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EFFECT OF MINERAL FERTILIZER INTEGRATION WITH ORGANIC MANURE ON GROWTH, YIELD AND QUALITY OF MAIZE (Zea mays l.)

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ABSTRACT

Two field experiments were conducted to evaluate the effect of integrated nutrients on growth, yield and quality of maize (Zea mays L.) c.v. single hybrid 30K8. Maize plants were grown in a sandy loam soil of El-kasasin (30º 33′ 31″ N- 30° 56′ 7″ E, elev. 15.8 m), region, Ismailia Governorate, Egypt during the summer seasons of 2013 and 2014. The experiments were laid out in a randomized complete block design in three replicates contained the following treatments: (T_1) recommended NPK (Control), (T_2) Compost(10 m^3 /Fed.), (T_3) Compost +PK, (T_4) Compost +N, (T_5) Compost +NP, (T_6) Compost +NPK, (T_7) Compost +NPK +Mg and (T_8) Compost +NK.

The results indicated that the recommended dose of NPK+ Mg + compost (T_7) significantly increased all the studied parameters. The application of compost +NPK +Mg (T_7) gave the highest grain yield (3745 Kg/fed) which was13.66 % higher than the control (3295Kg/fed) and 25% more than the sole compost (2996 Kg/fed). Different treatments of compost in combination with inorganic fertilizers resulted in high significantly increases of growth and yield of maize, i. e., plant height, ear characters (length, diameter and weight) as well as grain yield/fed., enhanced nutrition and quality of grain compared to control and compost alone.

The application of inorganic fertilizer combined with compost showed higher concentration of N, P and K in grains as compared to compost alone. Total soluble sugars, starch and total carbohydrate contents of grains varied within the ranges of 1.75-2.55%, 61.5-72.2% and 63.25-74.55%, respectively.

In general, compost as a manure in combination with inorganic fertilizers has been suggested to obtain better growth, yield and quality parameters (protein and oil yield, total carbohydrate, total soluble sugars (TSS) and starch) of maize under conditions of sandy loam soils.

Keywords: Compost, Inorganic fertilizer, Integrated Nutrient Management and Maize

INTRODUCTION

Maize (Zea mays L.) is an important cereal crop that provides staple food to large number of human population in the world. It occupies third position in production next to wheat and rice in the world. Maize grain contains about 80% starch, 10% proteins, 4.5% oil, 3.5% fiber and 2 % minerals (Amin, 2010). In the developed countries, about 90% of maize is used for animal feed and other for industrial by-products. Unlike in the developed countries, the same percentage (80 to 90%) of maize is used as food in the world (Reddy, 2006).Some of the major causes of low maize yield are declining soil fertility and insufficient use of fertilizers resulting in severe nutrient depletion of soils.

Maize requires supply of nutrients particularly nitrogen, phosphorus and potassium for good growth and high yield. Nitrogen and phosphorus are very essential for good vegetative growth and grain development in maize production. The quantity required from these nutrients particularly nitrogen depends on the pre-clearing vegetation, organic matter content, tillage method and light intensity (Onasanya et al., 2009).

Nitrogen metabolism is strictly related to the presence of magnesium in the chlorophyll and its role as a cofactor of the activity of enzymes responsible for the remobilization and transportation of metabolites (nitrogen among others) from the vegetative plant parts to the developing kernels. Moreover since magnesium activates a large number of enzymes in the plant, its simultaneous supply increases the rate of mineral nitrogen transformation into proteins (Pessarakli 2002). Magnesium is a component of the chlorophyll molecule. Therefore, it is essential for photosynthesis. As might be expected, plants that are deficient in Mg have an overall light green color. In corn, the veins are mainly white when concentrations are inadequate.

The integrated use of organic nutrient sources with inorganic fertilizer was shown to increase the potential of organic fertilizer (Heluf, 2002) and to improve the efficiency of inorganic fertilizer. So their use could be reduced up to certain levels. Incorporation of chemical fertilizers in composted materials improves its efficiency and reduces losses (Guar & Geeta, 1993). Application of organic fertilizer alone insufficiently increases crop yield because nutrient content of organic fertilizer is unbalanced and if it is applied in a large quantity to balance nutrient supply the loss will increase. Therefore integrated plant nutrient management can minimize the problem. Application of mineral fertilizer in combination with locally available organic fertilizer to maintain soil fertility and to balance nutrient supply in order to increase crop yield. It is one of the best practices of plant nutrient management to take into consideration mineral fertilizer integration with organic sources of the plant nutrients to optimize social, economic, and environmental benefits of crop production. The objective of the trials is to evaluate effects of integrated management of organic manure and mineral fertilizer on growth, yield and quality of maize

MATERIALS AND METHODS

Two field experiments were carried out during the summer seasons of 2013 and 2014 on maize plants (c.v. single hybrid 30K8) grown in a sandy loam soil at El-kasasin region Farm, Ismailia Governorate, Egypt, to study the Effects of application of NPK or compost alone and the combination of compost with mineral fertilizer on yield and its components as well as grain quality and some chemical contents of grain .Some physical and chemical properties of the experimental soil were analyzed using the methods described by Black et al., (1982) and the obtained results are given in Table (1). In each season, eight treatments were arranged in a randomized complete block design with three replicates. The treatments were as follow (T_1) NPK at the recommended rates (Control), (T_2) Compost, (T_3) Compost +PK, (T_4) Compost +N, (T_5) Compost +NP, (T_6) Compost +NPK, (T_7) Compost +NPK +Mg, (T_8) Compost +NK. Compost was mixed with soil surface layer (0-15) 15 days before sowing at a rate of $10m^3$/fed. and its chemical analysis is presented in Table (2). Maize plants were fertilized with the recommended doses (30kg P_2O_5/fed) as calcium superphosphate fertilizer (15 %P_2O_5) which added during grain bed preparation. Potassium sulphate (48%K_2O) at the rate of 24kg K_2O /fed. was added before the first irrigation. Nitrogen fertilizer as ammonium sulphate (20.6%N) at the rate of 150 (Kg N fed^{-1}) was splitted into three equal doses applied at planting, 21 and 35 days from planting. Mg fertilizer was applied foliarly twice at 45 and 65 days from planting as magnesium sulphate (Mg SO_4- $7H_2O$) at rate of 3 kg/400 L/fed.

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

Property	Value
Particle size distribution (%)	
Sand	69.80
Silt	18.20
Clay	12.00
Texture grade	Sandy loam
pH(1:2.5 soil water suspension)	8.2
ECe (dS/m, 1:5, soil: water extract.)	0.87
Soluble cations (meq/L)	
Ca++	3.90
Mg++	2.70
Na+	1.85
K+	0.55
Soluble anions (meq/L)	
CO_3^-	0.00
HCO_3^-	1.30
Cl^-	4.55
SO^-	3.15
Organic matter (%)	0.62
Available nutrient (mg/kg)	
N	34.0
P	7.20
K	165.3
DTPA-extractable ((mg/kg)	
Fe	3.52
Mn	3.14
Zn	1.25
Cu	0.31

Yield and Yield Components:

Plant samples were taken at harvest (about 4 months after planting) to estimate ear characters (i.e., ear length (cm), ear diameter (cm), ear weight (g), row number/ear and grain number /row); grain yield (kg/fed.), grain weight /ear (g) and grain quality i.e. weight of 100 grain (g)

Chemical Constituents:

Nitrogen in grains was determined using the modified “microkjeldahl” method, phosphorus was colorimetrically estimated by using stannous chloride reduced ammonium sulphomolybdate method and potassium was determined using the flame photometer as described by Jackson (1973). Grain protein content was calculated using the formula: protein concentration = % N × 5.75. Oil content (%) was determined by soxhelt apparatus using hexane as a solvent as described by A.O.A.C. (1990). Oil yield (kg/fed.) was estimated by multiplying grain yield (kg/fed.) by grain oil percentage. Total soluble sugars and total carbohydrate contents in maize grains were also determined according to Smith et al. (1956). Starch content was obtained by calculating the difference between total carbohydrate and total soluble sugar content. The obtained results were statistically analyzed according to Gomez and Gomez (1984) to define the statistical significance of L.S.D. at 0.05.

Table (2) Chemical analysis of the applied compost.

Property	**Value**
pH(1:10 water extract)	6.75
ECe (dS/m, 1:5, soil: water extract)	5.80
O.C (%)	24.52
Organic matter (%)	42.28
Total-N (%)	1.38
C/N ratio	17.77
Total-P (%)	0.89
Total-K (%)	1.46
Total soluble-N (mg/kg)	862.3
Available content (mg/kg)	
P	269.5
K	911.3
DTPA-extractable (mg/kg)	
Fe	508.4
Mn	52.6
Zn	38.2
Cu	8.7

RESULTS AND DISCUSSION

Growth parameters and yield of maize

The obtained results revealed that plant height was significantly affected by applied different treatments (Table 3). The highest plant height (285cm) was obtained by T_7 (compost +NPK +Mg) followed by T_6 (compost +NPK) and T_5 (compost +NP). It was observed that compost alone gave the shortest plants, but compost in combination with NP or NPK or NPK+ Mg had a significant impact on plant height. The increase in plant height can be attributed to the fact that nitrogen promotes plant growth, increases the number and length of the internodes which results in progressive increase in plant height. Similar results were reported by Abdel Gader, (2007). The favorable effect of mixed compost with chemical fertilizers may be due to the effect of compost on increasing the efficiency of chemical fertilizer, also the application of the organic manures enhances microbial activity that releases different organic acids which helps in solubilization of the native soil nutrients and makes them available for the uptake by plants.

In fact, organic fertilizers which include compost are one of the natural amendments which applied to correct and improve the physical, chemical and biological properties of the soil and this consequently encourage the plant to have a good growth. Adding of manures increases the percentage of organic matter in the soil. Organic matter increment in coarse-textured soils contribute to reduce the leaching out of nutrients through: (1) improving soil structure toward maximizing the ability of this soil to retain and conserve irrigation water against rapid loss by leaching and deep percolation and (2) ability of the active groups of organic matter (Fulvic and humic acids) to retain the inorganic elements in complex and chelate forms which are broken down slowly by soil microorganisms and release the elements over a period of time. The extent of availability of such nutrients depends on the type of organic materials and microorganisms and the slow released nutrients permit the plants to benefit of them. The finding in this experiment is in agreement with Makinde (2007) and Ayoola and Makinde (2009).

Data in Table (3) showed that ear length was significantly increased by T_7 (Compost +NPK +Mg) compared with T_1 (control) which gave the largest ear length followed by T_6 (Compost +NPK) and T_5 (Compost +NP). The increase in ear length may be due to more photosynthetic activities of the plant on the account of adequate supply of nitrogen in these treatments. A typical view of maize ear is that it serves as a temporary storage organ and as a conveyor of nutrients to the developing kernels. Therefore, the better the development of ear length will be the index of the better economic yield of maize (khan et al., 2008 and Rajeshwari et al., 2007). Data regarding row number/ear and grain number/row showed that no. of row/ear was not significantly affected by treatments application. While no. of grains was the maximum numbers of grains ear^{-1} (46.67and 45.67) were obtained from T_7 (Compost +NPK +Mg) and T_6 (Compost +NPK), respectively. Statistically the least number of grains ear^{-1} was recorded from T_2 (sole compost) and T_3 (Compost +PK) treatments. These findings are in harmony with those obtained by El Nagar, (2003).

Table (3) Influence of integrated nutrients management practices on maize yield and yield components (combined of 2013&2014 seasons).

Treatments	Plant height (cm)	Ear length (cm)	Ear diameter (cm)	Ear weight (g)	No. of rows/ear	No .of grains/row	Weight of 100-grain (g)	Grain weight/ear (g)	Grain yield (Kg/fed)
T_1	262.0	17.65	15.90	297.40	13.00	42.00	35.24	241.6	3295
T_2	259.0	17.00	15.83	269.96	12.00	38.00	32.56	225.4	2996
T_3	260.3	17.50	15.76	287.50	12.67	40.67	34.84	234.8	3136
T_4	264.3	17.86	16.30	308.36	13.33	43.00	36.12	251.7	3452
T_5	271.7	18.83	16.62	325.53	13.67	44.67	36.90	258.9	3550
T_6	283.0	19.16	16.80	339.03	14.00	45.67	37.62	260.7	3576
T_7	285.0	19.50	16.88	344.90	14.67	46.67	41.14	273.1	3745
T_8	265.0	18.00	16.50	329.20	13.67	44.33	36.86	255.2	3500
LSD (0.05)	8.74	1.60	0.63	7.26	n.s.	2.71	1.58	5.78	104.56

Key: T_1= (recommended NPK), T_2= (Compost), T_3= (Compost +PK), T_4= (Compost +N) T_5= (Compost +NP), T_6= (Compost +NPK), T_7= (Compost +NPK +Mg), T_8= (Compost +NK)

The data regarding the 100-grain are presented in table (3) showed that all treatments differed significantly from each others. Maximum 100-grain weight was shown by T_7 (compost + NPK+ Mg) 41.14g, followed by T_6 (Compost +NPK) 37.62g, T_5 (Compost +NP) 36.90g and T_8 (Compost +NK) 36.86g. Similar results were reported by Shah et al., (2009) who reported that 100- grain weight was significantly affected by combined application of mineral fertilizer with FYM. The obtained results are also in harmony with those undertaken by Yu et al., (1999) who showed that the beneficial effects of the applied treatments (T_7 and T_6)on either ear length or diameter might be due to their stimulation effect on cell division and expansion or elongation, consequently increasing of number and weight of grain/ear. Also, such beneficial effects of the studied treatments were actually reflected on increasing maize grain yield and its quality due to the applied organic manure which decreased the loss of soil moisture, enhanced soil water retention and the drought resistance of grown plants as well as increased the ability rate of leaves for photosynthetic process, increased the grain filling intensity, and consequently increased the grain weight.

Grain Yield (kg fed^{-1}):

The present study showed that, there was a significant and positive effect of different treatments on grain yield of maize (Tables 3, 4 and fig. 1).The grain yield of maize responded significantly to combined treatments of mineral fertilizer and compost except compost + PK treatment . The highest grain yield (3745kg/fed) was recorded by treatment T_7 (compost plus NPK +Mg) which was 25% more than the lowest yield of T_2. The lowest grain yield (2996 kg/fed) was obtained in T_2 (sole compost) which was significantly different with all other treatments. The maximum grain yield was 13.66% higher over the T_1 control (3295 kg/fed). Kimeto etal., (2004) also found that a combination of both organic and inorganic nutrient source gave higher maize yield than when each was applied separately.

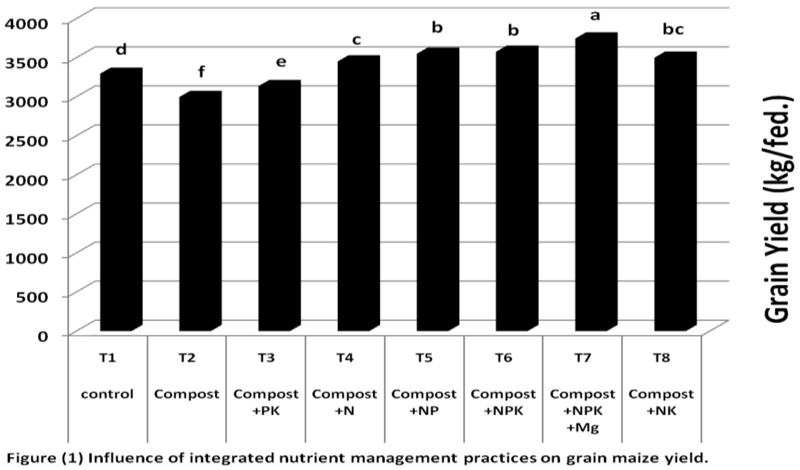

Figure (1) Influence of integrated nutrient management practices on grain maize yield.

Table (4) Influence of integrated nutrients management practices on Grain yield of maize (combined of 2013&2014 seasons)

Treatments	Grain yield		
	Grain yield (Kg/fed)	Increase or Decrease over Control T_1 (Kg/fed)	Increase or Decrease over Control (%)
T_1	3295	-	100.00
T_2	2996	- 299	90.93
T_3	3136	-159	95.17
T_4	3452	157	104.76
T_5	3550	255	107.74
T_6	3576	281	108.53
T_7	3745	450	113.66
T_8	3500	205	106.22
LSD (0.05)	***	-	-

Key: T1= (recommended NPK), T_2= (Compost), T_3= (Compost +PK), T_4= (Compost +N) T_5 = (Compost +NP), T_6 = (Compost +NPK), $T_{7=}$ (Compost +NPK +Mg), T_8= (Compost +NK)

The increase in grain yield of maize under combination of compost with mineral fertilizer application can be attributed to improving availability and corrects the balance of nutrient to achieve healthy growth and development of crop. An increase in the grain yield with compost along with NPK fertilizers may be due to the fact that added compost served as store house of several macro and micro-nutrients which are released during the process of mineralization. In addition to release of plant nutrients from the organic matter, the organic acids formed during the decomposition process also release the native nutrients in soil and increases their availability to plants. These findings are in conformity with the findings of other investigators particularly, Ayoola and Makinde (2009) and Khan et al., (2008). It was noticed that a magnitude of variation in the grain yield was proportional to the variation in the yield attributing parameters like ear length, 100-grain weight, ear weight (g) and grain weight/ear and their variation was attributed to the availability of nutrients in soil as indicated by significant and positive correlation observed between grain yield and available nitrogen status in soil. Grain yield is the end result of many complex morphological and physiological processes occurring during the growth and development of crop (Fanuel and Gifole 2012). The application of compost along with chemical fertilizers produced more grain yield as compared to the sole application of compost. The increase in grain yield of maize under NPK+ Mg application can be attributed to the positive effect of nitrogen on all the growth parameters. Nitrogen being the major constituent of chlorophyll, amino acids and proteins, phosphorus being the component of energy compounds viz., ATP, NADP and potassium serving as an activator/ cofactor for various enzymes involved in photosynthesis and CO2 fixation, could have promoted satisfactory plant growth, photosynthetic surface, yield structure and finally to ear yield. The role of Mg in plants is primarily in photosynthesis as a constituent of chlorophyll. Other roles include its involvement in cell wall structure and cell turgor, protein synthesis, carbohydrate movement and formation, as a carrier of phosphorus particularly in oil seed crops, as a component or activator of several enzymes, CO_2 assimilation, cation-anion balance and cellular pH (Reuter and Robinson 1998). The increase in grain yield was mainly due to better growth and yield attributing factors, better nutrient use efficiency and better grain development. The results of the present experiments indicated that maize grain yield and yield components increased significantly with the application of chemical fertilizer combined with compost (Tables 3 and 4).These results were in full conformity with those reported by (Parmer and Sharma 2002; Sarwar et al., 2007and Sarwar et al., 2008). Besides the positive effect of organic fertilizer on soil structure that lead to better root development that result in more nutrient uptake. Compost not only slowly releases nutrients but also prevents the losses of chemical fertilizers through denitrification, volatilization and leaching by binding to nutrients and releasing with the passage of time (Arshad et al., 2004).

Nutrient content of maize grain:

The content of N, P and K of maize grain was significantly influenced by T_5, T_6 and T_7 treatments (Table 5 and Fig. 2). T_7 (Compost +NPK +Mg) showed the highest N content (70.41kg /fed) which was significantly higher than that of all other treatments. The total N content ranged from 40.47to 70.41kg /fed with the following treatment orders - T7 > T6 > T5 > T8 > T4 > T1> T3 > T2 (Table 5and Fig. 2). Meena and Gautam (2005) reported that integrated use of organic manure and N fertilizer significantly increased the N content by pearl millet. Similar results were also reported by Djurovka et al., (2009). Phosphorus content of maize grain ranged from 9.87to 14.90kg/fed. The highest and lowest P values were recorded under T_7 (Compost +NPK +Mg) and T_2 (sole compost) respectively. The use of organic manure enhanced the fertilizer use efficiency (Muneshwar *et al.,* 2001; Nevens and Reheul, 2003).The maximum K content of maize grain (33.71kg /fed) was found by T_7 followed by content.

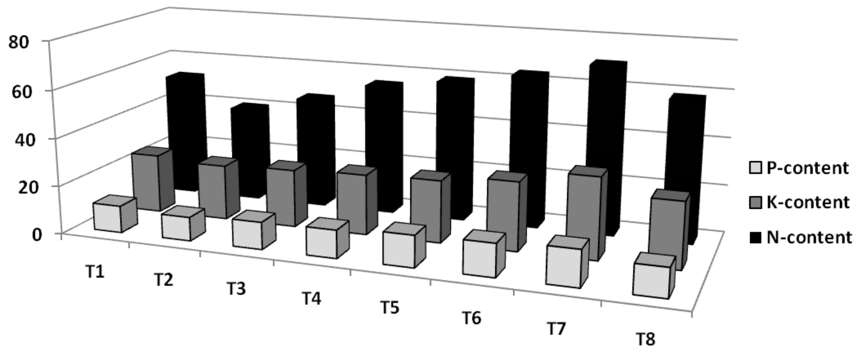

Figure (2) Influence of integrated nutrients management practices on nutrient

Table (5) Influence of integrated nutrients management practices on nutrient content of grain maize (combined of 2013&2014 seasons)

Treatments	Macronutrients (%)			Macronutrients contents (kg/fed)		
	N	P	K	N	P	K
T_1	1.65	0.342	0.79	54.37	11.27	26.03
T_2	1.35	0.331	0.77	40.47	9.87	23.07
T_3	1.50	0.359	0.77	47.05	11.26	24.15
T_4	1.60	0.335	0.73	55.23	11.57	25.20
T_5	1.65	0.365	0.73	59.14	13.08	25.92
T_6	1.69	0.379	0.80	64.00	13.55	28.61
T_7	1.88	0.398	0.90	70.41	14.90	33.71
T_8	1.69	0.339	0.78	58.81	11.87	27.30
LSD (0.05)	0.06	0.01	0.04	2.50	0.32	1.44

Key: T1= (recommended NPK), $T_{2=}$ (Compost), T_3= (Compost +PK), T_4= (Compost +N) $T_{5=}$ (Compost +NP), T_6 = (Compost +NPK), $T_{7=}$ (Compost +NPK +Mg), $T_{8=}$ (Compost +NK)

T_6 (28.61 kg /fed) and T_8 (27.30 kg /fed). T_2 (sole compost) showed the minimum content (23.07kg /fed). The effect of compost+ N P K+ Mg on K content was more pronounced in these experiments. Integration of mineral fertilizer with compost (T_7) increased nutrient content of maize grain. However with application of organic fertilizer (compost) T_2 alone the N-content, the P- content and the K- content of maize grain were reduced by 42.52, 33.76 and 31.56%, respectively in comparison to the highest nutrient content at the integration of mineral fertilizers with compost (T_7). Results indicate that application of compost combined with mineral fertilizers to soil had a marked effect on N, P and K concentration and content than the T_2 (sole compost).That is may be not only due to that the organic manure improved the soil conditions, but also due to that addition of the chemical fertilizers with the organic one may increase the exchangeable water soluble N, P and K in the organic one. These results are in agreement with that observed by Aly (1999) who obtained significant increases in N, P and K contents in maize as a result of combined effect of organic (compost) and inorganic fertilizers applied to soil.

Effect of the applied treatments on grain quality of maize

Data in Table (6) and Fig. (3) showed that treating plants by T_5, T_6 andT_7 treatments led to significant increases in protein percentage, protein yield, oil percentage, oil yield, total soluble sugars, starch and total carbohydrates percentage.

Protein Content and Yield as Influenced by different treatments

The applied T_6 andT_7 treatments caused increases in grain protein content (%) and T_7 recorded the highest protein yield (404.84 kg fed^{-1}) compared to T_2 (sole compost) 232.81 kg fed^{-1}(Table 6).Integrated nutrient management practices (T_6 and $T_{7)}$, exhibited their statistical superiority in the accumulation of grain protein yield compared to sole compost. The highest grain protein yield was observed when treatment receiving N P K+ Mg and compost (T_7) followed by treatment receiving compost +NPK (T_6). The maximum increase in grain protein yield was 73.89 and 29.47% higher over T_2 (sole compost) and T_1 NPK (Control) respectively. It also increased the protein yield fed $^{-1}$, resulting in an improvement in both grain yield and grain protein content. Addition of nitrogen caused significant increase in the grain protein content and yield fed $^{-1}$ (Table 6). The favorable effect of nitrogen on grain quality might be due to that nitrogen increases photosynthetic pigments content and photosynthesis rate, which in turn increased the amount of metabolites, synthesized and consequently resulted in higher dry matter accumulation in grains. Also, these results might be due to the important role of potassium in the activation synthesis of protein and many other compounds including starch, sugar, cellulose, cell wall and vitamins. Also, K encourages various enzymes and photosynthesis as well as plant root development .These results agreed with those obtained by (Patil et al., 1996 and Ibrahim et al., 2009).

Table (6) Influence of integrated nutrients management practices on maize quality (combined of 2013&2014 seasons).

Treatments	Protein (%)	Protein yield (kg/fed)	Oil (%)	Oil yield (kg/fed)	TSS (%)	Starch (%)	T.C. (%)
T_1	9.49	312.70	6.72	221	2.06	66.14	68.20
T_2	7.76	232.81	5.77	173	1.75	61.5	63.25
T_3	8.63	270.56	7.44	233	1.90	64.3	66.20
T_4	9.20	317.56	6.98	241	1.88	63.8	65.68
T_5	9.49	340.17	7.65	272	2.1	68.2	70.80
T_6	10.29	368.05	7.95	284	2.55	71.5	74.05
T_7	10.81	404.84	7.98	299	2.35	72.2	74.55
T_8	9.72	340.19	6.75	236	2.15	67.4	69.55
LSD (0.05)	0.33	35.15	0.15	5.88	0.30	1.58	1.78

Key: $T_{1=}$ (recommended NPK), T_2= (Compost), T_3 = (Compost +PK), T_4= (Compost +N) T_5= (Compost +NP), T_6= (Compost +NPK), $T_{7\ =}$ (Compost +NPK +Mg), $T_{8=}$ (Compost +NK)

Oil Content and Yield as Influenced by different treatments

The applied different combinations caused increase in grain oil content (%) and T_7 recorded the highest oil yield (299 kg fed^{-1}) compared to T_2 (sole compost) 173kg fed^{-1} (Table 6 and Fig. 3). The maximum value for oil contents was recorded by T_7 (7.98%) followed by T_6 (7.95%) and T_5 (7.65%) while the least value for crude oil content in grains was determined in T_2 (5.77%).The highest grain oil yield was observed when treatment receiving N P K+ Mg and compost (T_7) followed by (T_6) compost +NPK. The maximum increases in grain oil yield were 72.83 and 35.29% over the sole compost and control.

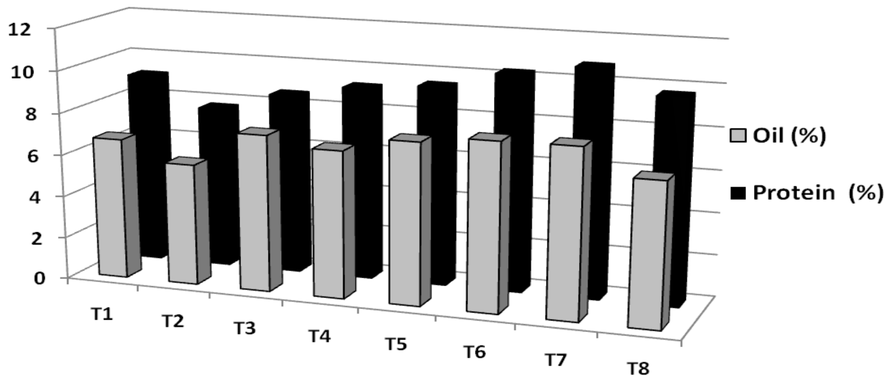

Figure (3) Influence of integrated nutrient management practices on protein and oil %.

The effect of nutrients and compost on increasing the oil content and oil yield might be attributed to their enhancing effect on vegetative growth and increasing the uptake of nutrients by roots of plant especially phosphorus element (P element is a main constituent of phospholipids, phosphoprorteins, nucleic acids and coenzymes). However, the most important compound in which phosphate groups are linked by pyrophosphate bonds is adenosine triphosphate (ATP). The energy absorbed during photosynthesis or released during respiration is utilized in the synthesis of the pyrophosphate bonds in adenosine triphosphate (ATP). This energy is then used in photosynthetic fixation of CO2 and in the synthesis of lipids and other essential organic compounds such as oils. Similar results were recorded by Mohamed and Matter (2001).

Biochemical alterations in grains as influenced by application of organic and inorganic fertilizers

Data in (Table 6 and Fi . 4) show that organic fertilization along with mineral fertilizers was beneficial in improving grain contents of total soluble sugars, starch and total carbohydrate compared to using mineral or compost only. Results also indicate that application of compost combined with mineral fertilizer to soil had a marked effect on the content of total soluble sugars, starch and total carbohydrate where the highest values were obtained when treatment receiving NPK+ Mg + compost (T_7) followed by compost +NPK (T_6). The favorable effect of organic manure on enhancement of chemical constituents of maize grains might be attributed to its beneficial effect on vegetative growth, yield and increasing the uptake of nutrient by roots of plant.

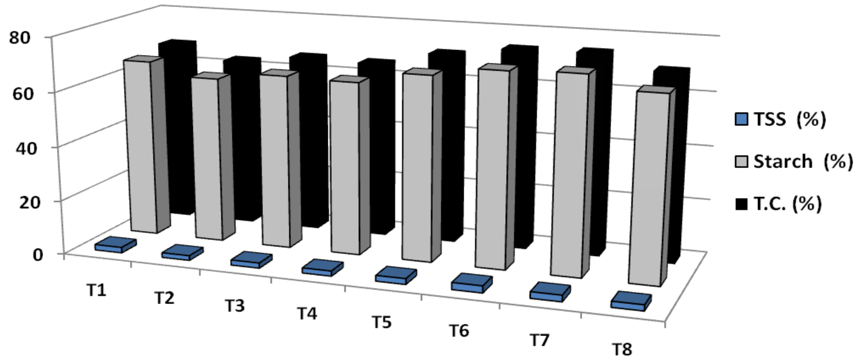

Figure (4) Influence of integrated nutrient management practices on maize quality.

CONCLUSION

The results obtained in the present study indicated that application of organic manure along with chemical NPK+ Mg fertilizer increased the yield and yield components and nutrient content of maize compared with sole application of inorganic or organic fertilizer. Integrated use of organic and inorganic fertilizer not only increased crop yield but also increased nutrient uptake, protein and oil content in maize grains. The results of the present study can be used for better organic and inorganic fertilizer practices to improve maize yield, nutrient content and grain contents of proteins, total soluble sugars, starch and total carbohydrate.

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أثر تكامل الاسمدة المعدنية مع السماد العضوى على نمو وإنتاج وجودة محصول الذرة

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أجريت تجربتان حقليتان على نباتات الذرة الشامية (صنف هجين فردى 30K8) بمزرعة القصاصين (أرض رملية طمية) بمحافظة الاسماعيلية خلال الموسمين الصيفيين 2013 - 2014 بهدف تقييم تأثير استخدام المغذيات المتكاملة على نمو نباتات الذرة وجودة المحصول حيث اشتملت التجربة على 8 معاملات كانت كالاتى:

(م1)كنترول (NPK) الموصى به ،(م2) كمبوست فقط (10 م3 للفدان) ، (م3) كمبوست + PK ، (م4) كمبوست +N ، (م5) كمبوست +NP ، (م6) كمبوست +NPK ، (م7) كمبوست +NPK+ Mg ، (م8) كمبوست +NK

اوضحت النتائج أن :

المعاملة بالجرعة الموصى بها من NPK+ Mg بالاضافة إلى الكمبوست ادت إلى حدوث زيادة معنوية فى جميع القياسات تحت الدراسة حيث تم الحصول على أعلى محصول من الحبوب (3745 كجم / فدان) بزيادة قدرها 13.66 % عن معاملة الكنترول (3295 كجم / فدان) و 25% عن معاملة استخدام الكمبوست فقط (2996 كجم / فدان) .

المعاملات المشتركة من التسميد العضوى مع التسميد المعدنى ادت إلى حدوث زيادة معنوية فى صفات النمو ومكونات المحصول مثل (طول النبات – وزن الكوز – وزن 100 حبه – طول وقطر الكوز-...الخ) ومحتوى العناصر بالحبةNPK وايضا قياسات الجودة(البروتين والزيت والكربوهيدرات الكلية والنشا والسكريات الذائبة الكلية) فى نباتات الذرة مقارنة بمعاملة الكنترول و التسميد العضوى فقط .

وكان أعلى تركيز من النتروجين والفوسفور والبوتاسيوم فى الحبوب كان مع اضافة التسميد المعدنى مع العضوى مقارنة بالتسميد العضوى فقط.

السكريات الذائبة الكلية والنشا والكربوهيدرات الكلية فى الحبوب تنوعت فى مدى 1,75-2,55 % ، 61,5 – 72,2 % ، 63,25 – 74,55 % على التوالى

وبصورة عامه كان الاستخدام المشترك للتسميد العضوى مع الاسمدة الغير عضوية افضل المعاملات فى النمو والمحصول وصفات الجودة (البروتين والزيت والكربوهيدرات الكلية والنشا والسكريات الذائبة الكلية) مقارنة بمعاملة الكنترول و معاملة التسميد العضوى فقط تحت ظروف الاراضى الرملية الطميية.