INTEGRAT ED EFFECT OF ORGANIC MANURE AND UREA ON WHEAT YIELD AND GRAIN QUALITY

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ABSTRACT:

A field experiment was conducted on a clay soil at a Private Farm, Damas Village, Mit Ghamer district, Dakahliea Governorate, Egypt during the growing winter season of 2009-2010 to study the integrated effect of organic manure (farmyard manure, FYM) as an organic soil amendment and urea on wheat yield (*Triticum aestivium* L., Gemmiza 9 cv.) and grain quality. Farmyard manure (FYM) was applied at three rates of 0, 15 and 30 m^3 fed^{-1}, while urea was added at the rates of 0, 46, 69 kg fed^{-1}. The experimental design was a split plot, with nine treatments, *i.e.,* F_0U_0 as a control, F_0U_1, F0U2, F_1U_0, F_1U_1, F_1U_2, F_2U_0, F_2U_1 and F_2U_2. The main plots were occupied with the applied FYM rates, meanwhile the added urea rates were arranged among the sub-plots, and then each treatment was replicated three times. The plot area was 10.5 m^2 (3 × 3.5 m), which represents approximately 1/400 feddan.

The obtained results showed that the applied different FYM and urea rates exhibited a significantly ameliorated for each of the studied wheat plant parameters at growth (*i.e.,* plant height and No. of either tillers or spikes/plant) and harvest stages (*i.e.,* biological yield of grain plus straw yields and their contents of N, P, K, Fe, Mn and Zn) as well as grain quality (*i.e.,* 1000 grain weight, grain contents of protein, carbohydrates and sugar fractions). The favourable effects of the applied treatments were extended to improve some soil properties, *i.e.,* lowering soil pH and increasing soil available contents of either macro- (N, P and K) or micronutrients (Fe, Mn and Zn).

Also, it was observed that the effect of the applied treatments was positively reflected on soil biological activity that represented by CO_2 evolution from soil before and after irrigation during the growing agriculture season. From the economical point of view, the results of this study showed that the integrated effect of the combined treatment of (30 m3 FYM/fed + 46 kg urea/fed) was recorded best values for all the aforementioned plant parameters and soil properties, taking into consideration the possible adverse fears of human health through environmental risks as a result of the excessive use of nitrogenous fertilizers.

Key Words: Farmyard manure, urea, wheat productivity, wheat grain quality.

INTRODUCTION

One of the factors directing crop production in terms of quality and quantity is well-balanced by plant nutrition and therefore suitable fertilization. Nitrogen fertilizers are one of the most used fertilizers in Egypt and the world, and its application increases day by day. Particularly since hybrid varieties were densely used in agriculture system of Egypt, which showed that the use of N fertilizer has increased greatly with effective irrigation. On the other hand, it is one of the elements that carry potential risk to environmental pollution of soil and water sources **(Marilla *et al*., 2004, Gallardo *et al*., 2005)**.

Human health and environmental quality will be settled under danger because of the polluted soil and water resources with residual effect of nitrogenous fertilizers **(Halvarson *et al.,* 2005)**. Part of the nitrogen fertilizer which could be absorbed by plants enters into a cycle in which chemical and biological processes occur. This cycle shows great variety depending on the soil, climate and land usage. Depending firstly on water parameters and soil texture, accumulation of nitrogen in the soil, its leaching and deformation determine the amount of fertilizer to be used **(Hofman and Cleemput, 2004)**.

Farmyard manure is an output function of aerobic fermentation of cattle dung and other animal waste. Such organic manure protects the environment from pollution as a result of rationalization of consumption of mineral fertilizers, producing the obtaining a sustainable agriculture as well as clean food. Thus, it is generally believed that combining organics with inorganic fertilizer will increase synchrony and reduce losses by converting N-inorganic into organic forms. Studies have shown that it is not always true. For example, **Janzen and Schaalje (1992)** found that N-fertilizer losses were twice as large as when green manure plus fertilizer was applied to barley. Their interpretation was that green manure promoted high levels of nitrate and available C in the soil, enhancing de-nitrification. However, losses were reduced with smaller repeated applications of green manure, implying that the use of high quality green manure as partial substitution for inorganic fertilizer rather than addition to inorganic fertilizer may increase nutrient use efficiency.

Xu *et al*. (1993) and Jones *et al*. (1997) found large losses of 25 to 41% of N added from leucaena prunings, and it could be attributed to the de-nitrification process. It was also found that losses were greater when materials were incorporated rather than surface applied. **Ganry *et al*. (1978) and Shah *et al.* (2002)** also concluded that large applications of low quality straw can result in large losses of N-fertilizer through de-nitrification. These results thus indicate that N losses can be quite high from both organic and inorganic sources, contrary to the popular belief that application of organic resources will result in fewer losses. According to **Zia *et al.* (2000)**, continuous use of chemical fertilizers even in balanced proportion will not. **Gupta *et al*. (2000)** reported that, combined application of urea and farmyard manure significantly enhanced available N status over similar N addition through urea alone. They also indicated that, available P and K content of the soil decreased with successive rise in levels of N addition through urea whereas the status of these nutrients increased in plots receiving combined application of urea and manures.

The objective of the current study was to evaluate the integrated effect of farmyard manure as a soil amendment and urea additions on available nutrients status as well as the growth parameters of grown plants, yield and grain quality. Such scientific research represents a trial for explaining the negative effect of the continuous use of chemical fertilizers, particularly nitrogenous ones which cause human health and environmental hazards as well as ground and surface water pollution by nitrate **(Pimentel, 1996)**.

MATERIALS AND METHODS:

To achieve the aforementioned target, a field experiment was conducted on a clay soil at a Private Farm, Damas Village, Mit Ghamer, Dakahliea Governorate, Egypt, during the growing winter season 2009-2010. Some physical, chemical and fertility characteristics of the experimental soil were determined according to the standard methods outlined by **Black *et al.* (1965) and Page *et al.* (1982)**, and the obtained data are presented in Table (1). Also, some chemical characters of used farmyard manure are shown in Table (2).

Table (1): Some physical, chemical and fertility characteristics of the studied soil.

Soil characteristics	Value	Soil characteristics.	Value
Particle size distribution %:		***Analysis of soil paste extract:***	
Sand	13.72	EC (dS/m)	1.67
Silt	28.77	*Soluble cations (m molc L^{-1}):*	
Clay	57.51	Ca^{++}	5.32
Texture class	Clay	Mg^{++}	3.68
$CaCO_3$ %	2.52	Na^{+}	7.15
Organic matter %	1.67	K^{+}	0.75
		Soluble anions (m molc L^{-1}):	
Soil available nutrients (mg kg^{-1}):		CO_3^{--}	0.00
N	45.67	HCO_3^{-}	2.90
P	8.70	Cl^{-}	8.85
K	429.50	SO_4^{--}	5.15
Fe	7.84	pH (1:2.5 soil water suspension)	7.95
Mn	3.12	CEC (c molc kg^{-1})	39.75
Zn	2.27	ESP	9.45

Critical levels of nutrients after Lindsay and Norvell (1978) and Page et al. (1982)

Limits	**N**	**P**	**K**	**Fe**	**Mn**	**Zn**
Low	< 40.0	< 5.0	< 85.0	< 4.0	< 2.0	< 1.0
Medium	40.0-80.0	5.0-10.0	85.0-170.0	4.0-6.0	2.0-5.0	1.0-2.0
High	> 80.0	> 10.0	> 170.0	> 6.0	> 5.0	> 2.0

Table (2): Some characteristics of used farmyard manure (dry weight basis).

Character	Value
Weight of 1 m^3 (kg)	718.00
pH (1:10 water suspension)	7.38
EC (dS/m, 1:10 water extract)	2.45
Moisture content %	12.35
Organic matter %	39.16
Organic carbon %	22.77
C/N ratio	18.07

Available nutrients (mg kg-1)

N	**P**	**K**	**Fe**	**Mn**	**Zn**	**Cu**
3800	1200	1980	481	215	114	78

Wheat (*Triticum aestivum* L., Gemmiza 9 cv.) was chosen as an indicator plant. Farmyard manure (FYM) was applied at three rates, *i.e.*, 0, 15 and 30 m^3 fed^{-1}, while urea was applied at the rates of 0, 46, 69 kg fed^{-1}. The experimental design was a split plot, with nine treatments of F0U0 as a control, F_0U_1, F_0U_2, F_1U_0, F_1U_1, F_1U_2, F_2U_0, F_2U_1 and F_2U_2. The main plots were occupied with the applied FYM rates, meanwhile the added urea rates were arranged among the sub-plots, and then each treatment was replicated three times. The plot area was 10.5 m^2 (3 × 3.5 m), which represents approximately 1/400 feddan.

Farmyard manure was applied throughout the soil plouhing before and thoroughly mixed with the 20 cm surface layer of the soil on the 1st of November 2009. On the 16th November 2009, wheat seeds were sown, its variety (Gemmiza 9) was obtained from the Plant Breeding Department, ARC, Giza.

Nitrogen fertilizer was added to the soil before the first irrigation in a solid form of urea (46.5 % N) at a rate of 46 and 69 kg fed^{-1}. P and K fertilizers as superphosphate (15.5 % P_2O_5) and potassium sulphate (48 % K_2O) were added at the rates of 100 and 50 kg fed^{-1}, respectively.

Wheat yield and its components, *i.e.*, plant height, No of tillers plant^{-1}, No of spikes plant^{-1}, dry weight plant^{-1}, 1000 grain weight, grain and straw contents of N, P, K, Fe, Mn, and Zn were determined. The grains and straw were dried, ground and digested according to **Peterburgski (1968)**. Nitrogen was determined using Microkjeldahl, P by stannous chloride method as described by **A.O.A.C. (1990)** and K was determined by using Flam photometer **(Yamagnchi and Minges, 1956)**. Fe, Mn and Zn were determined using Atomic Absorption Spectrophotometer Perkin Elmer 3110, according to **Cottenie *et al.* (1982)**. Total carbohydrates and sugars were determined according to **A.O.A.C. (1990)**.

Estimation of soil biological activity, which represented by measuring the carbon dioxide evolved from soil samples, in the laboratory, using the modified closed technique **(Pramer and Schmid, 1964)**. Soil samples were collected from each treatment determined at the maximum vegetative growth for determining available nutrients of N-NH_4, N-NO_3, P, K, Fe, Mn and Zn. Available nitrogen forms of NH_4 and NO_3 were determined by using Techniniciam Auto Analyzer according to **Markus *et al*. (1982)**, P and K were determined according to **Jackson (1967)**. Also, available Fe, Mn and Zn were determined according to **Buckanan and Muraoks (1964).** The obtained data were statistically analyzed using the using L.S.D. at 0.05 as described by **Snedecor and Cochran (1980)**.

RESULTS AND DICUSSION:

I. A general view on the characteristics of the experimental soil:

The field work and analytical data (Table, 1) of the representative soil sample leads to a good knowledge about the main characteristics of the experimental site, which is mainly encompassing the Nile alluvium as a parent material, developed on recent alluvial Nile Delta of Egypt. The climatic conditions characterized by a long hot rainless summer and short mild winter, with scare amounts of rainfall. The ground water table not appeared till 150 cm depth from ground surface due to the presence of an efficient field ditches, which were limited the current soil depth. Also, it is characterized by clay in texture, non-saline (i.e., ECe=1.67 dS/m), non-sodic (ESP=9.45 %), non-calcareous in nature ($CaCO_3$=2.52 %), well drained and sub-angular blocky in structure. These conditions are stood in harmony with the fact that the studied soil is predominated by the clay fraction (*i.e*., 57.51 %), which is more capable to retain adequate water and nutrients for growing plants.

II. Wheat growth, yield and grain quality as affected by the applied treatments:

Data in Table (3) reveal that wheat growth parameters (*i.e*., plant height, No. of tillers/plant, dry weight/plant and No. of spikes/plant), grain quality (*i.e*., grains weight/plant and 1000 grain weight) and biological yield (*i.e*., grain and straw yields) were significantly and positive affected by the applied treatments, particularly for the combined ones of (FYM + Urea) and with increasing the applied rates of both organic and inorganic fertilizers.

That was true, since the integrated effect for using urea and FYM on the plant height achieved a maximum plant height of 109.4 cm at the highest rates of FYM (30 m^3/fed) and urea (69 kg/fed) vs 107.9 cm at the same rates of FYM/fed and 46 kg urea/fed. The corresponding relative increase percentages were 27.06 and 25.32 % over the control treatment, respectively, with a slightly difference of 1.74 % vs a pronounced reduction in the applied N-mineral of urea reached about one third percent. Such results clearly obvious the effective role of the applied organic manure that is more attributed to nutrients slow release during its decomposition and mineralization processes as well as minimizing their possible lose from the soil. These positive effects were extended to dry weight plant^{-1}, Nos. of tillers and spikes plant^{-1}, where such growth characters showed significantly greatest values 14.15 g, 5.71 and 5.05 at the applied highest rates of FYM (30 m^3/fed) and urea (*i.e.*, 69 kg/fed), as shown in Table (3). It is noteworthy to mention that the obtained data showed that a partial substitution of N-mineral by FYM as shown in the treatment (30 m^3 FYM/fed + 46 kg urea/fed) led to an almost similar plant growth parameters, *i.e.*, 13.87 g, 5.64 and 4.90, with corresponding insignificant differences don't exceeding about 2-3 %, respectively. These results are in harmony with those results obtained by **Amanullah and Maimoona (2007)**.

Table (3): Effect of the different applied rates of farmyard manure and urea application on wheat yield and its components.

FYM, A (m^3/fed)	Urea, B (kg/fed)	Growth parameter				Biological yield		Grain quality	
		Plant height, cm	No. of tillers/plant	Dry weight/ plant, g	No. of spikes/ plant	Grain yield, ardab/fed	Straw yield, ton/fed	Grains weight, g/plant	1000 grain weight, g
0	0	86.1	2.85	9.10	2.41	12.40	2.58	4.85	37.78
	46	93.6	3.72	10.86	3.30	15.84	3.94	6.54	45.54
	69	97.5	3.97	11.75	3.67	17.65	4.25	6.90	47.09
Mean		92.40	3.51	10.57	3.13	15.30	3.59	6.10	43.47
15	0	95.5	3.91	10.85	3.23	16.51	3.25	6.15	43.20
	46	101.0	4.65	12.97	4.03	18.92	4.36	7.78	48.74
	69	104.8	4.81	13.20	4.20	20.10	4.68	7.95	49.08
Mean		100.43	4.46	12.34	3.82	18.51	4.10	7.29	47.01
30	0	102.6	4.85	12.92	4.00	18.37	4.03	7.23	47.80
	46	107.9	5.64	13.87	4.90	21.84	4.95	8.95	51.75
	69	109.4	5.71	14.15	5.05	22.12	5.04	9.17	52.10
Mean		106.63	5.40	13.65	4.65	20.78	4.67	8.45	50.55
L.S.D. at 0.05	A	4.70	0.71	1.11	0.75	1.81	0.50	0.92	2.11
	B	3.21	0.61	1.00	0.67	1.95	0.78	1.01	1.15
	A x B	2.92	0.54	0.83	0.51	2.10	0.13	2.10	2.13

*ardab=150 kg

These obtained results indicated that replacement of about on third percent of the applied urea as N-mineral dose by local natural organic manure (*i.e.*, FYM or cattle wastes) exerted a great beneficial effect on both soil-moisture regime and fertility status, *i.e.*, increasing the organic carbon and available nutrient contents, especially P and micronutrients of Fe, Mn, Zn and Cu. This is more related to the released organic acids through microbial decomposition of the added manure, the solubilization of both nutrient forms (native and added), reduction of nutrient fixation and forming the stable complexes of micronutrients-humic substances that are keeping in available forms for extended period.

Undoubtedly, these favourable conditions have been reflected positively on soil productivity of wheat biological yield (*i.e.*, grain and straw yields) and grain quality (*i.e.*, grain weight plant^{-1} and 1000 grain weight). However, the results in Table (3) showed a significantly increased in the biological yield of wheat as compared with the control treatment. The greatest value of biological yield reached of 8.36 ton/fed (*i.e.*, 22.12 ardab/fed of grain ≈ 3.32 ton/fed + 5.04 ton/fed of straw) was obtained at treatment receiving N-urea and FYM of 69 kg/fed and 30 m^3/fed, followed by that receiving the same rate of FYM and 46 kg urea/fed. In contrast, negotiable or insignificant differences don't exceeding about 1 % at both previous treatments.

These results revealed that wheat biological yield was more in response to the combined application of urea and FYM contributing the N- sources released from N-organic : N-inorganic with a ratio 30 m^3 FYM/fed : 46 kg urea/fed, indicate that a reduction of N-mineral was achieved in spite of such combined treatment was supporting higher biological yield of wheat. These findings are in agreement with **Negi and Mahajan (2000) and Mishra (2000)** who reported that a significant increase was achieved in wheat grain and straw yields with addition of FYM combined with N-inorganic fertilizers. Thus, these results indicated that under the current experimental conditions, combined application of FYM and urea significantly improved grain and straw yields of wheat only when the N-contribution from urea was 46 kg/fed and FYM at a rate of 30 m^3/fed. That was true, since farmyard manure plays an effective role for supporting N-urea source as a quick and more potent source of nitrogen released. These results are in harmony with those results obtained by **Amanullah and Maimoona (2007)**.

III. Grain and straw nutrient contents as affected by the applied treatments:

Data in Tables (4 and 5) indicated that the applied different rates of FYM and urea significantly increased nitrogen, phosphorus, potassium, iron manganese and zinc in wheat grain and straw yields. The greatest values were recorded with the applied highest rates of FYM (30m^3/fed) combined with urea (69 kg/fed), with slightly differences for the same applied rate of FYM plus urea rate of 46 kg/fed. These results are in line with those obtained by **Mohammed (2004)** who reported that organic substances are capable to produce some organic acids during microbial decomposition of added organic manure encouraged in the solubilization of macro and micronutrient in available forms from either native or added sources. Also, the organic matter tended to improved physical, chemical and biological soil properties, and consequently increased plant growth and grain yield. Similar results were also obtained by **Dahdouh *et al*. (1999) and Ahmed *et al.* (2004).** Concerning the integrated effect for the applied different rates of urea and FYM on the nutrients uptake by wheat grain and straw yields, it can be seen that the obtained results are in agreement with the findings of **Vyas *et al.* (1997)** who reported that application of FYM significantly increased nutrients uptake and grain and straw yields of wheat.

Table (4): Effect of the different applied rates of farmyard manure and urea on wheat grain nutrient contents.

FYM, A (m^3/fed)	Urea, B (kg/fed)	Macro nutrient contents %			Micronutrient contents (mg kg^{-1})		
		N	P	K	Fe	Mn	Zn
0	0	1.32	0.143	0.540	62.24	41.08	27.14
	46	1.84	0.260	0.690	79.80	59.74	34.35
	69	1.95	0.284	0.710	83.55	68.25	39.80
Mean		1.70	0.229	0.647	75.20	56.36	33.76
15	0	1.61	0.232	0.690	75.04	59.61	35.57
	46	2.20	0.371	0.830	95.12	70.54	40.51
	69	2.27	0.380	0.845	98.05	72.32	45.09
Mean		2.03	0.328	0.788	89.40	67.49	40.39
30	0	2.04	0.328	0.840	83.47	63.90	39.42
	46	2.46	0.496	0.947	109.85	81.96	45.59
	69	2.50	0.518	1.210	112.02	84.25	47.08
Mean		2.33	0.447	0.999	101.78	77.000	44.03
L.S.D. at 0.05	A	0.23	0.080	0.081	10.10	9.50	2.85
	B	0.19	0.107	0.121	5.70	7.73	3.24
	A x B	0.15	0.092	0.110	7.90	3.45	4.51

Table (5): Effect of the different applied rates of farmyard manure and urea on wheat straw nutrient contents.

FYM, A (m^3/fed)	Urea, B (kg/fed)	Macro nutrient contents %			Micronutrient contents (mg kg^{-1})		
		N	P	K	Fe	Mn	Zn
0	0	0.678	0.103	1.21	106.45	31.75	14.72
	46	0.795	0.187	1.44	120.09	45.84	22.85
	69	0.854	0.192	1.65	133.60	56.37	29.54
Mean		0.776	0.116	1.43	120.05	44.65	22.37
15	0	0.805	0.119	1.32	125.14	42.60	19.30
	46	0.909	0.136	1.53	150.50	57.19	30.18
	69	0.933	0.145	1.60	157.74	61.25	33.05
Mean		0.882	0.133	1.48	144.46	53.68	27.51
30	0	0.913	0.134	1.42	154.05	53.26	25.64
	46	1.082	0.161	1.65	175.43	69.95	38.37
	69	1.094	0.165	1.70	181.00	71.74	40.69
Mean		1.030	0.153	1.59	170.16	64.98	34.90
L.S.D. at 0.05	A	0.094	0.075	0.11	12.90	5.80	2.64
	B	0.131	0.094	0.09	21.03	7.73	3.80
	A x B	0.033	0.059	0.05	13.45	8.12	3.45

Also the application of N and P fertilizers significantly improved the grain and straw yields of wheat. Also, these findings are in accordance with those of **Metwally and Khamis (1998)** who reported that combination of organic manure and N-inorganic resulted in greater values of apparent net nutrients release than those obtained when each was applied singly. They also reported that N-requirements of wheat could not be met by solely applied FYM, meanwhile the best results were achieved due to application of a mixture between organic and inorganic N-sources. These results suggested that integrated use of urea and FYM performed better than the use of urea or FYM alone in terms of improving nutrients uptake by biological yield of wheat despite the fact that the recommended N-mineral dose, *i.e.*, 69 kg N-urea fed^{-1} could be partial substitution by FYM-Urea combinations. The combined application of FYM at a rate of 30 m^3/fed with urea as N-mineral source at the rates of 69 or 46 kg/fed based on net N-contribution produced an excellent result.

IV. Grain carbohydrate, sugar and protein contents as affected by the applied treatments:

Data in Table (6) showed that total soluble carbohydrates and non-soluble carbohydrate in wheat grain significantly increased with increasing the applied rates of FYM and N-mineral of urea, where the greatest values of 35.50 and 679.80 mg kg^{-1}, respectively, were found at the highest rates of FYM (30 m^3/fed) and urea (69 kg/fed), with an almost similar values of 34.10 and 672.54 mg kg^{-1}, respectively, were recorded at the same rate of FYM and urea at a rate of 46 kg/fed. It is noteworthy to mention that a parallel trend for increased both reducing and non-reducing sugar contents in wheat grain took place with the trend of carbohydrate fractions, where the greatest values were recorded when soil treated with 30 m^3 of FYM and either 69 or 46 kg of urea/fed.

The positive integrated effects of both previous applied combined treatments were extended to the pronounced increases in wheat grain protein content %. The effective role of these combination between the added farmyard manure and urea could be interpreted on the bases that the released active organic acids due to decaying FYM increasingly facilitate the mobility and uptake of nutrients in the soil, Accordingly, the plant vegetative growth status could be enhanced due to increasing the process of photosynthesis that leads to increase carbohydrates, sugars and protein contents in plant organs.

Table (6): Effect of the different applied rates of farmyard manure and urea on grain contents of carbohydrates, sugars and protein.

FYM, A (m^3/fed)	Urea, B (kg/fed)	Carbohydrates (mg g^{-1} dry weight)		Sugars (mg g^{-1} dry weight)		Protein %
		Soluble	Non-soluble	Reducing	Non-reducing	
0	0	19.74	546.10	2.39	17.50	7.59
	46	23.60	590.00	2.68	19.90	10.58
	69	27.89	623.25	2.85	22.00	11.21
Mean		23.74	586.45	2.64	19.80	9.79
15	0	24.81	587.60	2.96	21.80	9.27
	46	28.64	638.74	3.32	24.90	12.65
	69	30.70	643.52	3.36	26.15	13.05
Mean		28.05	623.29	3.21	24.28	11.66
30	0	29.20	625.70	3.48	23.90	11.73
	46	34.10	672.54	3.79	27.75	14.15
	69	35.50	679.80	3.83	28.00	14.38
Mean		32.93	659.35	3.70	26.55	13.42
L.S.D. at 0.05	A	2.11	20.71	0.11	1.11	0.51
	B	1.13	33.80	0.05	0.95	0.34
	A x B	1.10	21.91	0.11	1.29	0.45

V. Soil biological activation and pH as affected by the applied treatments:

The obtained data in Table (7) showed the integrated effect of applied FYM and urea rates on the microbial activity in the soil, as a function of CO_2 evolution from soil as mg 100 g-1 24 h^{-1}, which its value becomes clear throughout in three days before irrigation. The greatest values were (0.675 or 0.683) and (0.793 or 0.801), which were recorded at one and three days before irrigation at the highest rates of 30 m^3 of FYM and (46 or 69 kg of urea/fed).

Table (7): Effect of the different applied rates of farmyard manure and urea on soil biological activation and pH after harvest.

FYM, A (m^3/fed)	Urea, B (kg/fed)	Soil pH value	CO_2 evolution from soil (mg 100 g^{-1} 24 h^{-1})	
			One day before irrigation	3 days before irrigation
0	0	8.32	0.241	0.327
	46	8.27	0.386	0.481
	69	8.21	0.392	0.521
Mean		8.27	0.339	0.443
15	0	8.06	0.395	0.465
	46	7.93	0.548	0.635
	69	7.90	0.557	0.646
Mean		7.96	0.500	0.582
30	0	7.77	0.563	0.651
	46	7.52	0.675	0.793
	69	7.49	0.683	0.801
Mean		7.59	0.640	0.748
L.S.D. at 0.05	A	0.20	0.112	0.121
	B	0.11	0.101	0.111
	A x B	0.05	0.113	0.131

These relatively high values were accompanied with an increment of organic matter decomposition, where these values were higher than the values found in the control and tested other treatments. Data also showed that the biological activity in the soil as expressed by CO_2 evolution, generally, tended to increase with increasing the applied rates of FYM addition. In contrast, the increase of CO_2 evolution reflects the enhancement of biological activity, however, **Panikov *et al*. (1982) and Shehata (1992)** noted that the addition of FYM to soil increased CO_2 production from the soil when treated with organic manure.

Soil reaction is one of the most important parameter, which pin points the overall changes in soil properties **(Khafagi and Abdel-Hadi, 1990)**. Data in Table (7) showed that soil pH values were positively affected by the applied different rates of FYM and urea, where its values tended to decrease with the increment of rates. The lowest soil pH value of 7.97 was obtained at 30 m^3 FYM and 69 kg urea/fed. That is true, since the decomposition of FYM leads to release a pronounced amount of active organic acids, which causes a decline in the soil pH. This clear decline in soil pH from 8.32 (the control treatment) to 7.49 in case of the combined one of (30 m^3 FYM fed + 69 kg urea/fed) led to increase the availability and mobility of nutrients in the soil, and then their uptake by grown plants and increase their production.

VI. Soil available nutrient contents as affected by the applied treatments:

Data in Table (8) showed the available macro and micronutrient contents in the soil, *i.e*., N, P and K as macronutrients as well as Fe, Mn and Zn as micronutrients tended to significantly increases with increasing the applied rates of FYM and urea at the maximum growth stage of wheat plants as compared to the control treatment.

Table (8): Effect of the different applied rates of farmyard manure and urea on soil available macro and micronutrient contents.

FYM, A (m^3/fed)	Urea, B (kg/fed)	Macronutrients (mg kg^{-1} soil)				Micronutrients (mg kg^{-1} soil)		
		$N\text{-}NH_4$	$N\text{-}NO_3$	P	K	Fe	Mn	Zn
0	0	7.80	39.45	8.79	435.87	7.89	3.15	2.34
	46	10.35	48.74	9.52	467.90	9.01	3.86	2.75
	69	14.40	57.80	10.06	495.54	9.96	4.27	2.97
Mean		10.85	48.66	9.46	466.44	8.95	3.76	2.69
15	0	12.65	50.87	10.17	496.32	9.78	3.63	2.86
	46	15.32	61.50	11.65	518.49	11.25	4.45	3.15
	69	18.02	64.81	12.92	544.25	12.10	4.90	3.48
Mean		15.33	59.06	11.58	519.69	11.04	4.33	3.16
30	0	16.85	61.45	12.78	567.85	11.15	4.25	3.34
	46	19.75	75.90	13.18	596.90	12.87	5.34	3.95
	69	22.24	78.54	13.97	602.64	13.05	5.90	4.08
Mean		19.61	71.96	13.31	589.13	12.39	5.16	3.79
L.S.D. at 0.05	A	1.17	7.87	1.18	21.31	1.21	0.21	0.11
	B	2.21	8.79	0.95	14.81	0.65	0.49	0.13
	A x B	1.93	9.13	0.88	19.11	0.74	0.11	0.09

This is probably due to the slow release and mineralization processes of nutrients in the available forms during the decomposition of FYM, which tended to increase all available nutrient contents in the soil. In general, the high rate of FYM (30 m^3/fed) in combination with both two urea rates of 46 and 69kg/fed gave almost similar greatest values for available nutrient contents. These results are in harmony with those obtained by **Badran *et al*. (2000)**, **Massoud (2001), Mekhemar and Alkahal (2002) and Rifaat and Negm (2004)**.

In contrast, the integrated role of applied organic manure plus microbial activity in this soil medium enhanced the released active organic acids that encouraging the solubilization of nutrient from the native and added sources. Also, the applied organic manure was commonly achieved by lowering soil pH, and in turn encouraging the availability of plant essential nutrients, especially phosphorus and micronutrients that forming organo-metalic compounds of chelated micronutrients. The later represent the next superior available forms, this is due to a higher portion of these compounds still in maintained active ones for extended period.

The superiority of applied organic manure in such clayey soil medium could be interpreted on the basis that the released CO_2 enhances the creation of soluble Ca^{2+} from the native $CaCO_3$, which partial substitution by exchangeable Na and leads to coagulate Na-separated clay particles, and then ameliorating soil structure. Such favourable soil conditions leading to improvement aeration and drainage conditions of the soil that enhancing microbial activity which helps in the released nutrients as well as their mobility and uptake by the plant roots.

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التأثير المتكامل للمخصب العضوى واليوريا على محصول القمح وجودة الحبوب

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أجريت تجربة حقلية على تربة طينية القوام بمزرعة خاصة، قرية دماص، مركز ميت غمر، محافظة الدقهلية، مصر خلال الموسم الشتوى ٢٠٠٩-٢٠١٠ لدراسة التاثير التكاملى لاستخدام المخصب العضوى (سماد بلدى) كمحسن للتربة، واليوريا على انتاجية نباتات القمح (*Triticum aestivium* L., Gemmiza 9 cv.)، وجودة حبوبه. حيث تم إضافة السماد البلدى (F) بمعدلات ٠، ١٥، ٣٠ م٣/فدان، بينما أضيفت اليوريا (U) بمعدلات ٠، ٤٦، ٦٩ كجم N/فدان. وكان تصميم التجربة بنظام القطع المنشقة مرتين Split plot، حيث إشتملت على تسعة معاملات هى:

F_0U_0 as a control, F_0U_1, F0U2, F_1U_0, F_1U_1, F_1U_2, F_2U_0, F_2U_1 and F_2U_2.

وقد تم توزيع معدلات السماد البلدى على القطع التجريبية الرئيسية (Main plots)، بينما تم توزيع معاملات اليوريا على القطع التجريبية تحت الرئيسية (Sup-plots)، حيث تم تكرار كل معاملة ثلاث مرات. وكانت مساحة القطعة التجريبية ١٠.٥ م٢ (٣.٠ * ٣.٥ م)، والتى تمثل حوالى ١/٤٠٠ من الفدان.

أظهرت النتائج أن إضافة مختلف معدلات التسميد البلدى واليوريا قد أدت الى تحسن معنوى فى كل من القياسات النباتية للقمح فى مرحلة النمو (طول النبات، عدد التفريعات أو السنابل/نبات) وعند الحصاد (المحصول البيولوجى للحبوب والقش، ومحتواهما من المغذيات الكبرى والصغرى (N, P, K, Fe, Mn and Zn)، وكذلك جودة الحبوب (وزن الـ١٠٠٠ حبة، محتوى الحبوب من البروتين والكربوهيدرات والسكريات المختزلة وغير المختزلة). كما وأن تلك التأثيرات المفيدة للمعاملات تحت الدراسة قد إمتد إلى تحسين بعض صفات التربة ممثلة فى خفض قيم Soil pH وزيادة محتوى التربة من المغذيات النباتية الميسرة سواء الكبرى (N, P and K) أو الصغرى (Fe, Mn and Zn).

وأيضا، قد تلاحظ أن تأثير إضافة المعاملات المختبرة قد إنعكس بصورة إيجابية واضحة على النشاط الحيوى للتربة ممثلا فى انطلاق CO_2 من التربة قبل وبعد الرى طوال الموسم الزراعى. ومن الوجهة الإقتصادية، فان نتائج هذه الدراسة توضح أن التأثير التكاملى للمعاملة المشتركة (٣٠ م٣ سماد بلدى/فدام + ٤٦ كجم يوريا/فدان) قد سجلت أفضل القيم بالنسبة للقياسات النباتية وخواص التربة المدروسة، آخذة فى الإعتبار المخاوف العكسية المحتملة على صحة الإنسان من خلال المخاطر البيئية الناجمة عن الإسراف فى إستخدام الأسمدة الآزوتية.