Response of Wheat to Different Rates and Ratios of Organic Residues on Yield and Chemical Composition under Two Types of Soil

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Abstract: Two field experiments were conducted in two successive seasons (2007-2008 and 2008-2009) at Atta, Giza –Governorate and Nubaria region to study the effect of different rates and ratios of organic residues (Farmyard manure and filter mud) on yield and chemical composition of wheat under two types of soils (sandy and Calcareous soil). Results showed that, application of farmyard manure and filter mud residue gave a significant increase in grain and straw weight, total yield, crop index, harvest index, curd protein, N, P and K compared to the control treatment. Data also, indicated that significant increase grain, straw and total yield in sandy soil compared with calcareous soil under study in all treatments. On the other hand, the addition of organic materials (Farmyard manure and filter mud) were effective either individual or mixed with other. The pronounced increase in grain and straw weight, N, P and K content and uptake was noticed when farmyard manure was combined with filter mud at the rate of 2% compared with 1% of organic residues.

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1. Introduction:

Wheat is considered one of the most important and strategically crops in Egypt, but its area produced only about 30% of the domestic needs. There are several ways for increasing wheat production; one of them is the appropriate application of organic residues, especially in the newly reclaimed areas. Most of the newly reclaimed areas in the deserts of Egypt are sandy soils, which have certain problems in their cultivation. Sandy soils are very poor in their organic matter contents as well as their primitive fertility. On the other hand, organic materials such as crop residues, farmyard manure, industrial wastes (filter mud), etc., are available in abundance and reach tremendous amounts every day. Organic matter is a key component of the soil because it carries out many functions in agro-ecosystem. Organic manure is commonly applied to the soil to hence improve their physical, chemical and biological properties of many soils (Jimenez *et al.*, 2002 Nardi *et al.*, 2004, Weil and Magdoff, 2004 and Celik, *et al.*, 2004).

Fliessbach *et al.*, (2000) suggested that, organic manure application increased the transfer elements between the solid phase and soil solution in addition to higher microbial activity. They also, reported that organic soil management improved the soil structure by increasing soil aggregate, thus reducing the risk of soil erosion and promoted the development of the earth condition for plant. The activity of soil microorganisms was higher in the organic farming system, which helped the nutrient uptake to be faster.

Thind *et al.*, (2002) found that, significant increase in N uptake by maize and wheat was observed with continuous application of organic manures.

In wheat plant Sing *et al.*, (2002); Sushila and Gajendra (2002); Nehra and Hooda (2002); Thangavel and Prabakaran (2003); Tawfik and Gomaa(2005), and Zeidan *et al.*, (2005), found that farmyard manure application significantly enhanced the yield and N, P and K uptake of wheat. Sieling et *al.*, (2006) found that the former N treatments (pig slurry) enhanced grain yield and total N uptake of wheat compared with the former unfertilized control, Yaduvanshi and Sharma (2008), found that application farmyard manure with chemical amendment increased wheat yield and N, P and K uptake in grain yield.

Gong et al., (2009) and Enke Liu et al., (2010) indicated that, long-term additions of organic manure have the most beneficial effects on grain yield of wheat and maize.

In Egypt, a tremendous mass of filter mud as byproducts obtained from the clarification of cane juice in sugar industries. These waste residues present a problem for disposal; therefore, it was through useful to use residues as an organic source. Sugar can filter mud contain a considerable amount of plant

nutrients, mainly nitrogen (Arafat 1994). Sugar can filter mud is a good source of available N when applied to soil and its application cane reduce the amount of fertilizer nitrogen required for optimum crop yield and play a role in decreasing the pollution effect of excessive N mineral fertilizer in soil (Arafat *et al.,* 1997 and Yassen *et al.,* (2002).

The current investigation was carried out to study the effect of different sources and ratios of organic residues on yield and chemical composition of wheat under two types of soil.

2. Materials and methods

Two field experiments were conducted in two successive seasons (2007-2008 and 2008-2009) at Atta, Giza Governorate and Nubaria, Behaira Governorate to study the effect of different rates and ratios of organic residues on yield and chemical composition of wheat under two types of soil. Some soil physical and chemical characteristics of the studied soil are recorded in table (1).

The experimental design included 12 treatments which were as follows:

1- Control (without fertilizer)
2- NPK (recommended does 100: 50:50 kg /fed)
3 - FY (1 %)
4 - FY (2 %)
5 - FM (1 %)
6 - FM (2 %)
7- FY: FM (1%) 1: 1
8 - FY: FM (1%) 2: 1
9 - FY: FM (1%) 1: 2
10- FY: FM (2%) 1: 1
11 - FY: FM (2%) 2:
12 - FY: FM (2%) 1: 2

Table (1) some characteristics of soil under investigated

Characteristics	Sandy soil	Calcareous soil
pH 1.2.5	8.25	8.09
EC 1:5	0.15	3.99
CaCO3	1.73	18.43
Organic matter %	0.31	0.48
Available N ppm	33.0	24.0
Available P ppm	11.0	9.00
Available K ppm	4.00	2.00
Mechanical analysis		
Sand %	82.52	78.09
Silt %	10.68	3.49
Clay %	6.8	18.42

The design of each experiment was a complete randomized block system in three replicate. The area of the experimental plot was 10 m^2. The organic materials (Farmyard manure and filter mud) were thoroughly mixed with 0 – 30 cm of the surface soil layer before sowing, (Table2).

Table (2) some properties of farmyard manure (FY) and filter mud (FM)

characteristics	pH	EC dSm^{-1}	Organic matter %	Organic carbon %	Total (%)			Available micro.Nutrient (ppm)		
					N	P	K	Fe	Zn	Mn
Farmyard manure	7.97	2.6	66.68	38.76	1.78	0.31	0.89	412	138	281
filter mud	8.82	0.72	69.14	40.20	2.37	1.48	0.49	1854	121	253

Basal dose of 50 kg P_2O_5 fed^{-1} and 50 kg K_2O fed^{-1} in the form of Superphosphate (15.5%) and potassium sulphate (48% P_2O_5) was added before transplanting, the recommended does of nitrogen was 100 kg N/ fed.

Wheat seeds (Triticum *a estivum L,*) c.v Gemaza 9 were sown in the chosen soil on the last of November for both seasons. The grains were broadcasted on the soil at the rate of 60 kg/fed. At the maturity stage, the plants were harvested and separated into grains and straw. Production was recorded and prepared for analysis. Samples were digested with the acid mixture. Total nitrogen, phosphorus and potassium were determined according to the method described Cottonie et al., (1982).

Statistical analysis of all results was conducted using (NLSD) according to Gomez and Gomez (1984) and the combined analysis of the two seasons was calculated according to the method of Steel and Torrie (1980). The physical and chemical properties of the soil were determined according to Chapman and Pratt (1961)

3. Results and Discussion:

Effect of organic residue on wheat production

The data in table (3) represent that, the wheat production under different rates and ratios of organic

residues with the two types of soil of wheat. The addition of farmyard manure and filter mud residue within all tested rates resulted in a significant increase in grain, straw weight and total yield compared to the control treatment, and consequently, the biological yield of wheat plant. These results are in a good harmony with Yassen *et al.,* (2002) and Zeidan *et al.,* (2005), Yaduvanshi and Sharma (2008). They found that the addition of farmyard manure or/and filter mud had a beneficial effect on grain and straw of wheat plant.

Data also, indicated that application of filter mud decreased grain and straw yield compared to farmyard manure with the two types of soil. This phenomenon may be due to high C/N ratio of filter mud (Arafat *et al.,* 1997).

Concerning the effect of farmyard manure and filter mud, data showed that significant increase grain, straw and total yield in sandy soil compared with calcareous soil with all treatments. In the same time, data showed that, applying farmyard manure and filter mud as a soul at a rate of 2% were more effective in producing grain and straw than application farmyard manure and filter mud at a rate of 1% for both soil. It could be concluded that increasing organic matter to wheat plants induced more grain and straw yield. This may be due to the ability of organic manure to support the growth plants with micro and macro nutrients need for their growth. Similar Results were obtained by Barzegar *et al.,* (2002). Results also, indicated that application of the farmyard manure and filter mud ratio at (1: 1); (2: 1) and (1:2) in both rate at 1% and 2% improve grain, straw weight and biological yield compared with application farmyard manure and filter mud alone in both soil. Farmyard manure addition combined with filter mud may correct the final C/N ratio mixture in order to obtain a preferable condition for enhancing the mineralization of the organic N.

It was worthy to mention that data obtained FY: FM (1:2) had a beneficial and pronounced effect on yield production than other treatments. Data also, observed that application FY and FM increased crop index and harvest index compared the control under types of soil. It has been noticed that farmyard manure combined with filter mud at a ratio (1:1) were markedly increased in the crop index and harvest index in sandy soil while increased CI and HI at a ratio (2:1) in calcareous soil at rate 1%.

Table (3) effect of different rates and ratios of organic residue on grain and straw total yield of wheat plant under two types of soil (Average two seasons)

treatments	Sandy soil					Calcareous soil				
	Grain ten/fed	Straw ten/fed	Total ten/fed	CI	HI	Grain ten/fed	Straw ten/fed	Total ten/fed	CI	HI
control	0.625	1.663	2.288	0.38	27.73	0.544	1.430	1.974	0.38	27.25
NPK	2.161	3.929	6.090	0.55	35.48	1.892	3.282	5.174	0.58	36.57
FY 1 %	1.950	3.860	5.910	0.53	32.99	1.634	2.833	4.467	0.58	36.58
FY 2%	2.127	4.769	6.896	0.45	30.84	1.854	3.054	4.908	0.61	37.78
FM 1 %	1.747	3.073	4.820	0.56	36.24	1.522	2.673	4.195	0.57	36.28
FM 2%	1.815	3.279	5.093	0.55	35.64	1.678	2.895	4.573	0.58	36.69
FY : FM	1%									
1 : 1	2.808	3.431	6.239	0.82	45.00	1.830	2.982	4.812	0.61	38.03
2 : 1	2.597	3.617	6.241	0.72	41.50	2.091	2.987	5.078	0.70	41.17
1 : 2	2.236	4.242	6.478	0.53	34.51	1.793	3.550	5.343	0.51	33.55
FY : FM	2%									
1 : 1	2.330	3.674	6.003	0.63	38.81	1.687	2.901	4.588	0.58	36.77
2 : 1	2.154	4.094	6.048	0.48	35.61	2.084	3.834	5.918	0.54	35.21
1 : 2	2.225	4.259	6.479	0.52	34.26	1.723	3.952	5.675	0.43	30.36
L.S.D 0.05	0.15	0.23	0.36	0.04	2.33	0.11	0.20	0.30	0.03	2.18

FY: farmyard manure FM: filter mud CI: crop index = grain / straw x 100
HI: harvest index = grain /total yield x100

Chemical composition

The N concentration and uptake of nitrogen in wheat plant grown in sandy and calcareous soil treated with different rates and ratios of farmyard manure and filter mud are recorded in table (4). Data indicated that, all treatments tended to increase nitrogen concentration and uptake in grain and straw as compared with the control treatment. The increasing of N concentration and its uptake with organic matter application may be attributed to the mineralization of organic minerals and slow release of minerals in an available form, from organic manure and may be due to the effect of several organic acids, produced during manure decomposition. These results are in a good agreement with that obtained Zeidan *et al.,* (2005)

Sieling et *al.*, (2006) they stated applying farmyard manure to the soil increased content and uptake by grain and straw due to the beneficial effect of organic matter for improving the nutritional statue, particularly nitrogen.

It is interested to mention that, nitrogen concentration in grain and straw yield with respect to a ratio; rate and type of organic residue (FY and FM) were very clear. Taking the nitrogen uptake into consideration, data in the same table showed that, N uptake increased in sandy soil than calcareous soil. This increase seems to be due to the increase in dry matter formation.

With respect to the effect of farmyard manure and filter mud at different rates of 1% and 2 % and ratios (1:1), (2:1), and (1:2) combined with filter mud data declared that, applying the two sources with each other, gave the higher increase in total N content for both grain and straw compared to farmyard manure or filter mud applied alone. The same trend was observed in N uptake. The pronounced increase in N content and uptake was noticed when farmyard manure was combined with filter mud at a rate of 2%.

On the other hand, data in the same table indicated that, protein content increased when the two organic residues combined with each other as compared to farmyard manure or/ and filter mud alone, the highest value observed at 2%. These finding are harmony with those obtained by Eghbal et al.,(2004) and Mohammed (2004)

Data recorded in tables (5 and 6) illustrate that, effect of different organic residue farmyard manure either alone or in with mixed filter mud and different rates and ratios on phosphorus and potassium content and uptake, data showed the obvious increase for different as compare with control. Similar Suggestions was also reported by Barzegar *et al.*,(2002). In contrast, the addition of organic material was effective either individual or mixed with other.

Data indicated that, increased phosphorus and potassium concentration and uptake in grain and straw as compared with the control treatment. These results are in a good agreement that obtained by Nehra and Hooda (2002) and Thangavel and Prabakaran (2003)

Phosphorus and potassium content in wheat plant (grain and straw) increased in sandy soil as compared with calcareous soil, due to the differences in its physiochemical properties. Concerning P and K uptake data illustrated that, the uptake was higher in the sandy soil as compared to the calcareous soil for both P and K.

Data also, indicated that P and K content and uptake in both grain and straw increased continuously with increasing farmyard manure and filter mud rate applied from 1% and 2%. This indicates that, due to the increase in P and K farmyard manure and filter mud amended soil enhanced microbial activates, which increase nutrient availability and their uptake and increasing root distribution. These results are in a good agreement that obtained by Yaduvanshi and Sharma (2008)

Table (4) effect of different rates and ratios of organic residue on N content % and uptake kg/ fed. Protein % content of wheat plant under two types of soil (Average two seasons)

treatments	Sandy soil					Calcareous soil				
	Grain			straw		Grain			straw	
	N %	Uptake Kg / fed	Protein %	N %	Uptake Kg / fed	N %	Uptake Kg /fed	Protein %	N %	Uptake Kg /fed
control	098	3.85	5.64	0.26	4.32	0.88	4.79	5.06	0.22	3.15
NPK	1.55	33.50	8.91	0.70	27.50	1.46	27.62	8.40	0.45	14.77
FY 1 %	1.55	30.23	8.91	0.64	24.70	1.27	20.75	7.30	0.49	13.88
FY 2%	1.45	30.84	8.34	0.58	27.66	1.32	24.47	7.59	0.50	15.27
FM 1 %	1.10	19.22	6.33	0.39	11.98	0.99	15.07	5.69	0.28	7.48
FM 2%	1.26	22.87	7.25	0.45	14.78	1.11	18.63	6.38	0.33	9.55
FY : FM	1%									
1 : 1	1.64	46.05	9.43	0.61	20.93	1.55	28.37	8.91	0.48	14.31
2 : 1	1.56	40.51	8.97	0.66	23.87	1.49	31.16	8.57	0.52	15.53
1 : 2	1.61	36.00	9.26	0.56	23.76	1.61	28.86	9.26	0.55	19.53
FY : FM	2%									
1 : 1	1.71	39.84	9.83	0.65	23.88	1.57	26.48	9.03	0.50	14.50
2 : 1	1.75	45.41	10.06	0.68	27.84	1.72	35.84	9.89	0.52	19.94
1 : 2	1.67	37.34	9.60	0.61	25.98	1.58	27.22	9.09	0.49	19.36
L.S.D 0.05	0.09	2.75	0.45	0.04	1.57	0.08	1.83	0.51	0.03	1.14

Table (5) effect of different rates and ratios of organic residue on P content % and uptake kg/ fed. of wheat plant under two types of soil (Average two seasons)

treatments	Sandy soil				Calcareous soil			
	Grain		straw		Grain		straw	
	P %	Uptake Kg / fed	P %	Uptake Kg / fed	N %	Uptake Kg /fed	N %	Uptake Kg /fed
control	0.25	1.56	0.11	1.83	0.19	1.03	0.09	1.29
NPK	0.40	8.64	0.15	5.89	0.32	6.05	0.11	3.61
FY 1 %	0.32	6.24	0.14	5.40	0.28	4.57	0.13	3.68
FY 2%	0.35	7.44	0.15	7.15	0.32	5.93	0.15	4.58
FM 1 %	0.35	6.11	0.15	4.60	0.34	5.17	0.11	2.94
FM 2%	0.38	6.90	0.16	5.25	0.36	6.04	0.13	3.76
FY : FM	1%							
1 : 1	0.39	10.95	0.16	5.49	.35	6.40	0.12	3.57
2 : 1	0.41	10.64	0.18	6.51	0.37	7.74	0.14	4.18
1 : 2	0.44	9.84	0.19	8.06	0.42	7.53	0.15	5.33
FY : FM	2%							
1 : 1	0.41	9.55	0.16	5.88	0.37	6.24	0.11	3.19
2 : 1	0.45	9.69	0.20	8.19	0.41	8.54	0.15	5.75
1 : 2	0.48	10.68	0.22	9.37	0.48	8.28	0.16	6.32
L.S.D 0.05	0.02	0.24	0.01	0.44	0.02	0.22	0.01	0.31

Table (5) effect of different rates and ratios of organic residue on K content % and uptake kg/ fed. of wheat plant under two types of soil (Average two seasons)

treatments	Sandy soil				Calcareous soil			
	Grain		straw		Grain		straw	
	K %	Uptake Kg / fed	K %	Uptake Kg / fed	K %	Uptake Kg /fed	K %	Uptake Kg /fed
control	0.46	2.88	1.42	23.62	0.41	2.23	1.33	19.02
NPK	0.65	14.05	2.88	113.16	0.52	9.83	2.45	80.41
FY 1 %	0.71	13.84	2.09	80.67	0.50	8.17	2.19	62.04
FY 2%	0.74	15.73	1.91	91.09	0.55	10.20	2.82	86.12
FM 1 %	0.59	10.31	2.17	66.68	0.49	7.46	2.34	62.55
FM 2%	0.69	12.52	2.32	76.07	0.50	8.39	2.27	65.72
FY : FM	1%							
1 : 1	0.68	19.09	2.74	94.01	0.64	11.71	2.67	79.62
2 : 1	0.87	22.59	2.59	93.60	0.76	15.89	2.44	72.88
1 : 2	0.67	14.98	2.84	120.47	0.61	10.93	2.55	90.53
FY : FM	2%							
1 : 1	0.71	16.54	2.55	93.68	0.56	9.44	2.33	67.59
2 : 1	0.67	14.43	2.64	108.08	0.62	12.92	2.78	106.83
1 : 2	0.72	16.01	2.64	112.44	0.72	12.41	2.53	99.98
L.S.D 0.05	0.04	1.03	0.15	6.28	0.03	0.70	0.14	5.41

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