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EFFECT OF INORGANIC, ORGANIC AND BIO-FERTILIZER ON WHEAT PLANT GROWN IN NEW CULTIVATED LAND

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ABSTRACT: Two pot experiments were carried out during the two seasons of 2002 / 2003 and 2003 / 2004 to study the effect of inoculation by *Azotobacter and Azoaspirillum* combined with inorganic fertilizer (ammonium sulphate) or organic manure on the growth and yield of wheat plants. The results of this study showed that CO_2, NH_4 – N, P and K evolved, generally, increased with increasing organic manure and inoculation. A high by significant values were obtained with compost manure (50 Kg N / fed) + ammonium sulphat + inoculation, compared with application of inorganic manure. Generally, NH_4–N was increased in soil with stages growth by application of organic manure + inoculation .On the other hand , the maximum weight of straw grains (g/pot)were found with compost (50 kg N) + inoculation treatment. Whereas, the maximum plant height was recorded with ammonium sulphat (50kgN/fed) + inoculation treatment. The obtained results showed that addition of composted manure (50 kg N / fed) + inoculation gave higher values of N, Pand K uptake than the full dose (100 kg N / fed) of inorganic N – fertilizer or organic manure.

Key words: Composted manure, ammonium sulphate, bio-fertilizer.

INTRODUCTION

Wheat is considered as the most important cereal crop cultivated in Egypt. Most of the yield is coming from the fertile clay soil in the Nile valley and Delta. Plant is recently made to increase the production of wheat through horizontal expansion in sandy soils. Bio-fertilization with nitrogen fixers gave an appreciable improvement in the growth and yield of different plants. EL – Demerdash (1994) found that half of the recommended field rate of

added inorganic N – fertilizer can be saved by seed inoculation with a symbiotic N_2 – fixers. Zaghloul (1999) showed that caraway seed inoculation with *Azotobacter chrococcum* and provided with the half dose of inorganic N – fertilizer gave the highest values of N,P and total carbohydrates compared with other treatments. But caraway seed inoculation with *Azospirillum lipoferum* and provided with the half dose of inorganic N-fertilizer gave higher values of K percentage than other treatment. Nasef *et al* (2004) showed that application of com-post manure to soil improved physical, chemical and biological properties of these soils and, hence, increased their productivity.

The present study aims to investigate the effect of inoculation with a symbiotic N_2–fixers i.e. *Azotobacter or Azosperillum lpoferum*, ammonium sulphate fertilizer and composted manure on growth and yield of wheat plants, grown on sandy soil.

MATERIALS AND METHODS

Sandy soil was collected from surface (0- 30 cm)of a desert soil (about 40–Km from Cairo-Ismailia road). Soil was air – dried, passed through a 2 mm sieve and mixed thoroughly. Some physical and chemical properties of the soil were determined according to Black (1965) and shown in Table 1.

Organic manures used in this experiment was a compost contains rice straw and farmyard manure with the ratio of (1:2), respectively, incorporated for 6 weeks before sowing wheat. Chemical analyses of the tested compost were carried out according to Brumer and Wasner. (1987), as shown in Table 2. The compost was added before sowing at a rate of 100 Kg N / fed. While, the inorganic nitrogen fertilizer used in this experiment was ammonium sulphate (AS) $(NH_4)_2 SO_4$ (20.6 % N) added at a rate of 100 Kg N / fed in three equal doses i.e. at sowing, after 30 and 120 days from sowing. Inoculants (*Azotobacter chromium and Azospirillum lipoferum)* were provided from the soil microbiology, unit Soils, Water and Environments Res. Instit. Agric. Res. Center Giza, Egypt.

Seeds of wheat were successfully washed with water and air dried.Thereafter, seeds were soaked in cell suspension of *A-chrococcum* or *A - lipoferum* (1ml10^8 viable cell) for 30 min. The inoculated seeds were air dried at room temperature for one hour before Sowing. Two pot

experiments were carried out under greenhouse condition using wheat *(Triticum aestivum CV sakha 69)* were sown in pots on 2002 / 2003 and 2003/2004.seasons Earthenware pots of 8 Kg soil capacity were filled up with the soil to give the following treatments.

1. Control (without any fertilizer treatment)
2. Ammonium sulphate (100kg N/Fed =0.8 g N/ pot)
3. Compost (100kgN/ Fed = 53.3 g compost / pot)

4-inoculation *(Azotobacter + Azospirlium)*

5-Ammonium sulphate (50kgN-/Fed) +inoculation.

6-Compost (50kg N/Fed= 26.6 g N / pot) + inoculation

Table 1. Some physical and chemical characteristics of the used soil

Particle size distribution	
Coarse sand	82.84 %
Fine sand	8. 37%
Silt	3.18 %
Clay	5.61 %
Textural class	sand
Organic matter	0.03 %
Calcium Carbonates	0.67 %
pH (in soil Paste)	7.90
EC (in saturated soil paste extract)	2.1 ds/m

Soluble ions in soil paste extract (mmol / L)							
Cations				**Anions**			
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-2}	HCO_3^{-}	Cl^{-}	SO_4^{-2}
8.2	2.6	10.3	0.5	0.0	2.0	14.0	5.6
AB*- DTPAextractable micronutrients (Ug g^{-1} Soil)							
Fe	Mn	Zn	Cu				
10.0	0.2	0.1	1.0				

AB: Ammonium bicarbonate

Table 2 . Analysis of compost.

Parameters	Value	Parameters	Value
Ec dS / m / 25 C°	4.0	**Available micronutrients**	
pH (1 : 2 . 5)	7.2	**(ug g^{-1} soil)**	
Organic mater	49.9 %		
Organic carbon	30.36	**Iran**	30.0
Total nitrogen	1.5 %	**Manganese**	29.8
C / N ratio	20.24	**Zinc**	10.8
Total phosphorus	0.70 %	**Copper**	4.6
Total potassium	0.91 %		

7. Compost (50KgN) +AS (50 Kg N) +Inoculation
8. Compost (50KgN) + AS (50 Kg N/ Fed).
9. Compost (50KgN) + AS (25 Kg N) +Inoculation.

All treatments were carried out in a randomized complete blocks design with four replicates for each

Treatment: Each pot received 1.5 g super phosphate and 2g potassium sulphate before sowing.

Five plants per pot. Pots were watered daily with distilled water to maintain their soil moisture content at about 60%of the saturation percentage.

Soil samples were taken for determinations after 0.0, 40, 90and 160 days from sowing. The soil samples were microbiologically analyzed for carbon dioxide output from soil using the method of Antoun and Jensen (1979). Also, rhizosphere soil samples were chemically analyzed for NH4–N and Residual available potassium and phosphorus. Ammonia nitrogen was determined according to Bremnes and Keeny (1965). Available phosphorus was extracted from soil according to Olsen et al (1954) and colorimetric determined to American public Health Association (APHA, 1989). Available Potassium was determined according to Chapman and Pratt (1961) by flame photometer.

Plant samples were taken after 160 days from planting, washed with tap water and distilled water, and oven dried at 70 °C. Dry matter yield was recorded and samples were ground, kept in clean poly ethylenenitrogen, potassium and phosphorus. Total nitrogen in

plant samples was determined according to Jackson (1967), total P was determined by spectrophotometer using the ascorbic acid method (Black, 1965) total K was determined according to Chapman and Pratt (1961) by flame- photometer.

RESULTS AND DISCUSSION

Carbon Dioxide Evalution (Average of the Two Growing Seasons)

The rate of CO_2 output from soil is mainly a function of the activity of soil microorganism. Table 3 indicate that CO_2 evolved, generally, increased with increasing organic manure and inoculation by *Azotobacter chrococcum and Azospirillum lipoferum, applied to Soil.* This increase reflects the enhancement of the biological activity in soil rhizosphere. In this respect Kadhim (1986) mentioned that application of organic manures to old and virgin soils increased the total counts of bacteria and CO_2 in the soil and improved their biological and chemical properties.

Respiration(CO_2) was signifycantly higher with application of 50 Kg N/ Fed as composted manure plus inoculation. This was followed by the treatment, composted (50KgN/Fed) +AS (50 Kg N/Fed) + inoculation. On other hand, the lowest two values were obtained by the individual treatment of inoculation or AS (100 Kg N/ Fed). These results are in harmony with those of Neweigy *et al* (1997) who showed that increasing the dose of inorganic N fertilizer results in decreasing nitrogenous activity and CO_2 respiration. Also, El-Sebaey (2002) showed that the correlation between CO_2 and nitrogenase activity, was highly significant with the application organic manure treatment. Zaghloul *et al* (1996 b) showed the lowest values of CO_2 evolution resulted in case of sorghum plants fertilizer with ammonium sulphte and inoculation.

In addition, the data in Table 3 show that the rate of CO_2 evolution as a resulted of the activity of soil microorganisms, increased with the increasing of growth period. The highest values were found at 90 days of sowing and decreased thereafter at 160 days of sowing. (These stimulatory effects may be due to differences of stages grown plant and session variation in these soils). In this respect Zoghloul *et al* (1996 b) who showed the CO_2 increased with the increase of growth period at 60 days and decreased thereafter.

Table 3. Respiration (CO_2) in the rhizosphere at growth stages of wheat plants

Treatment	CO2 (u. g/ g dry soil/ hour) Periods after sowing (days)			
	0.0	40	90	160
Control	0.87	5.99	5.32	8.38
*As (100 Kg N)	1.86	7.72	7.81	6.32
**Co (100 Kg N)	2.22	8.41	11.6	10.10
***Inoc	2.81	6.38	7.21	5.80
AS (50 Kg N) + Inoc	1.60	8.70	8.39	8.21
CO (50 Kg N) + Inoc	4.68	10.1	12.7	10.29
CO (50 Kg N) + Inoc + AS (50 Kg N)	4.29	9.75	11.2	10.21
CO (50 Kg N) + AS (50 Kg N)	2.39	8.31	9.28	8.21
CO (50 Kg N) + AS + AS (25 Kg N) + Inoc	2.50	6.74	8.55	7.25
LSD at 5%	T= 0.886	P = 0.59	T.P= 0.620	

Periods Growth = Average Two Sessions.

*AS = Ammonium Sulphate

**CO = Composted manure.

***Inoc = Inoculation (*Azotobacter chromium Ac and Azospirillum lipoferum*)

Effect of Different Soil Applications of fertilizers on N, P and k Concentration in the Soil

Data presented in Table 4 indicate that ammania nitrogen as well as values of available phosphorus and potassium concentrations were significant increased in soil rhizosphere in all investigated treatments compared to the untreated (control). The highest values of NH_4 – N were resulted from the application of ammonium sulphate at a rate of 100 Kg N / Fed in the growth Periods 0.0 and 40 days of sowing and compost 50 Kg N Fed^{-1}+ ammonium sulphate 50 Kg N/Fed inoculation in growth periods 90 and 160 days of sowing, respectively. On the other hand the lowest values of NH4 – N were obtained in case of inoculation only in all growth periods. These results are in agreement with those obtained by Zaghloul *et al* (1996 b) who found that NH_4 – N was relatively higher in the tested soil when wheat grains were inoculated with VAM fungi. Data presented in Table 4 show that application of organic manure and inoculation wheat plants resulted in a significant increase in NH4 – N with growth periods, such increases was more pronouncedwith the treatment compost 50 Kg N / Fed + ammonium sulphat 50 Kg N / Fed + inoculation. Similar results were obtained by zaghloul *et al.* (1996b), who found that ammonia and nitrate nitrogen contents were higher in case of biofertilization than organic and inorganic N - fertilization in soil rhizosphere of wheat plants.

It is obvious from data recorded in table (4) that available phosphorus concentration was the highest in the treatment of compost (50 Kg N / fed) and AS (25KgN/fed)+inoculation followed by the treatment (compost 50 kg N / fed)+AS (50 kg N / fed) by Mahmoud *et al.*, (1984) and Neweigy *et al.*, (1997). They reported that organic application increase total and available phosphorus in soil rhizosphere.

Regarding the data indicated that the available potassium (K) concentration gave the height value application compost manure (100 Kg N / fed), This result in agreement with those obtained by Mahmoud *et al* (1984) and Neweigy *et al* (1997). Who reported that organic manure application increased available K in soil rhizosphere .

Table 4. Ammoniacal–nitrogen and available potassium and phosphaorus concentration in the soil rhizosphere of wheat plants during the growth period

Treatment	NH_4 - N(mg / K g soil) Periods after sowing (days)				P	K
	0.0	40	90	160	Mg / Kg soil (at 160 days)	
Control	9.600	19.80	20.3	21	26.30	76.00
*AS (100 Kg N)	145.0	141.6	76.3	64.3	62.00	180.0
*CO (100 Kg N)	90.60	78.00	93.3	79.7	87.30	245.7
*Inoc	26. 30	35.60	34.3	23	32.00	106.6
AS (50 Kg N) + Inoc	93.30	84. 6	82.6	82	42.00	140
CO (50 Kg N) + Inoc	42.30	94.00	95.0	71	110.3	240.0
CO (50 Kg N)+ AS (50 Kg N) + Inoc	109.0	117.6	109	104.3	69.67	156.6
CO (50 Kg N) + AS (50 Kg N)	76.30	79.30	60.0	68	133.0	200.0
CO (50 Kg N) + AS (25 Kg N) + Inoc	83.30	97.60	70.0	55.3	140.6	181.6
LSD at 5%	T = 2.85	P = 1.9	T.P	= 2.01	32.3	30.7

Effect of Different Applications of Fertilizer on Dry Matter Yield of Wheat Plants

The straw, grains (g/pot) and plant height (cm) of wheat plants were affected by different treatments as shown in Table 5. The maximum weight of straw and grains were recorded with compost (50KgN) + inoculation. Whereas the maximum plant height was recorded with ammonium sulphate (50Kg N) + inoculation. These result are in agreement with Omer *et al* (1993).

It obvious from the data in Table 5. That plant height, straw and grains of wheat plants were significantly increased with different applications of fertilizer compared to control in the average of the tow seasons.

Irrespective of control treatment, the lowest values of straw, grains, and height of wheat plants were resulted in case inoculation only without addition of compost or ammonium sulphate. Respecting the effect of various treatment on straw , grains and highest of wheat plants data in Table 5 clearly, indicate that the high records of dry weights were resulted in the treatment of wheat seed inocul- ation with *Azotobactey and Azospirillum by compost* manure (50 kg N/fed). The same trend of result was obtained in the two growing seasons. These results are in agreement with EL–Demerdash (1994). They reported that half of N – fertilizer can be saved through inoculation of seed with a symbiotic N_2 – Fixers.

Effect of Different Application of Fertilizers on Some Chemical Constituent of Wheat Plants

Date in Table 6 show of nitrogen, phosphorus and potassium uptake percent (%) in shoots and grains of wheat. Plants nutrients were significantly increased in the treatments as compared with the plant grown without addition. The AS (100 kg N/fed) highest records of N_2 percentage (%) resulted in the treatment, inoculation seeds by *Azotobacterspp and Azospirillum* and provided with the compost (50 Kg N)+ ammonium sulphate (50 Kg N) and compost (50 Kg N)+ Inoculation, in shoots and The highest records concerning P (%) was the treatment compost (50 Kg. N) + inoculation, in the shoot and grains of wheat. Concerning K (%) uptake the highest value resulted in the treatment, wheat seed inoculation with *Azotobacte, and Azospirillum* with compost (50 Kg N) in shoot and compost (50KgN) + Ammonium sulphate in grains. This result is in agreement

Table 5: Effect of inorganic organic and bio-fertilizers on dry matter yield of wheat plant

Treatment	Straw g / pot	Grains g / pot	Plant height (Cm)
Control	2.50	1.82	35.7
*AS (100 Kg N)	8.18	6.44	58.8
*CO (100 Kg N)	8.50	7.46	53.1
* Inoc	3.81	2.27	44.2
AS (50 Kg N) + Inoc	8.39	6.51	65.5
CO (50 Kg N) + Inoc	10.38	8.65	520
CO (50 Kg N) + AS (50 Kg N) + Inoc	9.57	8.58	62.5
CO (50 Kg N) + AS (50 Kg N)	6.85	8.08	54.1
CO (50 Kg N) + AS (25 Kg N) + Inoc	8.99	7.22	55.77
LSD at 5%	0.36	0.16	1.77

with in those obtaine by EL–Haddad *et al.* (1986) who mentioned that the inoculation with associative N_2 -Fixes AZ *Lipoferum or AZ brasilemse* had increased nitrogen uptake by maze or wheat plants, respectively,. Also Zaghloul et al (1996a) found that inoculation of wheat grains with *Azbrasilemse led to an increase of N*, p and k content of wheat plants compared with the organic manure.

CONCLUSION

The obtained results clearly show that compost manure and inoculation application gave higher CO_2than the application of inorganic N_2–fertilizer. In addition, compost manures (50 Kg N/Fed) + inoculation application gave higher records of N, P and K uptake than the full dose of inorganic or organic N-Fertilizer (100 kg N/fed) application.

Table 6. Effect of inorganic, organic and bio-fertilizers on percentage of N, P and K in some component of wheat plants in soil

Treatment	Percentage (%)					
	Straw			Grains		
	N	P	K	N	P	K
Control	0.031	0.007	0.012	0.091	0.008	0.018
*As (100 Kg N)	0.412	0.138	0.111	0.842	0.341	0.141
*Co (100 Kg N)	0.231	0.083	0.223	0.681	0.186	0.316
* Inoc	0.053	0.014	0.025	0.162	0.022	0.052
AS (50 Kg N) + Inoc	0.291	0.114	0.112	0.591	0.423	0.146
CO (50 Kg N) + Inoc	0.422	0.235	0.249	0.723	0.562	0.346
(CO + AS) (50 Kg N) +Inoc	0.211	0.124	0.201	0.442	0.226	0.629
(CO + AS) (50 Kg N)	0.161	0.13	0.118	0.631	0.177	0.139
CO (50 KgN) + AS (25 k. gn) +Inoc	0.162	0.154	0.216	0.632	0.144	0.317
LSD at 5%	2-11	0.012	0.031	0.212	0.025	0.049

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تأثير الأسمدة المعدنية والعضوية والحيوية علي إنتاجية القمح في أرض مستصلحة حديثا

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أقيمت تجربتان أصص خلال موسمين ٢٠٠٢/٢٠٠٣-٢٠٠٣/٢٠٠٤ في الصوبة بمركز البحوث الزراعية لدراسة استجابة نبات القمح للتسميد بسلفات الامونيوم والتسميد العضوي (كمبوست) يتكون من مخلفات المزرعة مع قش الأرز بنسبة (١: ٢) والتلقيح ببكتريا *(Azotobacter chrococcum and Azospirillum lipofrum)* وتأثير دلك على نمو القمح وخصوبة التربة وكانت النتائج متوسط الموسمين باستخدام التربة رملية من طريق مصر -الأسماعلية الصحراوى وقد دلت النتائج على الأتى:

١- ادى التسميد العضوى والتلقيح إلى زيادة CO_2 , NH_4 -N, P, K في التربة بالمقارنة بالكنترول أو استعمال التلقيح أو استعمال الأسمدة المعدنية فقط وكانت أفضل النتائج مع الكمبوست. (٠ ٥ كيلو جرام نتروجين للفدان) مع التلقيح وأيضا الكمبوست + الأسمدة المعدنية.

٢ - أدى التسميد العضوى (٠ ٥ كيلو جرام نتروجين/فدان) مع التلقيح إلى زيادة معنوية في وزن القش والحبوب مثل الأسمدة المعدنية بينما سجلت الأسمدة المعدنية أفضل فى الارتفاع للنبات ووزن الحبوب.

٣- أدى التسميد العضوى والتلقيح بالبكتيريا إلى زيادة النيتروجين تدريجيا مع فترات النمو على عكس الأسمدة المعدنية كانت تتناقص مع فترات النمو مما يوضح زيادة خصوبة التربة عند استخدام التسميد العضوي والتلقيح ببكتريا

٤- أدى التلقيح والتسميد العضوي (كمبوست) بنصف الجرعة إلى الحصول على زيادة معنويه فى محتوى النبات القمح من النيتروجين البوتاسيوم والفوسفور وذلك بالمقارنة بالتسميد بالجرعة الكاملة من سماد الكمبوست أو سلفات الأمونيوم.