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PLANT GROWTH AND NUTRIENTS UPTAKE AS INFLUENCED BY APPLICATION OF FARMYARD MANURE AND SOME NATURAL MINERALS TO SANDY SOILS [14]

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ABSTRACT

A field experiment was carried out for two seasons 2001 and 2002 at Ismailia Agric. Res. Station to study the comparative effect of farmyard manure (FYM) application, individually or in combination with natural minerals, as sources of micronutrients. Such effect was studied during successive growth stages of wheat (vegetative stage, flowering stage and harvest stage), as well as after maize harvesting, on plant growth, nutrients uptake and wheat - maize productivity. The experiment was designed in a randomized complete block design with three replications. Two levels of FYM (2 % and 3 %) and three natural minerals, i.e., magnetite (iron oxide, Mag.), basic slag (Bas.) and manganese dust (Md.) at three rates 0.02 %, 0.05 % and 0.07%, respectively. Obtained results revealed that, at vegetative stage, mineral fertilizers (MF) treatment positively affected the dry matter of both shoots and roots of wheat plants along with contents of nitrogen and potassium in both shoots and roots as well as shoot/root ratios. At flowering stage, obtained data showed that applied farmyard manure at the rate of 3 % (F_2) significantly affected the dry matter of both shoots and roots as well as their contents of N, P and K. A similar trend was obtained for micronutrients uptake at the two indicated growth stages of wheat, which recorded high values when FYM, at a rate of 3 % (F_2), was applied. On the other hand, obtained results indicated that applied FYM at the rate of 2 % (F_1) with high rate (0.07 %) of each of the used natural minerals and FYM at the rate of 3 % (F_2) in combination with the moderate rate (0.05 %) of such minerals recorded high values of all tested parameters. In addition, Basic slag (Bas.), generally, gave the highest values, over control, of dry matter content and macronutrients uptake during the studied two growth stages of wheat, (vegetative and flowering stages). The agronomic yield components of wheat (straw, grains and weight of 1000 grains) were increased when MF was applied; such significant increases were obtained in maize yield (residual effect) as a result of applied FYM individually or combined with natural minerals.

Keywords: Farmyard manure (FYM), Natural minerals, Magnetite, Basic slag, Manganese dust, Macronutrients uptake, Micronutrients uptake.

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INTRODUCTION

Farmyard manure has played an important role in the continuous supply of well-balanced diets of nutrients to crops, and represents an important component of the nutrients cycle in agricultural ecosystems. However, the use of FYM alone may not be enough to meet the enormous nutrient requirements of present-day high yielding cultivars. Thus, integrated nutrient management, in which both organic manures and inorganic fertilizers are used simultaneously, has been suggested as the most effective method to maintain a healthy and sustainable soil system with relatively high crop productivity **(Palm *et al* 1997)**.

In a pot experiment, **Barssom (1998)** reported that 5% FYM application increased the dry weight of 45 days age plants along with their N, P and K uptake over that of untreated soil. Also, **Tolessa and Friesen (2001)** added that the growth and yield of maize were increased significantly with the application of FYM enriched with chemical fertilizer. This increase in grain yield reached up to 40 % compared to conventional FYM; such increase in yield may be attributed to the nature and quality of enriched FYM which supplies nutrients in a readily available form to plants; also, such FYM reacts with native soil nutrients in a way that enhance their availability to crops. Moreover, **Salib *et al* (2002)** found that application of farmyard manure at a rate of 15 m^3/fed. was preferred for increasing P uptake by barely straw and K total content of both grains and straw; each of mineral P and K fertilization was, however, preferred for P total content of grains and whole plants. **Heluf (2002)** reported an increment of 0.47 t ha^{-1} in grain yield due to application of FYM during the first year over no FYM, whereas increasing FYM applications from 0 to 20 t ha^{-1} increased wheat grain yield from 1.97 to 3.31 t ha^{-1}.

Recently, **Yang *et al* (2004)** mentioned that both root length density and root weight density of rice plant increased by 30 and 40 % for organic fertilization treatments (chemical fertilizers and wheat straw along with chemical fertilizers and farmyard manure, respectively), as compared with the sole chemical fertilization. However, the effectiveness of FYM combined with micronutrients was previously discussed by **Basyouny (2001)** who reported that FYM mixed with Fe and Zn gave the highest increases in shoot dry weight at the first and second stages of growth and also the highest straw and grain yields of both wheat and maize.

The current work was planned to investigate the individual and interactional effects of farmyard manure and some natural materials on wheat growth stages (vegetative and flowering stages), yield components of wheat- maize crop system (harvest stage), as well as reflection of these applications on nutrients uptake by both wheat and maize plants.

MATERIAL AND METHODS

Field experiments were carried out at Ismailia Agriculture Research Station during two successive seasons, winter season 2001/2002 with wheat (*Triticum aestivum L.*, cv Giza 168) and summer season 2002 with maize (*Zea mays L.*, cv Giza 10), to study the effect of farmyard manure (FYM) and some natural materials on growth and uptake of nutrients by plants. Some physical and chemical char-

acteristics of the tested soil samples are shown in (Table, 1).

FYM was applied at two rates (2 % and 3 %) individually or combined with micronutrient sources. Used micronutrient sources were magnetic iron oxide (Mag), basic slag (Bas) and manganese dust (Md). They were applied alone at a rate of 0.07% (2 kg/ plot) or in combination with FYM levels of (0.02 %, 0.05 % and 0.07 % which were equivalent to 0.571, 1.432 and 2 kg/ plot for Mag, Bas and Md, respectively). The analysis of FYM and different micronutrient sources were carried out according to standard methods described by **Black (1982)**; values are shown in Table (2). The treatments were thoroughly mixed with the surface soil layer (0-15 cm.) of plots, a randomized complete block design with three replications being used, before 15 days from wheat planting (first season). In order to evaluate their residual effect, maize grains was planted on the same plots in summer season. The plot area was 10.5 m^2 (3.5 m long and 3 m width).

The plots received inorganic fertilizers as follows: ammonium sulfate (20 % N), superphosphate (15 % P_2O_5) and potassium sulfate (48 % K_2O) at rates of 100, 30 and 48 kg/fed of N, P_2O_5 and K_2O, respectively**.**

Mineral fertilizers (MF) were applied at full dose for control treatment; but partially added with other treatments receiving FYM, such inorganic fertilizers were applied to complete the recommended dose for wheat plants. Phosphorus and potassium fertilizers were added before planting, while ammonium sulfate was added in four equal doses after 2, 4, 6 and 8 weeks from planting. The recommended practices of cultivation were carried out till crop maturity. In the second season, maize grains were planted after 15 days from wheat harvesting and received one dose of nitrogen fertilizer at a rate of 20 kg/fed N in the form of ammonium sulfate (20 % N).

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

Soil characteristics	Values
Particle size distribution %	
Coarse Sand	45.23
Fine sand	39.53
Silt	9.24
Clay	6.00
Texture	Sandy
Chemical properties $CaCO_3$ %	2.4
pH (1:2.5 soil -water suspension)	7.68
EC dS/m (saturated paste extract)	0.37
Organic matter %	0.52
Cations and anions in sat. extract (meq/l)	
Ca^{++}	0.97
Mg^{++}	0.87
Na^{+}	1.51
K^{+}	0.45
HCO_3^{-}	1.42
CO_3^{--}	-
Cl^{--}	1.02
SO_4^{--}	1.36
Available nutrients (ppm)	
N	85
P	25
K	125
Fe	2.40
Mn	1.50
Zn	0.40
Cu	0.20

Table 2. Some characteristics of farmyard manure (FYM) and natural minerals used in the experiment.

Determination	FYM	Magnetite (Mag)	Basic slag (Bas)	Mn dust (Md)
EC dS/m	3.57*	0.33**	0.39**	18.0**
PH	7.85*	7.8**	10.70**	7.23**
C/N ratio	16:1	-	-	-
Available nutrients (ppm)				
N	9800	166	127	208
P	600	8.40	12.4	6.73
K	21900	146	133	287
Fe	66.6	22.0	18.2	1.92
Mn	85.4	7.48	231	3.23
Zn	13.9	2.70	3.65	12.5
Cu	8.84	0.43	0.06	8.41

*EC(1:10) FYM : water extract ** EC(1:5) natural minerals: water extract
*pH (1:10) FYM water suspension ** pH (1:2.5) natural minerals water suspension

Plant samples were taken from each plot at two growth stages (vegetative and flowering stages), other samples being taken at harvested stage for both wheat and maize plants. After maturity, wheat and maize plants were harvested and the yield components (grains, straw and weight of 1000 grain) of each plot were recoded. Plant samples of wheat and maize were collected from bulk plot, weighed, oven dried at 70 C^o, ground and prepared for digestion using H_2SO_4 and H_2O_2 method described by **Black (1982)**. The digests were then subjected to measurement for macronutrients (N, P and K) using procedures described by **Chapman and Pratt (1961)**.

Obtained results were subjected to statistical analysis according to **Snedecor and Cochran (1980)** and the treatments were compared by using L.S.D. at 0.05 level of probability. Expression of "total content" has been adopted, for both shoots and grains, to be equivalent to "uptake" used for roots.

RESULTS AND DISCUSSION

I- Growth of wheat and maize under tested treatments

1- Response of wheat growth stages to applied FYM and natural minerals

As shown in Table (3), dry matter yield of shoots and roots as well as shoot/root ratio, at vegetative stage, were significantly superior with application of mineral fertilizer (MF) for both shoots and roots; added (Bas), alone, at a rate of 0.07 was highly significant for shoot/root ratio. Relatively different trend was obtained at flowering stage whose values appeared to be significant with applied

Table 3. Dry matter of both shoots and roots (g/plant) along with shoot/root ratios of wheat plants at two growth stages as affected by applied FYM and natural minerals treatments.

Natural minerals		FYM levels	Vegetative stage			Flowering stage		
Forms	Rates (%)		Shoots	Roots	Shoot/root ratios	Shoots	Roots	Shoot/root ratios
Control			5.48	2.50	2.19	10.5	4.00	2.63
Mag		0%	2.59	1.06	2.44	9.21	2.51	3.68
Bas	0.07		3.01	1.29	3.14	8.69	3.02	2.88
Md			3.31	1.07	2.79	8.23	1.26	6.53
FYM (F_1)			3.54	1.66	2.13	9.48	2.80	3.38
Mag	0.02		3.11	1.81	1.72	9.71	1.44	6.74
	0.05		4.21	2.40	1.75	11.6	1.26	9.21
	0.07		4.68	2.44	2.19	11.7	2.97	3.94
Bas	0.02		4.10	1.50	2.73	9.39	1.95	4.82
	0.05	2 %	4.57	2.00	2.29	11.0	2.86	3.84
	0.07		5.05	2.35	2.15	15.9	3.24	4.91
Md	0.02		3.71	2.22	1.67	11.7	1.27	9.21
	0.05		3.90	2.08	1.88	11.5	1.63	7.06
	0.07		4.57	2.28	2.00	14.2	2.33	6.09
FYM (F_2)			3.67	2.21	1.66	11.4	3.23	3.53
Mag	0.02		4.70	1.95	2.41	13.7	3.24	4.23
	0.05		5.01	2.49	2.01	16.3	3.81	4.28
	0.07		4.02	1.70	2.36	12.0	3.14	3.82
Bas	0.02		4.43	2.08	2.13	18.3	3.83	4.78
	0.05	3 %	4.70	3.07	1.53	18.9	4.38	4.32
	0.07		4.26	2.04	2.09	14.7	3.43	4.29
Md	0.02		3.96	2.26	1.75	10.2	4.04	2.52
	0.05		4.05	2.36	1.72	13.2	4.24	3.11
	0.07		3.53	1.55	2.28	9.89	3.11	3.18
L.S.D. 5 %			0.43	0.19	0.02	0.005	0.005	0.02

FYM 3 % (F_2) combined with moderate rate of basic slag (Bas, 0.05 %) either for shoots or roots, both Mag at a rate 0.05 % and Md at rate of 0.02 % combined with FYM (F_1) being superior for shoot/root ratio. These variations may be due to the presence of available nutrients especially at vegetative stage as a result of added

mineral fertilizers. Also, at flowering stage, decomposition of FYM led to released available nutrients which should be reflected on dry matter for shoots and roots at this stage.

Generally, application for each of Mag, Bas and Md alone was inferior, regarding the effect on dry matter of both shoots and roots, as compared to combinations with FYM or control (MF) at the two studied growth stages; such effect agrees with the results reported by **Basyouny (2001)** who found that FYM mixed with Fe and Zn gave the highest increases in shoots dry weight during vegetative and flowering stages of wheat.

Effect of FYM was clear when FYM (F_1) was applied with high rates (0.07%) of each of the used natural minerals. Also, application of FYM with a rate 3% (F_2), however, recorded high values of shoots and roots when mixed with moderate rates (0.05%) of different sources of minerals at vegetative and flowering stages. On the other hand, shoot/root ratios did not show any obvious trend at both growth stages.

From the above mentioned data, it can be noticed that, regardless of applied natural mineral rates, applied basic slag (Bas) in combination with different rates of FYM, generally, gave the highest values over control for dry matter content of shoots and roots along with shoot/root ratios during the two studied growth stages.

2- Yield components of both wheat-maize crop systems

Data shown in Table (4) reveal that, values of wheat yield components (straw, grains and weight of 1000 grain) were significantly more stimulated with application of mineral fertilizer (MF) as compared to applied FYM either alone or in combination with natural minerals. These results are in agreement with those of **Salib *et al* (2002)** who reported that applied FYM alone was not significantly superior to the control treatment for barley grain and straw yields and 1000 grain weight. Opposite trend was obtained by maize yields (residual effect), effect appeared to be significant with applied FYM (F_2) combined with Md at a rate of 0.05%.

Regarding the application of natural minerals alone at a rate of 0.07%, there was no general effect on wheat and maize yield as compared to their combination with either FYM or mineral fertilizer (MF); manganese dust (Md) at a rate of 0.07%, as compared to other sources of natural minerals, tended to increase both of wheat and maize yields.

Responses of wheat- maize yield components (grains, straw and weight of 1000 grain) to rate of mineral application seemed to be, generally, most favoured with presence of FYM (F_1) accompanied with high rates (0.07%) of all natural minerals and FYM (F_2) accompanied with moderate rates (0.05%) of such minerals.

With respect to the effect of natural minerals forms, results show that wheat yield (first season) and maize yield (residual effect) were generally superior when using manganese dust (Md) at a rate of 0.07% and 0.05% combined with FYM 2% (F_1) and FYM 3% (F_2), respectively. This is true, in spite of high values of wheat yield recorded when Mag (0.05%) combined with FYM 3% (F_2) was applied. These data agreed with the results reported by **Basyouny (2001)** who found that the FYM mixed with Fe and

Table 4. Responses of wheat and maize yields to applied farmyard manure and natural mineral treatments

Natural minerals		FYM	Grain		Straw		Weight of 1000 grain	
Forms	Rates (%)	levels	Yield Kg/fed.	(R.P.)*	Yield Ton/fed	(R.P.)*	Gram	(R.P.)*
A- First season (wheat)								
	Control		2133	-	5.39	-	48.0	-
Mag			1250	58.6	2.25	41.7	40.5	84.4
Bas	0.07	0%	1245	58.4	2.12	39.3	39.9	83.1
Md			1258	59.0	2.35	43.6	41.9	87.3
	FYM (F1)		1041	-	2.11	-	42.6	-
	0.02		1766	169.6	3.18	150.7	41.2	96.7
Mag	0.05		1880	180.6	3.67	173.9	41.2	96.7
	0.07		1966	188.9	3.77	178.7	42.2	99.1
	0.02		1377	132.3	2.91	137.9	39.8	93.4
Bas	0.05	2%	1688	162.2	2.89	137.0	40.1	94.1
	0.07		1958	188.1	3.78	179.1	41.0	96.2
	0.02		1899	182.4	3.23	153.1	39.4	92.5
Md	0.05		2027	194.7	4.00	189.6	41.3	96.9
	0.07		2078	199.6	4.18	198.1	42.2	99.1
	FYM (F2)		1247	-	2.43	-	44.0	-
	0.02		1549	124.2	2.88	118.5	42.2	95.9
Mag	0.05		1654	132.6	3.36	138.3	43.3	98.4
	0.07		1272	102.0	2.34	96.3	42.1	95.7
	0.02		1556	124.8	2.94	121.0	43.2	98.2
Bas	0.05	3%	1585	127.1	3.11	128.0	44.4	100.9
	0.07		1377	110.4	2.64	108.6	40.8	92.7
	0.02		1490	119.5	2.81	115.6	42.5	96.6
Md	0.05		1511	121.2	2.95	121.4	43.1	98.0
	0.07		1415	113.5	2.69	110.7	42.0	95.5
L.S.D. 5%			14.2	-	0.02	-	1.02	-

Table 4. Cont.

Natural minerals		FYM levels	Grain		Straw		Weight of 1000 grain	
Forms	Rates (%)		Yield Kg/fed.	(R.P.)*	Yield Ton/fed	(R.P.)*	Gram	(R.P.)*
B- Second season (maize)								
	Control		1563	-	3.40	-	354	-
Mag			1120	71.7	2.10	61.8	349	98.6
Bas	0.07	0%	1157	74.0	2.31	67.9	372	105.1
Md			1200	76.8	2.54	74.7	377	106.5
	FYM (F1)		2693	-	2.32	-	326	-
	0.02		2650	98.4	3.02	130.2	311	95.4
Mag	0.05		3023	112.3	3.82	164.7	373	114.4
	0.07		3280	121.8	4.03	173.7	375	115.0
	0.02		2553	94.8	2.92	125.9	323	99.1
Bas	0.05	2%	3300	122.5	3.28	141.4	339	104.0
	0.07		3700	137.4	3.53	152.2	384	117.8
	0.02		2737	101.6	2.54	109.5	368	112.9
Md	0.05		3184	118.2	2.78	119.8	378	116.0
	0.07		3301	122.6	4.24	182.8	393	120.6
	FYM (F2)		3250	-	3.8	-	376	-
	0.02		2997	92.2	3.83	100.8	347	92.3
Mag	0.05		3070	94.5	3.83	100.8	376	100.0
	0.07		3600	110.8	3.72	97.9	321	85.4
	0.02		3810	117.2	2.84	74.7	385	102.4
Bas	0.05	3%	3985	122.6	4.12	108.4	387	102.9
	0.07		3163	97.3	2.73	71.8	341	90.7
	0.02		3290	101.2	3.65	96.1	374	99.5
Md	0.05		3863	118.9	4.72	124.2	433	115.2
	0.07		2487	76.5	3.12	82.1	336	89.4
L.S.D. 5%			23.5	-	0.02	-	2.15	-

* Relative percent (R.P.) = (Treatment / Control) X 100

Zn gave the highest yields of straw and grains of wheat and maize. These data was explained by **Zaharieva and Abadia (1998)** on the basis of the role of iron in the formation of chlorophyll molecule, which leads to a high growth of green parts then followed by high production of seeds.

II- Nutrients uptake by plants as affected by tested treatments

A- Macronutrients uptake by wheat during the studied growth stages

Table (5) shows data representing the N, P and K total contents of shoots and roots along with shoot/root ratios of the studied wheat plants at vegetative and flowering stages. At vegetative stage, results show that the values of nitrogen and potassium were generally significantly favoured in plants receiving mineral fertilizer (MF) as compared to applied FYM alone. This is true, in spite of superiority of phosphorus total content of shoots and roots when FYM 3 % (F_2) was applied. Obtained results may be due to the maintenance for fertilizer P in biological forms by supplying fertilizer P in combination with farmyard manure which promote the cycling of P through the soil microbial biomass and associated metabolite pools, with the expected result of decreasing P fixation and increased plant availability and consequently improved status of such element in plants. **(Ayaga *et al* 2006)**.

At flowering stage, relatively different trend was obtained; values of nutrients total contents in shoots along with shoot/root ratios appeared to be significantly affected with applied high rate of FYM 3 % (F_2), mineral fertilizer (MF) being superior for roots. This agrees with results reported by **Negm *et al* (2002)** who indicated that both of FYM (15 m^3 and 30 m^3 per fed.) were significantly effective in increasing absorbed macro elements by different parts of maize plants.

With regard to applied natural minerals alone at a rate of 0.07 %, indicated results reveal that manganese dust (Md) generally gave the highest values of nutrients total contents (N, P and K) by shoots and roots during the vegetative stage, basic slag (Bas) being superior for shoot/root ratios. An opposite trend was encountered during the flowering stage, whose values of nutrients uptake were superior for shoots and roots when Bas. was applied, superiority for shoot/root ratios being encountered when manganese dust (Md) was applied.

Generally, obtained results showed that applied FYM 2 % (F_1) in combination with high rate of natural mineral 0.07 % as well as applied FYM 3 % (F_2) with moderate rate 0.05 % was favourable for NPK uptake for both shoots and roots at the two studied growth stages of wheat.

Comparing the effects of natural mineral forms, at the rate of 0.07% and 0.05% combined with FYM (F_1) and FYM 3% (F_2), respectively, data show that, at vegetative stage, no clear trend was observed for NPK uptake by either shoots or roots of wheat plant. At flowering stage, Bas was superior for NPK uptake by indicated wheat plant parts.

B- Macronutrients uptake at harvest stage of wheat-maize system

With respect to nutrients uptake of both wheat (first season) and maize

Table 5. Macronutrients total contents of (mg/plant) of both shoots (S) and roots (R) along with shoot / root ratios (S/R) of wheat plants as effected by applied FYM and natural mineral treatments at both vegetative and flowering stages of growth.

Natural minerals		FYM levels	N			P			K		
Forms	Rates (%)		S	R	S/R	S	R	S/R	S	R	S/R
A- Vegetative stage											
Control			236	68.5	3.45	14.0	4.5	3.11	257	67.3	3.82
Mag			118	26.5	4.34	8.52	6.67	1.28	123	23.4	5.26
Bas	0.07	0%	123	22.6	5.44	7.82	4.70	1.67	149	25.3	5.89
Md			135	29.6	4.56	8.61	5.99	1.44	151	32.7	4.62
FYM (F1)			147	42.8	3.43	13.8	3.82	3.61	158	53.7	2.94
Mag	0.02		122	46.3	2.63	11.8	4.8	2.46	131	52.5	2.50
	0.05		173	56.2	3.08	14.9	9.27	1.61	132	60.9	2.17
	0.07		197	61.2	3.77	22.1	11.6	1.91	162	69.8	2.32
Bas	0.02		151	32.3	4.67	16.8	5.7	2.95	139	39.0	3.56
	0.05	2%	176	45.2	3.89	17.8	7.6	2.34	187	44.2	4.23
	0.07		196	61.3	3.20	19.7	8.69	2.73	221	56.2	3.93
Md	0.02		125	59.1	2.12	15.2	9.10	1.67	129	53.5	2.41
	0.05		149	52.8	2.82	15.2	8.11	1.87	161	58.1	2.77
	0.07		206	66.6	3.09	16.5	10.9	1.51	196	67.2	2.92
FYM (F2)			151	48.4	3.12	14.3	8.39	1.70	145	56.6	2.56
Mag	0.02		185	50.3	3.68	16.5	7.48	2.21	211	61.0	3.46
	0.05		232	60.5	3.83	17.5	10.2	1.72	234	64.6	3.62
	0.07		195	43.9	4.44	14.1	6.04	2.33	207	57.0	3.63
Bas	0.02		169	55.1	3.07	17.7	9.79	1.81	216	65.7	3.27
	0.05	3%	172	58.0	2.97	23.7	14.4	1.37	239	83.2	2.87
	0.07		167	55.0	3.04	17.0	9.56	1.78	186	82.9	2.24
Md	0.02		173	51.3	3.37	11.5	8.14	1.41	204	59.4	3.43
	0.05		187	56.4	3.32	21.9	12.0	1.83	228	61.1	3.73
	0.07		160	39.9	4.01	12.4	7.29	1.70	173	54.6	3.17
L.S.D. 5%			19.5	0.02	0.02	0.02	0.02	0.02	0.33	0.02	0.02

Table 5. Cont.

Natural minerals		FYM levels	N			P			K		
Forms	Rates (%)		S	R	S/R	S	R	S/R	S	R	S/R
B- Flowering stage											
Control			335	89.2	3.76	36.8	10.0	3.68	279	90.4	3.12
Mag.			302	59.9	5.11	28.6	5.52	5.20	223	55.5	4.36
Bas.	0.07	0%	306	73.1	4.18	32.2	6.34	2.10	242	66.7	3.62
Md.			266	42.2	6.30	27.2	2.65	10.3	181	27.9	7.68
FYM (F1)			317	571	5.55	32.2	2.52	12.8	257	58.5	4.39
Mag	0.02		293	36.0	8.14	25.2	3.17	7.90	245	32.3	7.59
	0.05		385	42.5	9.06	39.4	4.03	9.80	298	28.7	10.4
	0.07		408	70.9	5.75	44.5	5.94	7.50	307	64.2	4.78
Bas	0.02		365	58.9	6.20	39.8	10.7	3.72	269	43.9	6.13
	0.05	2%	448	87.5	5.12	43.2	12.6	3.43	352	65.2	5.40
	0.07		502	109	4.61	70.4	14.3	4.92	378	76.1	4.94
Md	0.02		409	30.7	13.3	42.1	3.68	11.4	294	27.6	10.7
	0.05		376	42.7	8.81	33.4	4.08	8.20	301	37.3	8.29
	0.07		491	54.8	8.96	61.1	6.06	10.1	381	51.5	7.42
FYM (F2)			443	65.9	6.72	60.4	4.20	14.4	323	69.4	4.65
Mag	0.02		489	88.1	5.54	59.3	9.39	6.30	393	70.9	5.54
	0.05		493	99.3	4.96	99.4	10.3	9.65	396	83.4	4.75
	0.07		440	75.0	5.87	44.0	9.11	4.83	368	68.8	5.35
Bas	0.02		584	89.2	6.55	92.6	11.5	8.05	467	86.2	5.42
	0.05	3%	684	114	6.00	93.3	18.4	5.07	524	101	5.14
	0.07		459	78.9	5.82	58.8	10.3	5.70	398	75.8	5.25
Md	0.02		361	103	3.50	46.2	10.9	4.24	283	89.7	3.15
	0.05		372	107	3.48	65.3	11.4	5.73	331	95.8	3.46
	0.07		322	77.8	4.14	41.8	8.09	5.17	249	68.7	3.62
L.S.D. 5%			0.19	0.33	0.02	0.12	0.02	0.02	19.4	0.62	0.02

(second season) at harvest stage, data presented in Table (6) show that applied Md alone at a rate of 0.07 % favoured N uptake; such rate of Bas was also superior for P and K total contents of straw and grain of wheat. Generally, behavior of nitrogen uptake, regarding effects on wheat yield (straw and grain), followed the same trend of those obtained at vegetative stage; obtained values were significantly higher when mineral fertilizer was applied. Uptake of phosphorus and potassium recorded high values for both straw and grain when FYM (F_1) was used accompanied with Md at a rate of 0.07 %. The residual effect of these treatments on yield (straw and grain) shows, however, relatively different trend whose values were superior significantly for plants receiving the FYM (F_2) accompanied with Md. at a rate of 0.05 %. Obtained results might be related to decomposition of organic manure, resulting in a possible release for nutrients at the second season especially when FYM (F_2) was applied.

In fact, **El-Maghraby *et al* (1997)** indicated that the long –term farmyard manure application decreased soil pH and increased humus content which should be reflected on increasing the N, P and K contents either in the straw or in the grains of wheat. Also, **Wong *et al* (1999)** found that the dry weight of plant was higher in soil receiving manure compost amendment; increases in dry weight yields indicated a better nutrient status in such compost-amended soil.

It may be worth to mention that high values of N, P and K total contents of wheat and maize plants were recorded when FYM 2 % (F_1) was applied in combination with the high studied rate (0.07 %) of all natural minerals; application of FYM at the rate 3 % (F_2) was more effective when used in combination with moderate rate (0.05 %) of all such minerals.

Concerning the effect of natural mineral forms, obtained data show that FYM 2% (F_1) combined with 0.07% of Md was more superior for nutrients uptake by wheat and maize yields; this is also true for FYM 3% (F_2) combined with 0.05% Bas for wheat yield only.

C- Micronutrients uptake by wheat during the studied growth stages

Table (7) shows data representing the Fe, Mn, Zn and Cu total contents of shoots and roots along with shoot/root ratios of the studied wheat plants at both vegetative and flowering stages. Data revealed that, at both studied growth stages, values were affected by FYM treatments; FYM (F_2) was superior as compared to other treatments. Obtained data agree with findings obtained by **Wehrheim *et al* (1999)** who reported that high application of sewage sludge raised significantly Zn concentrations in all plant parts over the whole growing season. Recently, **Rupa *et al* (2003)** reported that the effect of added FYM was more evident, on the percentage utilization of Zn by wheat, in comparison to other treatment combinations.

Concerning of applied natural minerals, alone, at the rate of 0.07 %, data show that the Mag, Bas and Md gave the highest values of Fe, Mn, Zn and Cu uptake, respectively, for both plant parts and shoot/root ratios. This result was not unexpected because the applications of natural minerals were sources of micronutrient elements. Also, results show that values of Fe and Mn as well as Zn total content of both shoots and roots, at the two concerned growth stages, increased

Table 6. Macronutrients total contents of straw and grains (mg/plant) of both studied wheat and maize plants as affected by FYM and natural minerals application.

Natural minerals		FYM Levels	Straw			Grain		
Forms	Rates (%)		N	P	K	N	P	K
A- Wheat								
Control			541	76.6	237	593	34.8	227
Mag		0%	260	65.8	142	343	30.2	85.0
Bas	0.07		256	70.4	169	347	30.6	130
Md			264	69.9	149	380	30.5	120
FYM (F_1)			328	66.7	228	441	32.3	219
Mag	0.02		298	84.4	315	439	33.7	196
	0.05		316	95.0	324	514	34.9	272
	0.07		410	105	378	521	36.7	290
Bas	0.02		320	66.4	290	424	34.9	268
	0.05	2%	323	86.7	309	498	37.1	269
	0.07		467	95.5	418	517	37.5	366
Md	0.02		392	63.7	253	492	32.7	262
	0.05		464	103	400	541	34.8	276
	0.07		499	113	464	584	38.4	378
FYM (F_2)			269	64.9	228	470	32.9	216
Mag	0.02		306	86.6	275	481	35.5	255
	0.05		319	89.2	279	485	35.8	354
	0.07		295	78.1	218	412	33.4	309
Bas	0.02		297	84.6	240	523	37.3	280
	0.05	3%	336	92.2	294	540	37.6	370
	0.07		285	68.9	221	525	33.1	242
Md	0.02		318	86.3	259	513	32.7	363
	0.05		327	87.7	267	517	32.9	368
	0.07		316	61.2	223	509	29.3	269
L.S.D. 5 %			61.9	0.19	0.44	1.88	0.02	33.2

Table 6. Cont.

Natural minerals		FYM	Straw			Grain		
Rates (%) Forms		Levels	N	P	K	N	P	K
			B- Maize					
Control			194	78.4	235	329	21.9	178
Mag		0%	289	62.6	286	92.0	22.5	100
Bas	0.07		244	63.0	279	92.0	22.0	69
Md			216	78.5	240	89.0	23.0	115
FYM (F_1)			223	85.1	410	227	23.1	109
Mag	0.02		336	73.8	430	290	22.4	168
	0.05		339	80.9	549	292	22.9	179
	0.07		421	88.8	601	316	26.0	186
Bas	0.02		280	73.0	432	193	19.8	138
	0.05	2%	295	76.9	395	225	19.9	158
	0.07		347	85.9	601	322	27.5	220
Md	0.02		385	82.9	390	114	14.5	115
	0.05		401	89.6	404	189	24.0	150
	0.07		472	89.9	629	335	36.7	266
FYM (F_2)			207	85.8	452	252	28.9	127
Mag	0.02		417	81.8	544	350	30.4	230
	0.05		426	92.5	645	461	35.3	242
	0.07		313	73.0	489	240	26.3	204
Bas	0.02		400	91.8	487	325	23.1	203
	0.05	3%	422	95.4	575	361	33.9	271
	0.07		391	85.9	457	208	22.8	166
Md	0.02		366	83.3	526	348	23.8	246
	0.05		484	100	645	468	36.9	276
	0.07		262	56.4	447	310	18.6	190
L.S.D. 5 %			0.45	1.94	0.44	54.9	0.02	45.9

Table 7. Micronutrients total contents of both shoots (S) and roots (R) (mg/plant) along with shoot / root (S/R) ratios of wheat plants as effected by applied FYM and natural mineral treatments at both vegetative and flowering stages.

Natural minerals		FYM	Fe			Mn			Zn			Cu		
Forms	Rates (%)	levels	S	R	S/R	S	R	S/R	S	R	S/R	S	R	S/R
A- Vegetative stage														
Control			3.33	0.73	3.98	0.37	0.15	2.47	0.41	0.46	0.89	0.08	0.08	1.00
Mag.		0%	2.49	0.97	2.57	0.36	0.06	6.00	0.21	0.03	7.00	0.09	0.04	2.25
Bas	0.07		2.13	0.85	2.51	0.58	0.16	3.63	1.52	0.06	25.3	0.11	0.04	2.75
Md			1.11	0.43	2.58	0.22	0.05	4.40	0.32	0.03	10.7	0.12	0.04	3.00
FYM (F1)			3.16	0.74	4.33	0.40	0.15	2.67	0.93	0.89	1.04	0.12	0.08	1.5
Mag	0.02		2.12	0.76	2.79	0.46	0.10	4.60	2.11	0.91	2.32	0.19	0.08	2.38
	0.05		2.65	0.85	3.12	0.64	0.17	3.76	2.10	1.07	1.96	0.17	0.04	4.25
	0.07		3.19	0.98	3.26	1.09	0.17	6.41	2.32	1.09	2.13	0.20	0.09	2.22
Bas	0.02		2.64	0.51	5.18	0.35	0.08	4.38	1.37	1.09	1.25	0.20	0.07	2.86
	0.05	2%	2.47	0.51	4.84	0.42	0.12	3.50	1.84	1.05	1.75	0.16	0.05	3.20
	0.07		3.03	0.94	3.22	0.87	0.14	6.21	2.37	1.07	2.21	0.19	0.07	2.71
Md	0.02		2.24	0.83	2.69	0.76	0.24	3.17	1.53	0.91	1.68	0.16	0.08	2.00
	0.05		2.51	0.89	2.82	0.92	0.23	4.00	1.54	0.92	1.67	0.13	0.08	1.63
	0.07		2.87	0.97	2.96	1.38	0.34	4.06	2.58	0.99	2.61	0.20	0.09	2.22
FYM (F2)			4.34	1.09	4.50	1.15	0.17	6.76	1.41	0.88	1.60	0.12	0.08	1.50
Mag	0.02		3.85	1.69	2.28	0.55	0.23	2.39	1.89	0.11	17.1	0.21	0.07	3.00
	0.05		3.97	1.77	2.24	0.89	0.20	4.45	2.27	0.16	14.2	0.13	0.08	1.63
	0.07		3.19	1.56	2.04	0.45	0.26	1.73	1.47	0.11	13.4	0.21	0.09	2.30
Bas	0.02		3.28	1.08	3.04	0.72	0.22	3.27	1.58	0.84	1.88	0.21	0.08	2.63
	0.05	3%	3.48	1.17	2.97	0.84	0.22	3.82	2.39	0.82	2.91	0.18	0.08	2.25
	0.07		2.56	0.83	3.08	0.61	0.16	3.81	1.29	0.52	2.48	0.26	0.11	2.36
Md	0.02		2.91	1.06	2.75	1.39	0.42	3.31	1.85	0.13	14.2	0.13	0.08	1.63
	0.05		3.77	1.11	3.39	1.51	0.44	3.43	2.67	0.16	16.7	0.12	0.06	2.00
	0.07		3.60	1.06	3.39	0.99	0.39	2.54	1.45	0.17	8.53	0.14	0.09	1.50
L.S.D. 5 %			0.01	0.01	0.04	0.01	0.01	0.01	0.02	0.03	0.07	0.01	0.01	0.01

Table 7. Cont.

Natural minerals		FYM	Fe			Mn			Zn			Cu		
Forms	Rates (%)	levels	S	R	S/R	S	R	S/R	S	R	S/R	S	R	S/R
B- Flowering stage														
Control			17.8	2.73	6.52	0.89	0.17	5.23	0.21	0.10	2.10	0.08	0.01	8.0
Mag			20.5	2.86	7.17	0.99	0.06	16.5	0.18	0.05	3.60	0.06	0.01	6.00
Bas	0.07	0%	19.1	2.60	7.36	1.52	0.15	10.1	0.10	0.03	3.30	0.05	0.02	2.50
Md			16.9	1.10	15.4	0.92	0.09	10.2	0.27	0.05	5.40	0.08	0.01	8.00
FYM (F1)			13.4	2.22	6.04	0.71	0.15	4.73	0.19	0.05	3.8	0.06	0.02	3.00
Mag	0.02		15.7	2.91	5.41	0.43	0.05	8.60	0.12	0.03	4.00	0.06	0.01	6.00
	0.05		24.5	4.20	5.83	0.71	0.04	17.8	0.35	0.10	3.50	0.06	0.01	6.00
	0.07		28.7	5.76	4.98	0.85	0.08	10.6	0.81	0.16	5.06	0.07	0.01	7.00
Bas	0.02		13.8	1.30	10.7	0.54	0.11	4.91	0.20	0.09	2.22	0.14	0.03	4.67
	0.05	2%	17.5	1.42	12.3	0.69	0.15	4.60	0.29	0.55	0.53	0.09	0.02	4.50
	0.07		27.7	2.67	10.4	0.79	0.18	4.39	0.35	0.56	0.63	0.14	0.06	2.33
Md	0.02		20.6	0.90	22.9	0.92	0.28	3.29	0.28	0.02	14.0	0.07	0.01	7.00
	0.05		22.5	1.37	16.4	1.14	0.25	4.56	0.32	0.02	16.0	0.10	0.01	10.0
	0.07		22.7	2.13	10.6	1.47	0.33	4.45	0.32	0.48	0.67	0.11	0.02	5.50
FYM (F2)			28.8	3.02	9.53	0.93	0.17	5.47	0.35	0.05	7.00	0.12	0.02	6.00
Mag	0.02		33.5	8.83	3.80	1.79	0.13	13.8	0.22	0.06	3.67	0.08	0.03	2.67
	0.05		40.6	9.16	4.43	2.30	0.19	12.1	0.77	0.48	1.60	0.07	0.04	1.75
	0.07		32.8	7.61	4.30	1.77	0.12	14.8	0.15	0.07	2.14	0.09	0.04	2.25
Bas	0.02		33.4	3.30	10.1	1.70	0.17	10.0	0.66	0.15	4.40	0.09	0.07	1.30
	0.05	3%	34.6	7.26	4.76	2.03	0.26	7.81	0.74	0.25	2.96	0.12	0.05	2.40
	0.07		29.2	2.87	10.2	1.60	0.14	11.4	0.56	0.08	7.00	0.14	0.08	1.75
Md	0.02		21.2	2.66	7.97	1.93	0.41	4.71	0.39	0.10	3.90	0.05	0.03	1.67
	0.05		33.0	2.92	11.3	2.85	0.46	6.20	0.93	0.86	1.08	0.07	0.03	2.33
	0.07		19.9	2.21	9.00	1.71	0.23	7.43	0.35	0.07	5.00	0.08	0.03	2.67
L.S.D. 5 %			0.42	0.23	1.03	0.23	0.01	0.25	0.01	0.01	0.45	0.01	0.01	1.00

significantly in both studied plant parts by application of FYM (F_2) accompanied with moderate rate (0.05%) of both magnetite (Mag) and manganese dust (Md); Cu uptake was significantly favoured for plants receiving FYM (F_2) combined with the high rate of basic slage (Bas., 0.07%).

With regard to the rate of natural minerals, the values for micronutrients total contents of shoots, roots along with shoot/root ratios at the two studied growth stages were, generally, high with application of FYM (F_1) accompanied with the high rate (0.07%) of all natural minerals (Mag, Bas and Md) while application of FYM (F_2) was more favourable with the moderate rate (0.05%) of all natural minerals. Relatively different trend was obtained with Cu uptake whose responses to applied FYM (F_2) were obtained when accompanied with the high rate of all natural minerals.

D- Micronutrients at harvest stage of wheat-maize system

Concerning the micronutrients uptake of both wheat (first season) and maize (second season) at harvest stage, data presented in Table (8) show general responses to applied FYM and natural minerals treatments. Application of natural minerals alone at a rate of 0.07 % seemed to be almost similar to those of growth stages of wheat. Furthermore, obtained results revealed that the Fe and Mn as well as Zn total contents of wheat (straw and grains) were significantly higher when FYM (F_1) was used accompanied with high the rate (0.07%) of Mag and Md, respectively, Cu total content for straw and grains being with no clear trend. Relatively different trend was obtained by maize yield (residual effect); obtained results reveal that superiority was significant when FYM (F_2) was accompanied with the moderate rate (0.05%) of the same natural mineral previously used.

With regard to the effect of natural mineral rates, high and moderate doses of all accompanied with FYM (F_1) and FYM (F_2), respectively, gave the highest values of micronutrients uptake during the two studied seasons.

Concerning the effect of natural mineral forms, Fe and Mn total contents of in straw and grains of wheat as well as maize were more superior when either of the two rates of FYM accompanied with Mag and Md Were used, respectively. On the other hand, Zn total content of wheat (straw and grains) was favoured in plants receiving FYM (F_1) accompanied with Md. but FYM (F_2) accompanied with Mag was superior, an opposite trend being shown for maize.

Hence, regardless of FYM application, micronutrients uptake for wheat and maize was, generally, superior when Md was used, Fe uptake being superior when Mag was applied.

CONCLUSIONS

Application of farmyard manure combined with studied natural minerals (magnetite, basic slag and manganese dust), as sources of micronutrients, increased nutrients availability which was reflected on growth and uptake of nutrients by plants. Generally, the highest yield of wheat (first season) was obtained by using the recommended dose of mineral fertilizers; highest yield of maize (residual effect) was, however, obtained when FYM was applied individually or combined with naturals. However, this

Table 8. Micronutrients total contents of straw and grains(mg/plant)of both studied wheat and maize plants as affected by FYM and natural minerals application.

Natural minerals		FYM	Straw				Grain			
Forms	Rates (%)	levels	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
A- Wheat										
Control			11.3	1.71	123	0.01	87.5	1.73	2.60	0.02
Mag			8.98	1.71	1.14	0.01	104	1.63	1.95	0.02
Bas	0.07	0%	6.00	1.83	1.44	0.01	70.5	1.88	1.46	0.01
Md			8.84	1.72	2.25	0.01	38.1	1.68	2.26	0.02
	FYM (F_1)		15.9	1.99	2.93	0.02	102	1.68	2.40	0.02
Mag	0.02		21.7	1.82	1.82	0.01	106	1.77	5.23	0.02
	0.05		27.9	1.88	2.07	0.02	139	1.77	6.27	0.02
	0.07		30.2	1.96	3.74	0.02	143	2.01	6.64	0.02
Bas	0.02		9.21	1.76	1.62	0.01	124	1.80	1.86	0.02
	0.05	2%	11.1	1.92	6.62	0.01	132	1.90	3.45	0.02
	0.07		14.9	1.93	2.35	0.02	138	1.97	5.91	0.02
Md	0.02		13.8	1.98	1.68	0.01	109	2.02	1.93	0.02
	0.05		14.3	2.02	8.42	0.02	126	2.13	2.93	0.02
	0.07		17.4	2.05	8.83	0.02	137	2.29	6.95	0.02
	FYM (F_2)		22.1	2.01	3.21	0.03	105	1.77	3.35	0.02
Mag	0.02		15.2	1.75	1.02	0.01	127	1.87	6.51	0.02
	0.05		18.4	1.78	1.24	0.01	128	1.97	6.76	0.02
	0.07		13.1	1.70	0.91	0.01	116	1.75	5.97	0.02
Bas	0.02		12.6	1.72	1.01	0.01	105	1.76	5.50	0.02
	0.05	3%	16.8	1.76	1.19	0.01	111	1.90	6.16	0.02
	0.07		11.7	1.75	0.83	0.01	107	1.66	2.00	0.02
Md	0.02		9.95	1.76	1.03	0.01	106	2.20	1.85	0.02
	0.05		11.5	1.82	1.12	0.01	116	2.26	3.15	0.02
	0.07		9.68	1.73	0.90	0.01	84.8	2.14	1.35	0.02
L.S.D. 5 %			1.01	0.02	0.01	0.01	0.52	0.24	0.02	0.01

Table 8. Cont.

Natural minerals		FYM	Straw				Grain			
Forms	Rates (%)	levels	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
B- Maize										
Control			7.66	0.30	0.36	0.02	4.98	0.09	0.15	0.01
Mag			12.5	0.50	0.54	0.02	4.73	0.14	0.22	0.01
Bas	0.07	0%	11.1	0.62	0.52	0.02	4.62	0.20	0.49	0.01
Md			9.22	0.71	0.45	0.02	4.29	0.28	0.21	0.01
FYM (F_1)			8.33	0.35	0.47	0.02	3.95	0.09	0.15	0.01
Mag	0.02		11.9	0.82	0.47	0.02	6.38	0.16	0.25	0.01
	0.05		13.2	0.88	0.62	0.02	6.89	0.20	0.31	0.01
	0.07		18.4	0.99	0.87	0.02	7.84	0.30	0.46	0.01
Bas	0.02		9.34	0.49	0.50	0.02	4.72	0.13	0.24	0.01
	0.05	2%	9.73	0.51	0.51	0.02	5.13	0.14	0.26	0.01
	0.07		11.6	1.08	0.56	0.02	8.04	0.24	0.37	0.01
Md	0.02		11.5	0.46	0.40	0.02	3.88	0.23	0.19	0.01
	0.05		13.2	0.87	0.55	0.02	4.63	0.30	0.19	0.01
	0.07		15.4	1.21	0.69	0.02	6.67	0.37	0.34	0.01
FYM (F_2)			12.9	0.73	0.49	0.02	6.11	0.13	0.29	0.01
Mag	0.02		15.5	0.76	0.58	0.03	6.03	0.16	0.26	0.01
	0.05		19.9	1.03	0.72	0.02	15.2	0.16	0.29	0.01
	0.07		13.0	0.71	0.57	0.02	8.50	0.13	0.23	0.01
Bas	0.02		10.5	1.14	0.67	0.02	6.44	0.22	0.36	0.01
	0.05	3%	10.9	1.37	0.73	0.02	10.1	0.24	0.78	0.01
	0.07		9.68	0.77	0.43	0.02	5.23	0.19	0.31	0.01
Md	0.02		14.8	1.29	0.91	0.02	9.91	0.51	0.54	0.01
	0.05		15.7	1.68	0.91	0.03	10.6	0.54	0.80	0.01
	0.07		11.6	0.94	0.47	0.02	5.82	0.33	0.47	0.01
L.S.D. 5 %			1.12	0.21	0.23	0.01	0.23	0.03	0.05	0.01

study needs to be confirmed by increasing searching work on other natural minerals, which are different in their content of micronutrients; suitable crops have to be established.

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تأثير نمو النبات و امتصاص العناصر الغذائية باضافة السماد البلدى وبعض المعادن الطبيعية للآراضى الرملية

[١٤]

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١. معهد بحوث الاراضى والمياه والبيئة– مركز البحوث الزراعية– جيزة – مصر

أجريت تجربتين حقليتين على نبات القمح والذرة بمحطة بحوث الإسماعيلية– مركز البحوث الزراعية خلال موسمين لعام ٢٠٠١ – ٢٠٠٢، بهدف دراسة التأثير المقارن لاضافة السماد البلدى المضاف منفرداً أو متحداً مع المعادن الطبيعية كمصدر للعناصر الصغرى أثناء مراحل نمو القمح (مرحلة النمو الخضرى، مرحلة التزهير و الحصاد) وكذلك تأثيرها على محصول الذرة وامتصاص العناصر الغذائية وإنتاجية كل من القمح والذرة.

وقد صممت التجربة فى قطاعات كاملة العشوائية مع أخذ ٣ مكررات للمعاملة حيث أضيف السماد البلدى بمعدلين (٢%، ٣ %) كما استخدم ٣ أنواع من المعادن الطبيعية وهى ميجناتيت (أوكسيد الحديد المغناطيسى) وخبث المعادن وتراب المنجنيز بثلاث معدلات هى ٠,٠٢ %، ٠,٠٥ %،٠,٠٧% على التوالى.

أوضحت النتائج المتحصل عليها لمرحلة النمو الخضرى ان معاملة التسميد المعدنى MF كان لها تأثير موجب على الوزن الجاف والمحتوى الكلى للنيتروجين والبوتاسيوم لكل من المجموع الخضرى والجذرى وكذلك نسبة المجموع الخضرى الى الجذرى لنبات القمح، وفي مرحلة الأزهار أظهرت النتائج أن إضافة

السماد البلدى بمعدل ٣% (F_2) كان لها تأثيراً معنوياً على الوزن الجاف لكل من المجموع الخضرى والجذرى بالإضافة الى المحتوى الكلى لكل من K, P, N في كل من المجموع الخضرى والجذرى. فضلاً عن ذلك، تم الحصول على اتجاه مشابه للمحتوى الكلى للعناصر الصغرى للنباتات خلال مرحلتى نمو القمح والتى سجلت قيما مرتفعة عند إضافة السماد البلدى بمعدل ٣% (F_2).

ومن ناحية أخرى اظهرت النتائج المتحصل عليها أن إضافة FYM بمعدل ٢% (F_1) مع المعدل المرتفع (٠,٠٧%) لكل من المعادن الطبيعية وكذلك FYM بمعدل ٣% (F_2) متحد مع المعدل المتوسط (٠,٠٥%) من هذه المعادن سجلت قيما مرتفعة لجميع القياسات.

أيضاً فأن اضافة خبث المعادن عموماً أعطت قيما مرتفعة عن الكنترول بالنسبة لمحتوى المادة الجافة والعناصر الغذائية الكبرى أثناء مرحلتى نمو القمح المذكورة.

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