A COMPARISON STUDY ON EFFECT OF ORGANIC AND MINERAL FERTILIZERS ON SOME WHEAT CHARACTERISTICS GROWN ON THE NILE ALLUVIAL AND DESERT SANDY SOILS

Nader R. Habashy, Laila K.M. Ali and Mostafa H. Abd El Salam
Soils, Water and Environment Res. Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT:

Two field experiments were conducted during a winter growing season of 2007 on two soil types of newly reclaimed and ancient agricultural areas, however, their soils having different origins and characteristics (*i.e.,* desert sandy soil calcareous in nature at Noubaria area and the Nile alluvial clayey one at Gemaiza Agric. Exp. Station) to evaluate the effect of organic compost (as a source of N-organic) on availability and uptake of essential nutrients and their positively effects on plant growth and nutritional status at different physiological stages of wheat (*Triticum aestivum*, Sakha 69 c.v.) as well as yield and its components. However, a partial 20 % of N-mineral was substituted by N-organic manure derived from composted corn stalks and broad bean straw as compared to applying 100 % N-mineral fertilizer in form of ammonium sulphate (20.6 % N).

The obtained data show that the applied composted plant residues increased dry matter yield of wheat plants at all physiological stages under study in both the studied soil types. Also, the application of composted plant materials was achieved as a superiority effect on nitrogen, phosphorus and potassium uptake by wheat plants. The grain quality as a function of total protein and carbohydrates was also superior affected by the applied composted plant residues, particularly in case of composted broad bean straw under the conditions of the studied two soil types. That was discursive, since a partial N-mineral mineral substitution by N-organic manure plays an important role for maximizing the biological yield of wheat (straw and grain yields) as well as grain quality. This is mainly due to such agro-management practice is not only partially capable to retain nutrients in soil for a long-term use, but also leads to improve soil properties which encouraging the availability, mobility and uptake of nutrients by growing plants. Consequently, the field experiments under study emphasized the importance of organic fertilization for either sandy or clayey soils, due to assess N, P and K availability in soils as well as their mobility and easily uptake by plant roots as affected by the applied composted plant materials. Taking into consideration the nutrients enrichment of clayey soil, the rate of availability and uptake of nutrients in sandy soil was more clearly obvious, probably due to the soil media have no restrictive agents.

An economical evaluation was performed for the partial N-mineral mineral substitution by N-organic manure (20 % of N-mineral), by using the composted plant residues as related to the full dose of N-mineral fertilizer, which showed that those of low C/N ratio such as composted broad bean had a relatively superior profitability. Actual net profit of applied fertilizers appeared to be no pronounced differences in both soil types. This may be due to the easily losses of N-mineral fertilizer by either volatilization or leaching from a soil calcareous in nature and relatively coarse in texture, and in turn this reason may be attributed with external conditions.

Key words: Composted plant residues, nutritional status of wheat, available NPK in soil, Nile alluvial and sandy soils.

INTRODUCTION:

The way of clean agriculture with minimum pollution affects the use of natural materials such as composts are recommended to substitute the chemical fertilizers. The application of manure to soil provides several potential benefits, including improving the fertility, structure, and water-holding capacity of the soil, increasing soil organic matter, and reducing the amount of synthetic fertilizer needed for crop production **(Grandy *et al.*, 2002)**. **Antoun and Besada (1990)** showed that highest levels of NH^+_4-N occurred with clover residues, whereas nitrogen from reached its lowest value with maize stalks treatments. They added that the addition of maize stalk depressed the level of soil mineral nitrogen. **Awad (1994)** concluded that the enrichment of the soil with crop residues specially those of high nitrogen content enhanced N mineralization as it produced in the order: peanut > corn > untreated.

In fact, many investigators reported that the nutrients release from plant residues and organic materials during mineralization process, which is dependent mainly on C/N and different nutrients ratio. The optimal value of C/N ratio is in fact between 26 and 33 **(Chaparro *et. al.*, 1984)**. Corn yield response to compost and soil amendments depended on the C/N ratio of the compost, however, at a low C/N ratio (<20:1) of compost applied at 88 t ha^{-1} might be sufficient to meet the needs of the crop in the first year after application. When compost with a C/N ratio >20:1 was applied at the same rate, additional N fertilizer would be needed to maximize yield potential. Another study involving solid waste from potato (*Solanum tuberosum* L.) processing operations resulted in high rates of N mineralization **(Smith, 1986)**.

In respect to of effect organic materials on macronutrients uptake by plants, **Laila (2001)** reported that the application of cotton stalks and rice straw composts and improved farmyard manure significantly increased the chemically available N, P, and K in the cultivated soil; rice straw was better than cotton stalks. Yield of wheat and corn crops and concentration of N, P, K, Fe, Mn, Zn and Cu either in plant leaves at flowering stage or in grain yields of wheat and corn were increased in all treated treatments. Also, P, K and micronutrients concentrations in leaves or grains of wheat or corn crops were significantly higher in all treated treatments, except of nitrogen, as compared to those of inorganic fertilizer, especially after corn harvesting.

Eghball and Power (1999b) found that P- or N-based compost or manure application resulted in similar corn grain yield, but the P-based systems had significantly less soil available P after 4 yr of application. In this connection, **Eghball (2002)** reported that after 4 yr of N- or P-based manure and compost applications, soil surface C and N concentrations and quantities were greater in the N- compared with the P-based management systems. **Singer *et al.*, (2004)** studied that applying organic matter as a soil amendment to cropland reduces requirements for synthetic fertilizer and may eliminate yield differences between conventional and minimum tillage. Also, they found that averaged across all crops and tillage, compost-amended soil had 63 g kg-1 organic matter and 164 mg kg-1 P vs 56 and 55 in untreated compost. Corn and soybean producers can enhance yield with multiple compost applications and eliminate yield differences between conventional and no-till systems. Nevertheless, compost application for soil OM enhancement must be balanced with P input to minimize the potential for excessive soil P accumulation.

Yung-Yu Shu (2006) studied the effects of the application of two different kinds of composts: pea-rice hull compost (PRC) and cattle dung-tea compost (CTC) on rice growth. These composts differed in their nitrogen composition, as well as in their effect on plant height, number of tillers, dry matter yield and nutrient uptake (nitrogen (N), phosphorus (P), potassium (K)) of rice plants. At the most active tillering and heading stages of the plants of the first crop, the number of tillers, dry matter yield and the amount of nutrients absorbed from the chemical fertilizer (CHEM) treatment were found to be higher than those in the other treatments. The values of the plant height, straw growth and nutrient uptake of the rice plants with the PRC treatment were the highest among all the treatments at the maturity stage. In the plants of the second crop, the values of the plant height, number of tillers, straw and whole plant yield and the N and K uptake from the PRC treatment were the highest among all the treatments at the heading and maturity stages. The chemical fertilizer was a fast-release fertilizer used to supply nutrients at the early stage of rice growth in the first crop. The beneficial effect of the composts on rice growth and nutrient uptake was conspicuous in the second crop, compared with that of routine treatment of chemical fertilizer.

Singer *et al.* (2007) reported that compost amendment increased corn whole-plant P and K uptake 19 and 21%, averaged across 2 yr. Because compost amendment increases soil organic matter, soil–plant water status was hypothesized to affect the tillage by compost response. On the other hand, corn plants growing in compost-amended soil accumulated more P and K than plants growing in non-amended soils, but the greater uptake was not associated with increased grain yield. Sequential compost application can reduce inorganic N inputs for corn production, but must be balanced with P removal to avoid excessive soil P accumulation.

Uhart and Andrade (1995) reported that availability of reduced N in corn can be more limiting than availability on non structural carbohydrates for grain dry weight accumulation, the relatively flows and remobilization of C and N to grain during the grain filling period being dependent on the particular source/sink ratio of the corn plants. **Stewart *et al.* (1997)** pointed out the increased carbohydrate production might not be associated with increased availability of carbohydrates for grain filling in corn plants. The distribution of sugar and starch within leaves, steams and ear in slinking stage indicated that stem served as the largest reservoir for carbohydrates although the ears began to fill and were already important storage regions. **Gebbing and Schnyder (1999)** reported that within a given nitrogen fertilizer treatment, there appeared to be appositive relation ship between nitrogen mobilization and pre- a thesis carbon deposition in grain carbohydrate. An analogous relation ship was apparent for pre-an thesis carbohydrate C mobilization and pre-an thesis carbon in corporation ingrain protein. These effects were due to variation in tiller mass and associated differences in carbohydrates and protein (storage and mobilization).

Wanas (2006) executed a study to maximize the efficiency of plowing through incorporating some types of composts (cotton stalks compost, sugar cane refuse compost and water hyacinth plant compost) to a clayey soil during plowing operation and creating the physical soil and water conditions suitable for corn production. He found the obtained results revealed that soil bulk density significantly decreased and total porosity increased with the treatments of plowing + composts compared with plowing only treatment (control). The reduction and / or increase were higher in shallow plowing than deep one. The percentage of water stable aggregates (> 0. 25 mm) significantly increased more than those of < 0 25mm, which acted positively upon the structure coefficient. On the other hand, drainable pores significantly increased and water holding ones as well, but the increase in drainable pores was much higher than those of water-holding pores. The changes in WSA% and pore system significantly influenced on soil water content and saturated hydraulic conductivity. The grain yield of corn significantly increased and it was higher with the deep plowing than with shallow one. According to the obtained results, one can say generally that applied composts had the ability to change positively clayey soil hydrophysical properties and raising its productivity.

The current study aimed at evaluating the effect of composted plant residues as related to applying N-mineral fertilizer on growth, nutritional status, yield and yield its components of wheat plants grown on two different soil types, *i.e.,* newly reclaimed desert sandy and the Nile alluvial clayey soils.

MATERIALS AND METHODS:

To achieve the aforementioned target, two field experiments were conducted during a winter growing season of 2007 on two soil sites of newly reclaimed and ancient agricultural areas, which their soils having different origins and characteristics (*i.e.,* desert sandy soil calcareous in nature at Noubaria area and the Nile alluvial clayey one at Gemaiza Agric. Exp. Station) to evaluate the effect of some composted plant residues (*i.e.,* corn stalks and broad bean straw) as compared with applying N-mineral fertilizer (*i.e.,* ammonium sulphate, 20.6 % N) on growth and nutritional status at different physiological stages of wheat (*Triticum aestivum*, Sakha 69 c.v.) as well as yield and its components. Some physical and chemical properties of investigated two soil types were analyzed according to **Black (1982)**, and the obtained data are tabulated in Table (1).

Table (1): Some physical and chemical characteristics of the two studied soils.

Soil characteristics	Soils under study	
	Noubaria	Gemaiza
Particle size distribution %:		
Clay	2.8	45.0
Silt	3.5	31.0
Coarse sand	40.8	9.5
Fine sand	52.9	14.5
Textural class	Sandy	Clayey
$CaCO_3$ %	12.20	2.11
Soil pH (1:5 soil water suspension)	7.86	7.37
Organic matter %	0.63	2.15
Chemical analysis of soil paste extract (ions in m molc L^{-1}):		
ECe ($dS.m^{-1}$)	1.20	3.40
Ca^{++}	4.75	14.20
Mg^{++}	1.25	2.73
Na^{+}	5.80	16.50
K^{+}	0.25	0.75
CO_3^{--}	0.00	0.00
HCO_3^{-}	2.20	3.00
Cl^{-}	5.37	18.20
SO_4^{--}	4.48	12.98
Available macronutrients in $mg.kg^{-1}$ soil:		
N	15.30	68.90
P	3.42	10.65
K	66.70	498.00

The wheat was taken as indicator winter plants and the field experimental trail was carried out in soil plots of an area of 67.5 m^2 for each one. After soil preparation, wheat seeds were sown on October 2007, and the soil moisture was always kept at to be almost at the available range. The field experimental was designed in a complete randomized block **(Gardiner, 1997)**, each treatments was thrice replicated. The two types of composted plant residues (*i.e.,* corn stalks and broad bean straw) were prepared according to the method described by **Abou El Fadl (1960)**. The chemical analysis of the two composted plant residues are shown in Table (2).

Each plot received mineral broadcast fertilization of 120, 30 and 48 kg/fed N, P_2O_5 and K_2O, respectively. The corresponding used mineral fertilizers were ammonium sulphate (20.6%N), superphosphate (15 % P_2O_5) and potassium sulphate (48% K_2O). The applied rates of tested organic composts were added to partly substitute 20% of the added N-mineral. The agro-management practices, including irrigation, were applied as recommended by

Ministry of Agriculture Guidance. Representative shoot samples were taken, after being cut 2 cm from soil surface, from each plot, at successive periods representing different stages of growth (tillering, flowering and harvest).

Table (2): Some chemical analysis of composted plant residues.

Compost characteristics	Corn stalks	Broad bean straw
Total macronutrients %:		
N	1.43	1.65
P	0.22	0.30
K	2.40	2.70
Organic matter %	45.9	48.1
Organic carbon%	26.69	27.97
C/N ratio	18.66	16.95
pH (1:5 compost: water)	7.50	7.40
Available macronutrients in mg.k^{-1}:		
N	590	890
P	83	92
K	277	318

The plant samples were oven dried at 70 C^{o} and their dry matter yield being evaluated. Then such plant dry samples were ground and amounts of 0.2 g were digested according to **Jackson (1978)**, and the digested solutions were subjected to chemical analysis for determining the studied nutrients. Nitrogen was determined using micro kijeldhel distillation technique **(Black, 1982)**, phosphorus being determined colourmetrically using ascorbic acid method **(Watanabe and Olsen, 1965)** and potassium was assayed Flame-photometrically. Total carbohydrates were determined using phenol-sulfuric acid reagents according to **Norris and Ribbons (1971)**. Wheat grain protein was calculated according to **(AOAC, 1990)** as the N-content multiplied by 6.25.

For monitoring the changes in the available contents of N, P and K in soil during the successive periods representing different stages of growth (tillering, flowering and harvest), representative soil samples were taken at each plant sample taken. The samples were air dried, ground and kept in plastic bags to be later analyzed. The available nitrogen was extracted with 1% potassium sulphate solution using steam distillation procedure according to **Black (1982)**. Available phosphorus was extracted according to **Olsen *et al.* (1954)** using 0.5M $NaHCO_3$ solution at pH 8.5, and then P was determined spectrophotometrically. Available potassium was extracted as described by **Dewis and Freitas (1970)** and was assayed as previously in the plant.

The chemical analysis of prepared organic composts, *i.e.*, pH value was measured in water suspension 1:5 according to **Jodice *et al.* (1982)**, while the other analysis were determined according to the abovementioned standard methods used for both plant and soil analysis.

RESULTS AND DISCUSSION:

I. Response of plant growth and nutritional status to the applied organic composts and N-mineral fertilizer:

a. Dry matter yield of wheat plants at different growth stages:

Data in Table (3) showed an obvious clear response for both studied soils to the applied either organic composts or N-mineral fertilizer, however, the Nile alluvial clayey soil exhibited a relatively more effective response or a best condition regardless of the plant dry matter yields among the different growth stages (tillering, flowering and harvest).

Table (3): Dry matter yield at different growth stages as affected by both soil types and composted plant residues.

Soil type (S)	Fertilizers (F)	Dry matter content (g plant^{-1})		
		Growth stages (P)		
		Tillering	Flowering	Harvest
Sandy	Control	1.40	1.47	1.50
	N-mineral fertilizer	3.13	4.15	4.77
	Composted corn stalks	3.62	4.71	5.25
	Composted broad bean straw	4.10	5.45	6.93
Mean		3.06	3.95	4.68
Clayey	Control	1.63	3.79	7.60
	N-mineral fertilizer	3.98	5.79	8.75
	Composted corn stalks	4.30	6.36	9.39
	Composted broad bean straw	4.66	5.84	8.19
Mean		3.64	5.65	8.16
Mean	Control	1.52	2.63	4.55
	N-mineral fertilizer	3.62	4.97	6.76
	Composted corn stalks	4.11	5.53	7.32
	Composted broad bean straw	4.38	5.64	7.56
L.S.D. at 0.05				
Growth stages		S	F	S x F
Tillering		0.41	0.25	0.48
Flowering		0.60	0.10	0.71
Harvest		1.50	0.20	0.77

Organic compost represents 20 % N-organic + 80 % N-mineral fertilizer

Also, the obtained results reveal that the composted broad bean straw had a general superior effect on plant dry matter yield of wheat in both the desert sandy and the Nile alluvial clayey soils. The differences in dry matter yields were more pronounced as plants progressed in age towards the harvesting stage. In this concern, there were another effective factors should be taken in consideration, *i.e.,* natural distribution plant roots and soil capacity to retain the different plant nutrients. In general, the values of dry matter yield were higher with composted broad bean straw than composted corn stalk and even the N-mineral fertilizer. Thus, the applied treatments could be arranged in an almost descending order according their positive effects as follows: composted broad bean straw > composted corn stalks > N-mineral fertilizer > the control treatment. This trend may suggest that the studied sandy soil was poor native fertility status as compared to the productivity of a clayey soil, which is characterized by a heavy texture grade supported with native fertility status. At the same time, the fertility status of sandy soil may reach that of the heavy textured one if it is practiced carefully particularly with respect to N-mineral and organic fertilization.

b. Nutritional status of wheat plants receiving composted plant residues as affected by soil types during the different growth stages:

1. Nitrogen:

Data in Table (4) showed a slight difference in the response of N uptake by wheat plants received the tested two organic composts under the conditions the studied two soil types regardless of the different growth stages. Data indicated also an almost similar trend, more or less, similar to that has previously recorded for dry matter yield during the different growth stages. Furthermore, higher values being generally fulfilled from nitrogen uptake by wheat plants grown on the clayey soil than those of sandy soil at the different growth stages.

Table (4): N, P and K uptake by wheat plants at different growth stages as affected by the applied N-mineral and organic composts under the conditions of studied soil types.

Soil type (S)	Fertilizer (F)	Nitrogen uptake (mg kg^{-1} plant^{-1})			Phosphorus uptake (mg kg^{-1} plant^{-1})			Potassium uptake (mg kg^{-1} plant^{-1})		
		Growth stages of wheat			Growth stages of wheat			Growth stages of wheat		
		Tillering	Flowering	Harvest	Tillering	Flowering	Harvest	Tillering	Flowering	Harvest
Sandy	Control	13.2	35.8	47.2	0.21	0.41	0.49	7.90	17.20	20.4
	Mineral fertilizer.	41.9	97.0	110.0	0.54	0.75	0.98	13.80	50.40	89.5
	Composted corn stalks	55.9	102.0	122.0	0.63	0.89	1.23	14.80	62.20	97.4
	Composted broad bean straw	60.6	112.0	124.0	0.78	0.92	1.85	15.20	65.20	98.3
Mean		42.8	86.7	100.8	0.54	0.74	1.07	12.92	48.75	76.4
Clayey	Control	41.0	115.0	124.0	0.48	0.51	0.55	9.45	25.40	33.6
	Mineral fertilizer.	76.7	110.0	146.0	0.78	1.02	1.89	33.20	65.40	98.5
	Composted corn stalks	81.4	133.0	158.0	0.81	1.08	2.06	43.20	80.50	107.0
	Composted broad bean straw	87.5	142.0	175.0	0.84	1.17	2.25	48.60	79.90	106.8
Mean		71.7	125.0	150.8	0.73	0.95	1.69	33.61	62.80	86.50
Mean	Control	27.10	75.4	85.6	0.35	0.46	0.52	8.68	21.30	27.0
	Mineral fertilizer.	59.30	103.6	128.0	0.66	0.89	1.43	23.50	57.90	94.0
	Composted corn stalks	68.65	117.5	140.0	0.72	0.99	1.64	29.00	71.40	102.0
	Composted broad bean straw	74.05	127.0	150.0	0.81	1.05	2.05	31.90	72.55	102.55
L.S.D. at 0.05										
Growth stage		S	F	S x F	S	F	S x F	S	F	S x F
Tillering		12.1	3.1	4.3	0.81	0.04	0.31	9.50	1.30	1.31
Flowering		11.3	10.3	3.0	0.90	0.06	0.41	6.20	1.30	1.43
Harvest		20.7	8.1	2.5	0.21	0.22	0.37	5.90	1.21	1.32

The corresponding beneficial effects of the tested organic composts and N-mineral fertilizer as related to the studied two soil types could be categorized in an ascending order of: composted broad bean straw > composted corn stalks > N-mineral fertilizer > the control treatment. That means a positive response was achieved for composted broad bean straw as compared to the tested other treatments. A Similar result found by **Wang *et al.* (1995)** who pointed out that nitrogen accumulation, nitrogen concentration and total nitrogen uptake increased significantly when the nitrogenous fertilizer was added as mineral combined with organic source. As for over all effects, the obtained data reveal that mostly either composted broad been straw or corn stalks combined with N-mineral source was the most effective treatment with respect to inducing utilization by wheat plants in all the different growth stages at both the studied two soil types, with a relatively different trend was observed towards the tillering stage.

2. Phosphorus:

The obtained data in Table (4) showed also a pronounced response of wheat plants to the applied N-mineral fertilizer combined with composted broad bean straw, which represented the best treatment for raising the P uptake by wheat plants, followed by composted corn stalks and N-mineral fertilizer. It was noticed that P uptake tended to increase from tillering stage towards the harvest one. Data indicated also that P uptake wheat plants as affected by the applied two composted plant residues and N-mineral fertilizer took place a trend almost similar to that of N uptake at all different growth stages, with superiority for the clayey soil. The later observation could be emphasized by the native fertility status of the Nile alluvial clayey soil as compared to the desert sandy one, which is not only poorer in the nutrients bearing minerals but also it is not partially capable to retain neither nutrients nor water for growing plants.

It is noteworthy to mention that a partial N-mineral mineral substitution by N-organic manure was the most inferior source at all growth stages of wheat plants, which were generally superior under the prevailing conditions of fine textured soil, as shown in Table (4). That was true, since the Nile alluvial clayey soil is characterized by maintaining adequate phosphorus supply for wheat plants. These findings are in agreement with results obtained by **Mengle and Kirkby (1987)** who reported that the form of applied nitrogen played an important role in nutrition status of plants, however, plants supplied with NH_4^+-N took up more cations than anions with release of H^+ into the soil rhizosphere to finally resulted in a more P-solubility. Later on, **Wang and Below (1998)** showed that the accumulation and partitioning of mineral nutrients were dependent on the applied nitrogen form and the nature of the concerned nutrient.

Finally, the interaction effect, Table (4), confirmed the abovementioned presentation about either the clayey soil or the desert sandy treated with composted broad bean straw seemed to be superior at all different growth stages of wheat plants as compared to soil treated with the composted corn stalks, N-mineral and the control treatment.

3. Potassium:

Data in Table (4) represent potassium uptake by wheat plants as affected by different treatments during the successive growth stages. The obtained values of K uptake showed an almost trend to both behaviors previously mentioned for the N and P uptake by wheat plants, however, the applied composted broad bean straw was more effective than composted corn stalks that being more favourable than N-mineral at all physiological stages. This may be due to the relatively low C/N ratio and higher content of active organic acids. That was true, since the active organic materials enhancing the released K from the K bearing minerals. In addition, response of potassium uptake under the treated clayey soil with organic composts was frequently the more effective as compared to the desert sandy one during all different growth stages due to it attains a pronounced content of K bearing minerals. Thus, the corresponding arrangement of the tested treatments according to their beneficial effects could be categorized in an ascending order of composted broad bean straw > composted corn stalks > N-mineral fertilizer > the control treatment under the different growth stages.

The aforementioned results may suggested that the treatment of organic compost combined with N-mineral fertilizer in a form of ammonium sulphate was generally the inferior, this could be explained according to **Mengle and Kirkby (1987)** who reported that maize and sugar beet plants when grown with nitrogen as ammoniac source, took up less K^+ than when urea source was used. This may be reasoned on the basis of behavior similarity of both K^+ and NH_4^+, *i.e.,* competition between the two ions.

The data of interaction effect, Table (4), reveal that the clayey soil with composted broad bean straw was generally the most suitable at the different growth stages, with a more increase from tillering stage towards harvest one. Finally, results may suggest the possibility of substituting to a rather large extent the mineral fertilization practice of soils with composted plant materials, which may progressively lead to realizing the sustainable agricultural production policy, *i.e.,* the main goal of agricultural utilization in Egypt.

II. Straw and grain yields of wheat as affected by applied composted plant materials and mineral fertilizer at different soils:

Data in Table (5) reveal that there was a positive effective role of the applied composted plant residues on both straw and grain yields of wheat plants, taking into consideration the significant differences between the prevailing conditions of the studied desert sandy and the Nile alluvial clayey soils. The later was better for both straw and grain yields, particularly with the wheat plants received composted broad bean straw, which their values were higher than those treated with composted corn stalks and N-mineral fertilizer.

That means a partial N-mineral mineral substitution by organic manure plays an important role for maximizing the biological yield (straw and grain yields) of wheat. This is mainly due to such agro-management practice is not only partially capable to retain nutrients in soil for a long-term use, but also leads to improve soil properties which encouraging the availability, mobility and uptake of essential nutrients by growing plants. This may suggest a close combination between growth and nutritional status parameters with wheat yield. If this is true, the selection for a practical source and soil used could be suggested depending on the economical point of view.

The quality of crop production is usually evaluated according to the purpose of which final product is used. On the other hand, environmental conditions and agro-management practices, including nutrition, are greatly affected factors through influencing biochemical or physiological processes. The content of organic constituents, which is storage in tissues of grain or seeds, should be related to photosynthetic activity of plants and translocation rate of photosynthesis to the indicated plant parts (**Mengle and Kirkby, 1987**).

Grain protein quality in wheat is usually low and of poor quality due low content of anion acids lysine and tryptophan **(Eleptherios and Christos 1999).** Data in Table (5) showed different responses between both the soils used, however, the Nile alluvial clayey soil was usually more affected by both the applied composted plant residues and N-mineral fertilizer. The obtained data reveal that the effect of used fertilizers on the grain quality parameters, *i.e.,* total protein and carbohydrate contents % followed an almost similar trend to that of N uptake possibly due to high correlation between the two parameters of nitrogen uptake and protein content in plants.

Table (5): Biological yields and grain quality of wheat plants receiving the tested organic composts and N-mineral fertilizer under the studied soil types and at different growth stages.

Soil type (S)	Fertilizers (F)	Wheat yield ($kg.fed^{-1}$)		Grain quality (total amounts as a percent)	
		Straw	Grain	Total protein	Total carbohydrate
Sandy	Control	1670	469	5.97	43
	N-mineral fertilizer	2820	1200	13.4	64
	Composted corn stalks	3050	1460	11.2	55
	Composted broad bean straw	3390	1800	14.2	71
Mean		2733	1232	11.2	58.2
Clayey	Control	700	580	9.8	52
	N-mineral fertilizer	4450	1690	17.9	78
	Composted corn stalks	4560	1900	17.1	70
	Composted broad bean straw	4820	2150	20.1	88
Mean		3633	1580	16.2	72
Mean	Control	685	525	7.89	48
	N-mineral fertilizer	3635	1445	15.6	71
	Composted corn stalks	3805	1680	14.2	63
	Composted broad bean straw	4105	1975	17.2	80

L.S.D. at 0.05

Biological yield	S	F	S x F
Straw	817	111	150
Grain	150	135	10
Protein	0.5	1.0	1.8
Carbohydrate	7.0	6.0	3.0

Organic compost represents 20 % N-organic + 80 % N-mineral fertilizer

a. Grain quality:

Finally, data in Table (5) indicated that response of wheat grain quality to the tested treatments followed an ascending order of: composted broad bean straw > N-mineral fertilizer > composted corn stalks > the control treatment. Such an arrangement or sequence may be due to either grain density or weight for wheat plants. Also, there was a similar trend for the parameters of grain quality in the used soil types, in spite of the pronounced differences, where the clayey soil was recorded the best with composted broad bean straw and N-mineral fertilizer. This behavior suggests that composted broad bean straw was the more suitable; due to it gave higher values of total protein and carbohydrate. This is possibly due to improving both plant growth and its nutritional status, which are more related to a parallel trend of nutrients availability in soil. These findings are in agreement with results of **Stewart *et al.* (1997)** who reported that the plant dry matter was an important factor for determining the magnitude of leaf carbohydrates storage and export.

The abovementioned presentation and discussion may suggest that there were no similarity for both studied soil types (i.e., clayey and sandy) as for as their responses for the concerned grain quality parameters, *i.e.*, total protein and carbohydrate contents, which showed the best values with composted broad bean straw followed by N-mineral fertilizer.

III. Nutrients status in the soils used:

Data of available N, P and K in soil as affected by the applied composted plant residues as compared with N-mineral fertilizer at different growth stages of wheat plants grown on the studied two soil types are presented in Table (6).

Table (6): Soil available N, P and K at different growth stages as affected by the applied N-mineral and organic composts under the conditions of studied soil types.

Soil type (S)	Fertilizer (F)	Soil available nitrogen ($mg\ kg^{-1}$ soil)			Soil available phosphorus ($mg\ kg^{-1}$ soil)			Soil available potassium ($mg\ kg^{-1}$ soil)		
		Growth stages of wheat			Growth stages of wheat			Growth stages of wheat		
		Tillering	Flowering	Harvest	Tillering	Flowering	Harvest	Tillering	Flowering	Harvest
Sandy	Control	16.12	21.00	14.90	3.96	4.28	4.13	69.60	78.90	72.70
	Mineral fertilizer.	39.00	59.00	41.70	4.84	5.96	5.12	75.00	82.00	79.00
	Composted corn stalks	25.90	36.90	32.30	5.93	6.60	5.90	79.00	86.00	84.00
	Composted broad bean straw	32.80	41.90	35.50	6.67	7.40	6.70	84.20	91.00	89.00
Mean		28.46	39.7	97.47	5.35	6.06	5.46	76.95	84.48	81.10
Clayey	Control	98.00	186.00	194.00	11.50	12.40	11.90	537.00	576.00	561.00
	Mineral fertilizer.	61.00	138.00	169.00	14.60	16.80	15.50	597.00	640.00	610.00
	Composted corn stalks	84.00	150.00	182.00	17.90	18.20	17.60	619.00	682.00	636.00
	Composted broad bean straw	48.10	76.50	80.95	7.43	8.04	7.67	285.30	84.95	293.35
Mean		80.75	151.5	173.0	13.73	14.8	14.05	563.5	604.5	580.3
Mean	Control	43.45	87.45	100.65	10.26	11.70	10.70	338.00	363.00	347.00
	Mineral fertilizer.	58.40	95.95	108.75	12.28	12.80	12.15	351.60	386.50	362.50
	Composted corn stalks	16.12	21.00	14.90	3.96	4.28	4.13	69.60	78.90	72.70
	Composted broad bean straw	39.00	59.00	41.70	4.84	5.96	5.12	75.00	82.00	79.00
L.S.D. at 0.05										
Growth stage		S	F	S x F	S	F	S x F	S	F	S x F
Tillering		25.10	3.90	3.95	3.19	1.40	2.11	85.0	11.91	22.10
Flowering		40.20	6.50	20.31	2.99	1.10	1.31	99.7	17.70	11.90
Harvest		3.14	7.32	4.39	3.32	1.53	1.13	30.41	15.90	9.81

The obtained results showed pronounced differences between the available contents of N, P and K in the studied soil types of sandy and clayey texture grades. In general, sandy soil contains available N, P and K fractions less than clayey one at all different growth stages of wheat plants. This could be easily related to the initial status of these nutrients in both the studied soil types, as shown in Table (1), which are more related to the occurrence of the nutrient bearing minerals. With regard to applied composted plant residues and N-mineral fertilizer, results again revealed a trend of N-mineral fertilizer > composted broad bean straw > composted corn stalks > the control treatment as an ascending order for the available N content in both the studied soil types at the different stages of growth stages. On the other hand, the corresponding ascending order for both the available contents of P and K was as follows: composted broad bean straw > composted corn stalks > N-mineral fertilizer > the control treatment. The later case indicated that composted broad bean straw was the best materials, due to it resulted in an increase for each of soil available P and K over the another treatments with significantly differences at all the studied growth stages.

The aforementioned results showed that the amounts of available N, P and K differed according to the soil type, plant physiological stage and their contents in the applied organic composts, which are more related to the source of composted materials. It is noteworthy to mention that the time of soil with different composted plant residues resulted in the released active organic acids, which are responsible for most of nutrients availability in soil. This result is in harmony with that reported by **Abd El-Reheem (1982)** who found that organic phosphorus mineralization process varies with the soil type, time of incubation and the soil organic phosphorus content. He added that mineralization of organic phosphorus in the sandy soil being higher than in the alluvial soil.

Regardless the soil effect, results revealed that composted plant materials indicated a significantly increased in soil phosphorus than mineral fertilizer, however, the relative P increases could be categorized according to the following descending order: composted broad bean straw > composted corn stalks > N-mineral fertilizer > the control treatment. This may suggest that composted plant materials was again suitable source to maximum values and mineral fertilizer leading to minimum ones, where the change in pH induced by either NH_4^+ or NO_3^- absorption being a wheat effect. Also, results indicated that enrichment of sandy soil with composted plant materials significantly increased potassium availability, might be due to the fixation of K in the calcareous soil. This result agrees with that of **Montasser (1987)** who noted that the application of organic matter increased soil available potassium at early time intervals then decreased at the latter of periods.

IV. Economical evaluation for the organic and inorganic fertilizers:

An evaluation was performed for the economical aspect of the tested N-mineral fertilizer and composted plant residues (Table 7). A comparison between price of true yield increment due to fertilizer use and total spent costs for planting at the whole growth season must take in consideration.

Such comparison was performed through calculating the actual net profit obtained from different treatments after subtracting the value of control treatment from each one giving the true value from which the price of applied fertilizers as well as other costs (*i.e.*, labor and weed control…act.) would be finally subtracted. In other words, actual net profit = gaining from both grain and straw obtained from treatment-corresponding data of control treatment – (cost of applied fertilizer + others) L.E /fed. As for calculation of the actual net profit of wheat crop, data in Table (7) showed some differences between both studied soils, where clayey soil being the superior. The presented data of wheat crop showed that composted broad bean had a relatively superior profitability.

In fact, **Yibirin *et al.* (1996)** reported that application of fertilizer significantly increased the net invested over no fertilizer application, fertilizer input could increase profit by 2.84 times.

Table (7): Economical evaluation for wheat crop receiving different composted plant materials and N-mineral fertilizer under the studied soil types.

Soil type	Fertilizer	Total profit (L.E./fed)	Net* profit (L.E./fed)	Actual net profit (L.E/fed)
Sandy	Control	520	460	--
	N-mineral fertilizer	1070	890	430
	Composted corn stalks	1250	1000	540
	Composted broad bean straw	1550	1340	880
Clayey	Control	540	480	--
	N-mineral fertilizer	1540	1010	530
	Composted corn stalks	1690	1330	850
	Composted broad bean straw	1890	1550	1070

* Net profit = total profit – total cost L.E/ fed, Price of fertilizer unit was calculated as price of year 2007, Ammonium sulphate 7.0 L.E /kg, Composted plant materials 350 L.E/ m^3, Organic compost represents 20 % N-organic + 80 % N-mineral fertilizer.

Actual net profit of applied fertilizers appeared an insignificant difference for both soil types. However, the corresponding benefit of the studied fertilizers for both sandy and clayey soils could be categorized in as ascending order of: composted broad bean straw > composted corn stalks > N-mineral fertilizer. So that, a partial N-mineral mineral substitution by N-organic manure (20 % of N-mineral), especially those of low C/N ratio such as composted broad bean that had a relatively superior profitability. This may be due to the easily losses of N-mineral fertilizer by either volatilization in soil calcareous in nature or leaching in soil coarse in texture, for this reason the order were externally different.

REFERENCES:

Abd El-Reheem, M.A.S. 1982. Studies on organic phosphorus in some Egyptian soils with special reference to response of grown plants. Ph. D. Thesis, Fact. of Agric. Ain Shams Univ., Egypt.

Abou El Fadl, M. (1960). Organic Manures. El Safa Publ., Cairo, Egypt (In Arabic).

Antoun, G.G. and Besada, Y.B. 1990. Nitrogen transformation during mineralization of some organic materials in clayey soil. Agric. Res. Rev., 68: 373.

AOAC 1990. Official Methods of Analysis. 15th Ed., Association of Official Analytical Chemists. Arlington, Virginia, USA.

Awad, A.M.A. 1994. Crop residues effects on soil organic matter wheat yield and nutrients dynamics. Ph. D. Thesis, Fac. of Agric., Alex. Univ., Egypt.

Black, G. R. 1982. Methods of Soil Analysis. Amer. Soc. of Agronomy, Madison, Wisconsin. USA.

Chaparro, B.M.; Castillo, F. and Salazar, I. (1994). Composts from urban wastes. Univ. Oriate. Venez. Rev., 18: 19 (Span). [(c.f. Chemical Abst. 103:128549 (1985)].

Dewis, J. and Freitas, F. 1970. Physical and Chemical Methods of Soil and Water Analysis. FAO, Soil Bull. No. 10, pp. 163.

Eghball, B. and Power, J.F. 1999b. Phosphorus- and nitrogen-based manure and compost applications: Corn production and soil phosphorus. Soil Sci. Soc. Am. J., 63: 895-901.

Eghball, B. 2002. Soil properties as influenced by phosphorus- and nitrogen-based manure and compost applications. Agron. J., 94: 128-135.

Eleptherios, A.B. and Christos, K.G. 1999. Mass selection improvement of organic and protein in maize population. Crop Sci., 39: 1302.

Gardiner, W.P. 1997. Statistics of the biosciences. Prentice Hall Europe. London.

Gebbing, T. and Schnyder, H. 1999. Pre-anthesis reserve utilization for protein and carbohydrate synthesis in grain of wheat. Plant Physiology, 121: 871.

Grandy, A.S.; Porter, G.A. and Erich, M.S. 2002. Organic amendment and rotation crop effects on the recovery of soil organic matter and aggregation in potato cropping systems. Soil Sci. Soc. Am. J., 66: 1311-1319.

Jackson, M.L. 1978. Soil Chemical Analysis Prentice- Hall, Englewood Cliffs, New Jersey, USA.

Jodice, R. Luzzatio, A. and Nappi, P. 1982. The influence of organic fertilizers, obtained from popular barks on the correction of iron chlorosis of *Lupines alb us L.* Plant and Soil, 65: 309.

Laila, K.M. Ali 2001. Use of improved organic fertilizers as nutrients sources. Ph. D. Thesis, Fac. of Agric., Ain Shams Univ., Egypt.

Mengle, K. and Kirkby, E.A. 1987. Principles of Plant Nutrition. 4th Ed., International Potash Institute, Bern, Switzerland, 62: 524.

Montasser, S.Y.B. 1987. Organic manuring and behavior of certain elements in Egyptian soils with special reference to response of grown plants. Ph. D. Thesis, Fac. of Agric., Ain Shams Univ., Egypt.

Norris, S.R. and Ribbons, D.W. 1971. Methods in Microbiology. Vol. 53, Acadimic Press. New York, USA.

Olsen, S.R.; Colc, C.V.; Watanab. F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soil by sodium bicarbonate. U. S. Dep. Agric. Circ. 939.

Singer, J.W.; Kohler, K.A.; Liebman, M.; Richard, T.L.; Cambardella, C.A. and Buhler, D.D. 2004. Tillage and compost affect yield of corn, soybean, and wheat and soil fertility. Agron. J., 96:531–537.

Singer, J.W.; Logsdon, S.D. and Meek, D.W. 2007. Tillage and compost effects on corn growth, nutrient accumulation and grain yield. Agron. J., 99: 80-87.

Smith, J.H. 1986. Decomposition of potato processing wastes in soil. J. Environ. Qual., 15: 13-16.

Stewart, D.W.; Dwyer, L.M.; Anderws, C.S. and Dugas, J. A. 1997. Modeling carbohydrates production strange and export in leafy and normal maize. Crop Sci., 37: 1228.

Uhart, S.A. and Andrade, F. H. 1995. Nitrogen deficiency in maize. I: Effect on crop growth development, dry matter partitioning and kernel set. Crop Sci., 35: 1376.

Wanas, Sh.A. 2006. Towards proper management of clayey soils: II: Combined effects of plowing and compost on soil physical properties and corn production. J. Appl. Sci. Res., 2 (3): 123-128.

Wang, X. and Below, F.F. (998). Accumulation and partitioning of mineral nutrient in wheat as influenced by nitrogen form. J. of Plant Nutr., 21: 49.

Wang, X.; Xin, J.F.; Grant, C.A. and Bailey, L.D. (1995). Effect of placement of urea with urease inhibitor on seedling emergence, uptake and dry matter yield of wheat. Can. J. Plant Sci., 5: 449.

Watanabe, F.S. and Dlsen, S.R. 1965. Test of an ascorbic and method ford determining phosphorus in water and $NaHCO_3$ extracts from soil. Soil Sci. Soc. Amer. Proc., 29: 677.

Yibirin, H.; Johnston, J. W. and Eckert, D. 1996. Corn production as affected by daily fertilization with ammonium nitrate and phosphorus. Soil Sci. Soc. Am. J., 60: 512.

Yung-Yu Shun 2006. Effect of application of different types of organic composts on rice growth under laboratory conditions. Soil Sci. and Nutrition, 51: 443 – 449.

دراسة مقارنة عن تأثير التسميد العضوى والمعدنى على بعض خصائص نباتات القمح النامية فى أراضى طينية رسوبية نهرية وأخرى رملية

نادر رمزي حبشى   ليلى قرنى محمد على   مصطفى حامد عبد السلام
معهد بحوث الأراضى والمياة والبيئة- مركز البحوث الزراعية

أجريت تجربتين حقليتين خلال الموسم الشتوى لعام ٢٠٠٧ على نوعين من الأراضى يمثلا المناطق حديثة الإصلاح وقديمة الإستزراع، ومن ثم فانهما يختلفا فى مادة الأصل (رملية صحراوية ذات طبيعة جيرية بمنطقة النوبارية، رسوبية نهرية بمحطة البحوث الزراعية بالجميزة) وخصائص التربة، وذلك لتقييم تاثير بعض مكمورات مخلفات النباتات بنسبة إحلال جزئى لـ ٢٠٪ من النتروجين المعدنى (مكمورة حطب الأذرة، وقش الفول البلدى) على تيسر العناصر الضرورية للنبات فى التربة وكذلك امتصاصها بواسطة نبات القمح وإنعكاس ذلك على النمو فى مراحله الفسيولوجية المختلفة، جودة وكمية المحصول الناتج تحت ظروف نوعى الأراضى تحت الدراسة وذلك مقارنة بالسماد المعدنى النتروجينى (كبريتات الأمونيوم- ٢٠٪ نتروجين).

وتشير النتائج إلى أن إضافة مكمورة المخلفات النباتية قد أدى إلى زيادة فى محصول المادة الجافة لنباتات القمح على إمتداد مراحل النمو الفسيولوجية المختلفة فى كلا الأرضين تحت الدراسة، حيث كانت معاملة مكمورة قش الفول هى الأفضل فى زيادة النتروجين والفوسفور والبوتاسيوم الممتص بواسطة النبات، كما وأن جودة حبوب القمح معبرا عنها بالمحتوى الكلى من البروتين والكربوهيدرات كانت أفضل فى حالة إضافة المكمورة العضوية – خاصة مكمورة قش الفول البلدى – عنه فى حالة النتروجين المعدنى تحت ظروف كلا الأرضين تحت الدراسة. وهذا منطقى، حيث أن الإحلال الجزئى للنتروجين المعدنى بآخر عضوى يلعب دورا ها ما فى تعظيم المحصول البيولوجى للقمح (محصول القش، الحبوب وجودتها) وذلك لأن مثل هذه الخدمة المزرعية ليست فقط لزيادة قدرة التربة على الإحتفاظ بالمغذيات لأطول فترة إستخدام بل أيضا لتحسين خواص التربة والتى تشجع من تيسر وسهولة حركة وإمتصاص المغذيات بواسطة النباتات النامية، ولذا فان تلك التجارب الحقلية تؤكد أهمية التسميد العضوى لكلا التربة الرملية والطينية على حد سواء لسهولة إنطلاق المغذيات النباتية (N, P and K) فى التربة وكذا إمتصاصها بواسطة جذور النبات متأثرا بالمكمور العضوى المضاف للتربة. آخذا فى الإعتبار غنى الأراضى الطينية فى المغذيات النباتية، فان معدل تيسر وإمتصاص المغذيات فى الأراضى الرملية كان أكثر وضوحا لعدم وجود معوقات أرضية تحد من إنطلاقها فى صورة ميسرة.

ولقد أجريت محاولة تقييم إقتصادى للإحلال الجزئى لبعض النتروجين المعدنى (٢٠٪) من مصدر عضوى، وذلك باستخدام مكمور المخلفات النباتية وعلاقته بالمعدل الموصى به كاملا من النتروجين المعدنى، وتوضح النتائج أن المكورات ذات الـ C/N ratio المنخفضة مثل مكمورة قش الفول البلدى تعتبر ذات فائدة كبيرة، حيث أن العائد الحقيقى من إضافة المخصبات تحت الدراسة لم يظهر فروق محسوسة مع إستخدام الأسمدة المعدنية النتروجينية فى كلا الأرضين تحت الدراسة، وربما يرجع ذلك إلى سهولة فقد النتروجين المعدنى بالتطاير فى التربة ذات الطبيعة الجيرية كذا بالغسيل فى التربة خشنة القوام، ولهذا السبب فان الأمر قد يرجع إلى ظروف خارجية.