of interaction between organic manure and biofertilizer inoculation on potassium concentration of wheat grains, it's appeared that the highly significant increment of potassium concentration in wheat grains was attained by applying no compost and inoculated with *Bacillus polymyxa*. However, the highest value of potassium concentration of wheat straw was attained by applying 5 ton compost and inoculated with *Bacillus polymyxa*.

Highly significant increment of potassium concentration in wheat grains was attained by the interaction between applying 75% of the recommended nitrogen dose and inoculated with *Bacillus polymyxa*. However, the interaction between applying 75% of the recommended nitrogen dose and inoculated with *Saccharomyces cerevisiae* gave the highly significant increment of potassium concentration in wheat straw.

In regard to the effect of interaction between organic manure, nitrogen fertilizer and inoculated with *Bacillus polymyxa* on potassium concentration of wheat grains, the highly significant increment of potassium concentration was attained by applying 75% of the recommended nitrogen dose, inoculated with *Bacillus polymyxa* and applying 5 ton compost. However, the interaction between applying 5 ton compost, inoculated with *Bacillus polymyxa* and applying 50% or 75% of the recommended nitrogen dose obtained the highly significant increment of potassium concentration in wheat straw.

6- Wheat grain yield (kg/fed) and 1000 grain weight as affected by different N fertilization sources.

Data in Tables (8 and 9) demonstrate that wheat grain plants receiving 5 ton compost/fed had higher significant of each wheat grain yield and 1000 grain weight (g) than no compost treatment. This increment may be ascribed to improve some soil physical properties such as organic matter and soil hydraulic conductivity for the studied sandy soil, Table (3). Moreover, the applied compost intensified the soil availability of NPK and consequently the protein and phosphorus concentrations of wheat grains, Tables (4, 5 and 6). These results are coinciding with those obtained by El-Sedfy, 2002.

It's worthy to mention that the wheat grain yield as well as 1000 grain weight were positive by responded where the rate of nitrogen fertilizer addition was intensified from 50% to 100% of recommended dose, Tables (8 and 9). This increment may be ascribed to high values of available N in soil treated with 100% of recommended nitrogen dose as compared to those

which dealed with 50% of the recommended nitrogen dose, Table (4). Besides, the highly significant increment of protein concentration was obtained by applying 100% of the recommended nitrogen dose, Table (5). These results were corresponding with El-Sedfy *et al*. (2005).

The obtained results clearly revealed that the inoculation with *Bacillus polymyxa* significantly increased the wheat grain yield from 1945.6 to 2342.6 kg/fed in uninoculation and inoculated treatments, respectively. This increment may be attributed to high values of available NPK for studied sandy soil, Table (4). In addition to, highly significant increment of protein, phosphorus and potassium concentrations in wheat grains were attained by inoculating with *Bacillus polymyxa*, Tables (5, 6 and 7). In the fact, there have been many reports on the effects of the inoculation with Azospirillum spp. on cereals growth and yield (Okon and Lavandera-Gonzalez,1994). It has been suggested that Azospirillum ssp. benefits the host plant producing growth regulators that increase root growth and improving growth, improving soil exploration for nutrients.(Okon and Kapulnik, 1986). However, Saubidet *et al*.(2002) concluded that the observed increase in plant growth is not because of a better soil exploration, but a specific effect on the shoot growth.

Concerning the effect of interaction between organic manure and nitrogen fertilizers on wheat grain yield and 1000 grain weight, the statistical analysis showed that maximum values of wheat grain yield and 1000 grain weight were obtained by applying 5 ton compost and 100% of the recommended nitrogen dose. On the opposite, applying no compost and 50% of the recommended nitrogen dose gave the minimum values of wheat grain yield and 1000 grain weight.

The highly significant increment of wheat grain yield and 1000 grain weight were realized when adding 5 ton compost and inoculation by *Bacillus polymyxa*. However, applying no compost and no inoculation gave the lowest values of wheat grain yield and 1000 grain weight.

Regarding the effect of interaction between nitrogen fertilizer and biofertilizer inoculation on wheat grain yield and 1000 grain weight, the statistical analysis reveal that the application of 100% of the recommended nitrogen dose and inoculation by *Bacillus polymyxa* recorded the highly significant increment of wheat grain yield and 1000 grain weight. On the other side, applying 50% of the recommended nitrogen dose and no inoculation recorded the least values of wheat grain yield and 1000 grain weight.

Table (8): Wheat grain yield (kg/fed) as affected by different N-fertilization sources.

Organic fertilizer	N-fertilization levels												Means of organic fert.
	50%				75%				100%				
	Inoculation												
	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	
No compost	1485.7	1646.0	1569.7	1532.0	1650.7	1821.3	1770.7	1740.0	1942.3	2362.7	2334.3	2312.0	1847.3
5 ton compost	1970.7	2463.7	2344.0	2222.0	2189.7	2728.0	2665.7	2452.3	2434.7	3034.0	2964.0	2724.7	2516.1
Means of N levels	1904.2				2127.3				2513.6				

Means of Bio_1= 1945.6, Bio_2=2342.6, Bio_3=2274.7, Bio_4=2163.8

L.S.D. at 5% for:

Organic fertilizers = 20.9

Inorganic-N = 12.5

Inoculation = 16.4

Organic fertilizer x Inorganic-N = 17.6

Organic fertilizer x Inoculation = 23.1

Inorganic-N x Inoculation = 28.4

Organic fertilizer x Inorganic-N x Inoculation = 40.0

Table (9): 1000 grain weight (g) of wheat as affected by different N-fertilization sources.

Organic fertilizer	N-fertilization levels												Means of organic fert.
	50%				75%				100%				
	Inoculation												
	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	Bio_1	Bio_2	Bio_3	Bio_4	
No compost	25.5	42.1	37.7	32.4	29.3	44.7	39.8	36.0	29.7	49.6	44.2	40.0	37.6
5 ton compost	29.4	46.1	42.3	38.4	32.6	52.0	46.5	41.3	32.7	56.2	52.1	46.8	43.0
Means of N levels	36.7				40.3				43.9				

Means of Bio_1=29.9, Bio_2=48.5, Bio_3=43.8, Bio_4= 39.2

L.S.D. at 5% for:

Organic fertilizers = 1.217
Inorganic-N = 0.528
Inoculation = 0.710
Organic fertilizer x Inorganic-N = 0.75
Organic fertilizer x Inoculation = 1.00
Inorganic-N x Inoculation = 1.29
Organic fertilizer x Inorganic-N x Inoculation = 1.74

In regard to the effect of interaction between organic manure, nitrogen fertilizers and biofertilizer inoculation on wheat grain and 1000 grain weight, the statistical analysis show that the highly significant increment of wheat grain and 1000 grain weight were achieved by applying 5 ton compost, 100% of the recommended nitrogen dose and inoculated by *Bacillus polymyxa*. Although, the minimum values of wheat yield and 1000 grain weight were attained by applying no compost, 50% of the recommended nitrogen dose and no inoculated.

From the obvious results, it could be recommended to apply 5 ton compost, 100% of the recommended nitrogen dose and inoculated by *Bacillus polymyxa* in order to improve some soil physical properties and maximize the soil nitrogen availability and wheat grain yield.

REFERENCES

Abu-Sharar, T. M. (1993). Effects of sewage sludge treatments on aggregate slaking, clay dispersion and hydraulic conductivity of semi-arid soil sample. Geoderma 59, 327.

Al- Kahal, A. A.; G. A. A. Mekhemar and S. M. Ahmed (2002). Effect of diazotrophs inoculation on performance of wheat plants amended with different levels of olive wastes. Annals Agric. Sci. Ain Shams Univ. Cairo, 47(1):123-138.

Awad, Y. H.; H. A. Ahmed and O. F. El-Sedfy (2003). Some chemical properties and NPK availability of sandy soil and yield productivity as affected by some soil organic amendments. Egypt. J. Appli. Sci; 18(2):356-365.

Black, C. A. (1965). Methods of Soil Analysis. Part 1. Am. Soc. Agron. Agronomy No. Madison Wisconsim.

Chapman, H. D. and P. F. Pratt (1961). Methods of Analysis for Soils, Plants and Waters. Agric. Pub. Univ. of California Riverside.

Chikowo, R.; P. Mapfume; P. Nyamugafata and K. E. Giller (2004). Maize productivity and mineral N dynamics following different soil fertility management practices on a depleted sandy soil in Zimbalwe Agriculture. Ecosystems and Environment V(102)Issue 2:119-131.

Dewis, J. and F. Fraitas (1970). Physical and Chemical methods of Soil and Water Analysis. Food and Agriculture Organization of the United Nations, Rome.

El- Baisary, E. M.; M. A. Negm and E. M. Abd-El-Naim (1982). A study on nitrogen application to wheat (*Triticum vulgare*) in calcareous soils. Agricultural Research Review. 60(5):179-196.

El-Sedfy, O. F. (2002). Effect of bentonite, compost and biofertilizers additions on some physical properties of sandy soil and wheat and peanut yields. J. Agric. Sci. Mansoura Univ., 27(10):7117-7126.

El-Sedfy, O. F.; A. M. M. Biomy and A. A. Badawy(2005). Response of maize to Bio, organic and nitrogen fertilization in sandy soil. Egypt. J. of Appl. Sci., 20(11):269-284.

El-Sersawy, M. M. ; Bouthaina F. Abd El-Ghany; K.W. Khalil and S. Y. Awadalla (1997). Interaction between organic manure mixtures, applied N-level and biofertilization on calcareous soil properties and wheat production in Wadi Suder, South Sinai. Egypt. J. Soil Sci. 37(3):367-397.

Fallik, E. and O. Yaacov(1996). Inoculation of Azospirillum brasilensei biomass production, survival and growth promotion of setaria italica and Zea mays. Soil Biol. Biochem. 28:123-126.

Fresquez, P. R.; Francis, R. E. and G. L. Dennis (1990). Sewage sludge effects on soil and plant quality in a degraded semi-arid grassland. J. Environ.Qual. 19,324.

Galal, Y. G. M.(2003). Assessment of nitrogen availability to wheat (*Triticum aestivum* L.) from inorganic and organic N sources as affected by Azospirillum. Egypt. J. Microbiol. 38(1):57-73.

Jackson, M. L. (1967). Soil Chemical Analysis. Prentice Hall of India Private Limited, New Delhi.

Jllick, B. R. (1995). The enhancement of plant growth by free-living bacteria. Can. J. Microbiol. 41:109-117.

Moussa, S. A.; A. Sakina; M.M.M. Abdel-Ghani and Y. H. Awad (2000). Efficiency use of algifert bio-fertilizer on cucumber production and some sandy soil properties. J. Agric. Sci. Mansoura Univ., 25(8):5527-5532.

Neyra, C. A. and J. Dobereiner (1977). Nitrogen fixation in grasses. Adv. Agron. 29,1.

Okon, Y. and C. A. Lavandera-Gonzalez (1994). Agronomic applications of Azospirillum an evaluation of 20 years worldwide field inoculation. Soil Biol. Biochem. 26,1591-1601.

Okon, Y. and Y. Kapylnik (1986). Development and function of Azospirillum-inoculated roots. Plant and Soil. 90,3-16.

SAS Institute (1982). SAS User's guide: Statistics SAS Institute, Inc., Raleigh, NC, pp.84.

Saubidet, M. I.; F. Nora and A. J. Barneix (2002). The effect of inoculation with *Azospirillum brasilense* on growth and nitrogen utilization by wheat plants. Plant and Soil, 245:215-222.

Snedecor, G. W. and W. G. Cochran (1976). Statistical Methods 6th ed., Iowa State Univ. Press, Iowa, USA.

Sommers, L. E. (1977). Chemical composition of sewage sludges and analysis of their potential use as fertilizers. J. Env. Qual. 6, 225.

Tajnsck, A.; I. Santavec and B. C. Breznik (2001). The influence of production system and nitrogen fertilization rate and economical and ecological parameters of arable crops in a three year crop rotation. Archives of Agronomy & Soil Science (47)5/6:409.

أثر إضافة مصادر مختلفة من التسميد النتروجينى على تيسر العناصر الكبرى ومحصول القمح

أسامه محمد فتحي الصدفي – وليد محمود الفرغل – عبد الرحيم بدوى

معهد بحوث الأراضي والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر

الملخص العربى

أقيمت تجربة حقلية فى محطة البحوث الزراعية بالإسماعيلية خلال موسم الشتاء ٢٠٠٤ /٢٠٠٥ لدراسة أثر إضافة الكمبوست كسماد عضوي والتسميد النتروجينى المعدني والتسميد الحيوي على تيسر عناصر النتروجين ، الفوسفور ، البوتاسيوم في التربة وعلى محصول حبوب القمح وكان تصميم التجربة قطع منشقة مرتين.

وأضيفت المعاملات الأرضية على النحو التالي قبل الزراعة :-

التسميد العضوي – بدون تسميد عضوي ، ٥ طن كمبوست / فدان

التسميد النتروجينى ٥٠% ، ٧٥% ، ١٠٠% من الاحتياجات النتروجينية الموصى بها

التسميد الحيوي : استخدمت أربعة أنواع من التلقيح البكتيري : –

١– بدون تلقيح بكتيري

٢– تلقيح البذور ببكتريا *Bacillus polymyxa*

٣– تلقيح البذور بالخميرة*Saccharomyces cerevisiae*

٤– تلقيح البذور بخليط من البكتريا والخميرة

Mixture of Bacillus polymyxa and Saccharomyces cerevisiae

وزرعت حبوب القمح صنف جيزة ١٦٨ في ١٥ نوفمبر سنة ٢٠٠٤ وبعد ٦ شهور من الزراعة تم الحصاد وقدر محصول الحبوب للقمح ومن أهم النتائج المتحصل عليها :-

- أن إضافة ٥ طن كمبوست / فدان للأرض الرملية زادت المادة العضوية من ٠.٤٦ الى ٠.٥٩ % ومن جهة أخرى أدت هذه الإضافة إلى خفض قيمة التوصيل الهيدروليكي من ٢.٧٥ إلى ١.٨٣ متر / يوم.
- ارتفعت قيم النتروجين الميسر ، البوتاسيوم الميسر في الأرض الرملية نتيجة لإضافة أي من ٥ طن كمبوست/فدان ،تلقيح البذور ببكتريا ***Bacillus polymyxa***
- في حين أن قيم الفوسفور الميسر زادت زيادة واضحة نتيجة لإضافة أي من ٥ طن كمبوست / فدان ، تلقيح البذور بخليط من بكتريا ***Saccharomyces cerevisiae*** والخميرة ***Bacillus polymyxa***
- في مرحلة النضج زادت نسبة البروتين فى كل من حبوب القمح ، القش زيادة معنوية نتيجة لإضافة أي من ٥ طن كمبوست / فدان ، ١٠٠% من الاحتياجات النتروجينية الموصى بها ، تلقيح القمح ببكتريا ***Bacillus polymyxa*** بينما كان أعلى قيمة التركيز الفوسفور في حبوب القمح أمكن الحصول عليها نتيجة لإضافة أي من ٥طن كمبوست/فدان ،٥٠%من الاحتياجات النتروجينية الموصى بها وتلقيح بذور القمح بالخميرة ***Saccharomyces cerevisiae***
- أمكن الحصول على أعلى زيادة معنوية لمحصول حبوب القمح نتيجة لإضافة أي من ٥طن كمبوست/ فدان ، ١٠٠% من الاحتياجات النتروجنية ، تلقيح البذور ببكتريا ***Bacillus polymyxa*** بينما كان أقل محصول لحبوب القمح أمكن الحصول عليه بإضافة أي من بدون سماد عضوي ، ٥٠% من الاحتياجات النتروجنية الموصى بها ، بدون تلقيح بكتيري لبذور القمح
- مما سبق يمكن أن نوصى بإضافة ٥ طن كمبوست / فدان لتحسين بعض خواص التربة الطبيعية في الأرض الرملية المدروسة وكذلك إضافة ١٠٠% من الاحتياجات النتروجينية الموصى بها وتلقيح بذور القمح ***Bacillus polymyxa*** من أجل الحصول على أقصى تركيز من النتروجين الميسر وأعلى محصول حبوب القمح.