World Journal of Agricultural Sciences 6 (2): 218-223, 2010
ISSN 1817-3047

Influence of Nitrogen Sources on Yield and its Components of Some Maize Varieties

[1]N.Kh.B. El-Gizawy and [2]H.M. Salem

[1]Agron. Department, Fac.of Agric. Moshtohor, Benha Univ., Egypt
[2]Soil Department, Fac.of Agric., Moshtohor, Benha Univ., Egypt

Abstract: A field study was carried out in the Agricultural Research and Experimental Center, Faculty of Agriculture at Moshtohor, Kalubia Governorate, Benha University, Egypt during 2006 and 2007 seasons. The aim of this study was to assess influence of nitrogen sources i.e. 120 kg N/feddan as a mineral form (min.), 120 kg N/feddan as organic form (org.), 90 kg N/feddan min. + 30 kg N/feddan org., 60kg N/feddan min. + 60 kg N/feddan org. and 30 kg N/feddan min. + 90 kg N/feddan org. on yield and its components of some maize varieties i.e. S.C 3084, S.C.10 and T.W.C.351. The obtained results showed that the S.C 3084 significantly surpassed the other hybrids in ear leaf area and chlorophyll SPAD-units, number of ears/plant, number of grains/ear, ear weight, grain weight/ear and grain yield/feddan (one feddan = 4200 m^2). It was noticed that the maximum values of plant and ear height, ear leaf area, chlorophyll units, number ears/plant, 100-grain weight, ear weight, grain yield/fed, grain protein content (GPC) and grain NPK uptake in both seasons were obtained by application of 120 kg N/fed as a mineral form. Whereas, no significant difference was noticed between 90kg N min.+30kg N org./fed and 120 kg N min/fed on most characters studied in both seasons. The interaction between maize hybrids and nitrogen sources significantly affected ear leaf area, chlorophyll SPAD-units, number of grains/ear and grain N uptake in the 2nd season only.

Key words: Maize · Varieties · Grain yield . Nitrogen and compost

INTRODUCTION

Maize *(Zea mays L.)* is one of the most important cereal crops grown principally during the summer season in Egypt. It ranks the third position among cereal crops after wheat and rice, which ranked as first and the second, respectively. Increasing maize production became one of the most important goals of the Egyptian government to face the human and animal demands. This could be achieved through following the proper management systems which could lead to maximize its productivity. Growing new high yielding varieties under the most favorable cultural practices such as the application of the needed nutrients is considered as one of the successful ways.

Regarding maize varieties differences, El-Sheikh [1] found that S.C 10 cultivar produced the highest values of plant height, ear leaf area, ear length, ear weight, 100-kernel weight, grain yield/fed and N use efficiency. Abo-Shetaia *et al*. [2, 3] mentioned that single crosses of maize significantly surpassed other cross hybrids in days to silking, growth, yield and yield components. Mehasen and Alfageh [4] reported that S.C. 3062 gave the highest values of plant and ear height; whereas S.C.3080 recorded the highest grain yield/fed.

Nitrogen fertilizer is a major nutrient for maize production in Egypt. Ideal N management optimizes grain yield, farm profit and N use efficiency, while it minimizes the potential for leaching of N beyond the crop rooting zone. Egyptian soils are known to be poor in available nitrogen due to their low content of organic matter and the small amounts of organic manures added annually. Excessive N fertilization may results in low nitrogen use efficiency (NUE) and potentially exerts more pressure on the environment. Therefore, applying the optimum N level and suitable N carrier are most important means for raising the yield of maize and improving plant efficiency in using nitrogen. Recently, mineral fertilizers are not available in

Corresponding Author: Nasser Kh.B. El-Gizawy, Department of Agronomy, Faculty of Agriculture, Benha University, Egypt. P.O Box 13736

some critical periods due to a shortage in production and consequently the prices are increasing continuously. To face this situation, the use of organic manures, may help in solving this problem. A mixture of inorganic and organic fertilizer had been successfully used to obtain optimum yield in maize varieties [5]. However, Negassa *et al*. [6] found that application of 5 tons compost/ha without NP fertilizer increased maize yield by 1.41 tons/ha, while the recommended fertilizer rate (110/20 N/P kg/ha) increased the yield by 3.45 tons/ha over the control treatment. Application of composted manure resulted in an increased soil concentrations of nutrients and organic matter [7, 8]. Various studies have shown the importance of organic nutrient sources in improving crop yields and land productivity, Loecke *et al*. [9] found that corn in the composted manure treatment produced 10% more grain than the fresh manure treatment. Basso and Ritchie [10] found that more nitrate was leached as a result of untreated manure use than from compost application. El-Gedwy [11] reported that application of 60kg N org. +120kg N min. /fed gave the highest values of grain yield and its components, GPC and N uptake. El-Gizawy [12] demonstrated that chlorophyll SPAD-units, growth characters, yield of maize and yield components significantly increased with increasing the rate of N fertilizer up to 120 kg/fed as mineral form.

Therefore, the aim of this study was to investigate the effect of nitrogen sources on yield and its components of some maize varieties

MATERIALS AND METHODS

Experimental Site and Soil Characteristics: Two field experiments were carried out in the Agricultural Research and Experimental Center, Faculty of Agriculture at Moshtohor, Kalubia Governorate, Benha University, Egypt during 2006 and 2007 seasons. The aim of this study was to assess influence of nitrogen sources on yield and its components of some maize varieties. The soil was clay textured and the preceding crop was wheat in the two seasons. Results of soil analysis samples were taken from the surface 20 cm are presented in Table 1.

Treatments and Experimental Design: Each experiment included 15 treatments which were the combination of three maize varieties and five nitrogen sources as follows:

Maize Varieties: The three maize varieties used for study is shown in Table 2.

Nitrogen Sources

- 120 kg N/fed as a mineral form (min.)
- 120 kg N/fed as organic form (org.)
- 90 kg N/fed min + 30 kg N/fed org.
- 60 kg N/fed min + 60 kg N/fed org.
- 30 kg N/fed min + 90 kg N/fed org.

A split plot arrangement of a randomized complete block design with three replications was used with maize varieties as main plots and nitrogen sources as subplots. Plot area was 10.5 m^2 (3 x 3.5) having 5 ridges of 3 m in length and 0.7 m in width.

Crop Management Practices: Planting date was on 12th and 5th of June in 2006 and 2007 growing seasons, respectively. Two kernels were hand planted in each hill. Phosphorus fertilizer was applied before planting at the rate of 150 kg calcium super phosphate (15.5 % P_2O_5)/fed. Plots were hand-thinned at the V_3-V_4 leaf stage (before the 1st irrigation) to one plant per hill. Hand hoeing twice was done for controlling weeds before the first and second irrigations. Recommended pest control was applied when necessary. Compost was used as the organic N source, which was applied during seedbed preparation. Chemical analysis of compost is presented in Table 3. Compost was produced by Kaha for Env. and Agric., projects. Ammonium nitrate (NH_4 NO_3-33.5% N) was used as the inorganic nitrogen source in both seasons, which was applied in two equal doses, at the V_3-V_4 and at V_5-V_6 leaf stage (before the 1st and 2nd irrigations).

Data Collected: Time of tasseling and silking were determined as number of days from sowing to 50 % tasseling and silking on the whole plot basis. Plant and ear heights and area of the top most ear leaf were measured after 75 days from planting as the average of 10 plants. At growth stage R_1 (silking) average of thirty chlorophyll meter readings of the ear leaf were taken in each plot using a portable chlorophyll meter (SPAD-502, Minolta, Tokyo, Japan) and was expressed in arbitrary absorbance (or SPAD) values [14]. At harvest time the following data were recorded on 10 plants random samples: number of ears/plant, No. of grains/ear, 100-grain weight, ear weight, grains weight/ear. Grain yield kg/fed was recorded on whole plot basis adjusted to

Table1: Soil chemical analysis of the experimental site in 2006 and 2007 seasons*

Parameters	Season 2006	Season 2007
Organic matter %	1.87	1.82
pH(1:2.5 suspension)	7.88	8.40
Total N %	0.13	0.11
Total P %	0.14	0.12
Total K %	0.45	0.52
$CaCO_3$ %	1.57	1.51
E.C (dS/m)	1.58	1.93

*Determined according to Black [13].

Table 2: Characteristics of maize varieties used for study in 2006 and 2007

Varieties	Type	Color	Developed by
S.C 3084	Single-cross	Yellow	Pioneer Co.
S.C 10	Single-cross	White	Agricultural Research Center, Egypt
T.W.C 351	Three-way cross	Yellow	Agricultural Research Center, Egypt

Table 3: Chemical properties of compost*

Compost parameters	Season 2006	Season 2007
Density (g/cm^3)	0.51	0.52
Moisture content %	28.0	29.1
Organic matter (%)	48.0	36.5
E.C (dS/m)	3.85	4.5
pH(1:2.5 suspension)	7.6	8.2
Total N (%)	1.50	1.34
Total P (%)	0.50	0.58
Total K (%)	1.40	1.18
C: N ratio	15:1	16:1

*The amount of compost needed to represent 30 kg organic N was 2 tons/fed in the first season and 2.23 tons/fed in the second season

15.5 % moisture content. Grain protein content (GPC %) was estimated as N% x 6.25 on dry weight basis (N % in grain was determined by the microkjeldahl method according to A.O.A.C. [15]. Phosphorus content (P %) in seeds was determined as reported by Frei *et al*. [16] using colorimetric determination with ascorbic acid. Potassium (K%) was determined by flame emission spectroscopy, Grain nitrogen uptake (NUP) per unit area was obtained as a product of grain N content and grain yield per unit area (kg/fed). Phosphorus uptake (PUP) in seeds kg/fed = seed yield kg/fed x total P% in seed. Potassium uptake (KUP) in seeds kg/fed = seed yield kg/fed x total K% in seed

Statistical Analysis: Data were statistically analyzed according to Gomez and Gomez [17] using the MSTAT-C Statistical Software Package [18]. Where the F- test showed significant differences among means, Duncan's multiple range test was performed at the 0.05 level of probability to compared means.

RESULTS AND DISCUSSION

Varietal Differences: All growth traits under study in each season differed significantly ($P<0.05$) among the three maize hybrids except 50% tasseling and silking in the 2nd season and ear height in both season as shown in Table 4. S.C 3084 was significantly the earliest in tasseling and silking in the 1st season. However, T.W.C351 was the latest in tasseling and silking. Data also indicated that S.C. 3084 gave the highest values of ear leaf area and chlorophyll SPAD-units but without significant differences compared with S.C10 in ear leaf area. Such results could be attributed to differences in the genetic constitution of the tested varieties. Similar results were also reported by Mehasen and Alfageh [4] who reported that S.C. 3062 gave the highest values of plant and ear height, whereas S.C.3080 recorded the highest grain yield/fed.

Table4: Effect of nitrogen sources on flowering date, plant and ear height, ear leaf area and chlorophyll content of some maize varieties in 2006 and 2007 seasons

	50 % Tasseling		50 % Silking		Plant height(cm)		Ear height (cm)		Ear leaf area (cm^2)		Chlorophyll SPAD-units	
Treatments	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Maize varieties (V)												
S.C 3084	61.0b	61.2a	63.9b	64.1a	272.3a	289.3a	133.6a	141.3a	607.0a	617.6a	50.2a	49.5a
S.C 10	61.9ab	61.8a	64.9a	64.6a	281.6a	289.0a	136.2a	138.0a	594.3ab	615.0a	48.8b	47.2b
T.W.C351	62.3a	62.4a	65.2a	65.4a	279.6a	285.6b	135.2a	135.3a	584.3b	594.0b	44.8c	42.2c
N sources (N)												
120 kg/N min	61.5bc	60.7c	64.4b	64.0bc	288.3a	299.4a	141.8a	143.6a	616.1a	631.6a	51.0a	49.5a
120 kg/N org	62.6a	62.6a	65.5a	65.2ab	268.8b	282.2b	131.6cd	131.4b	586.1c	606.1b	46.4b	47.4b
90 kg/N min + 30 kg/N org.	61.0c	61.2bc	64.1b	63.8c	285.5a	299.4a	139.4ab	141.1a	610.0ab	628.3a	47.8ab	46.2c
60 kg/N min + 60 kg/N org	61.4bc	61.8ab	64.3b	65.0a-c	278.8c	285.0c	134.5bc	138.6ab	599.4bc	613.8b	48.2ab	43.8d
30 kg/N min + 90 kg/N org	62.1ab	62.5a	65.0ab	65.4a	267.7b	273.8b	127.7d	136.3ab	564.4d	564.4c	46.4b	44.5d
F test Prob.						*P>F*						
V	*	N.S	*	N.S	N.S	*	N.S	N.S	*	*	**	**
N	**	**	**	*	**	**	**	*	**	**	**	**
V x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	*	N.S	*
CV %	1.53	1.80	1.49	1.98	2.83	3.42	4.96	6.49	2.85	1.95	5.72	6.65

Note: Means with different alphabets indicate significant difference between treatments by Duncan's multiple range test at p=0.05.
*, ** significantly different at 0.05 and 0.01 probability levels, respectively N.S: not significant.

Table 5: Effect of nitrogen sources on number of ears/plant, number of grains/ear, 100-grain weight, ear weight, grain weight/ear and grain yield/fed of some maize varieties in 2006 and 2007 seasons

	No. ears/plant		No. grains/ear		100-grain wt. (g)		Ear wt. (g)		Grain wt./ear (g)		Grain yield kg/fed	
Treatments	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Maize varieties (V)												
S.C 3084	1.39a	1.26a	620.3a	618.0a	33.9a	34.6a	273.8a	272.8a	236.8a	235.6a	3425.3a	3315.0a
S.C 10	1.14b	1.11b	605.3b	607.3a	33.5ab	34.0a	260.7b	264.5a	213.6b	230.5a	3173.3b	3086.5b
T.W.C351	0.99c	0.91c	558.0c	570.8b	32.3b	32.8b	251.6c	253.6b	217.6b	220.6b	2878.4c	2969.8c
N sources (N)												
120 kg/N min	1.32a	1.22a	604.4a	617.7a	34.9a	35.4a	273.6a	273.6a	238.8a	236.4a	3378.6a	3381.7a
120 kg/N org.	1.01d	0.97c	583.3a	575.0b	32.3c	32.6c	257.4bc	256.8d	222.5a	224.2c	2975.7c	2877.7d
90 kg/N min + 30 kg/N org.	1.28ab	1.18ab	598.3a	610.8a	33.5ab	34.2ab	263.8b	266.6b	230.8a	230.1b	3254.2ab	3230.8ab
60 kg/N min + 60 kg/N org.	1.16bc	1.06bc	602.7a	606.1a	33.0bc	33.5bc	259.7bc	262.7bc	223.4a	227.2bc	3162.4b	3126.6bc
30 kg/N min + 90 kg/N org.	1.08cd	1.02c	583.8a	583.8b	32.5bc	33.3bc	255.5c	258.2cd	197.8a	226.6bc	3024.1c	3002.2cd
F test Prob.						*P>F*						
V	**	**	*	**	*	**	**	*	*	*	**	**
N	**	**	N.S	**	**	**	**	**	N.S	**	**	**
V x N	N.S	N.S	N.S	*	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
CV %	12.79	12.66	3.99	2.32	3.12	2.92	2.70	1.90	4.24	2.60	3.89	4.69

Note: Means with different alphabets indicate significant difference between treatments by Duncan's multiple range test at p=0.05.
*, ** significantly different at 0.05 and 0.01 probability levels, respectively N.S: not significant.

Table6: Effect of nitrogen sources on grain protein content (GPC) and NPK uptake in 2006 and 2007 seasons

	GPC%		Grain N uptake kg/fed		Grain P uptake kg/fed		Grain K uptake kg/fed	
Treatments	2006	2007	2006	2007	2006	2007	2006	2007
Maize varieties (V)								
S.C 3084	8.29a	8.62a	45.5a	45.9a	14.0a	13.6a	15.9a	16.3a
S.C 10	8.37a	8.33a	42.5b	41.2b	12.5b	11.7b	14.0b	14.7b
T.W.C351	8.20a	8.25a	37.8c	39.2b	11.3c	10.5c	12.7c	14.0b
N sources (N)								
120 kg/N min	8.81a	8.95a	47.7a	48.7a	13.9a	13.8a	15.5a	17.2a
120 kg/N org	8.47ab	8.40b	40.3bc	38.6cd	11.5c	10.9d	13.2b	13.9cd
90 kg/N min + 30 kg/N org.	8.33bc	8.61ab	43.4b	44.5b	13.8a	12.8b	15.3a	15.9b
60 kg/N min + 60 kg/N org	7.98cd	8.19bc	40.4bc	41.0c	12.4b	11.7c	13.8b	14.7c
30 kg/N min + 90 kg/N org	7.84d	7.84c	37.8c	37.6d	11.2c	10.6d	13.1b	13.4d
F test Prob.				*P>F*				
V	N.S	N.S	**	**	**	**	**	**
N	**	**	**	**	**	**	**	**
V x N	N.S	N.S	N.S	*	N.S	N.S	N.S	N.S
CV %	5.50	6.32	7.87	8.25	6.96	7.69	6.96	7.69

Table 7: Effect of the interaction between maize varieties and nitrogen sources on leaf area, chlorophyll content, grains/ear and grain N uptake in 2007 season

		Nitrogen sources					
Characters	Maize varieties	120 kg/N min	120 kg/N org	90 kg/N min + 30 kg/N org	60 kg/N min + 60 kg/N org	30 kg/N min + 90 kg/N org	Mean
Ear leaf area cm^2	S.C 3084	648.3 a	631.6ab	635.0ab	623.3bc	550.0f	617.6A
	S.C 10	636.6ab	608.3cd	630.0ab	610.0c	590.0de	615.0A
	T.W.C351	610.0 c	578.3e	620.0bc	608.3cd	553.3f	594.0B
Mean		631.6A	606.1B	628.3A	613.8B	564.4C	
Chlorophyll SPAD-units	S.C 3084	56.6a	52.0ab	47.3b-e	44.0d-g	47.6b-e	49.5A
	S.C 10	50.3bc	47.6b-e	48.6b-d	46.6c-f	42.6e-g	47.2B
	T.W.C351	41.6fg	42.6e-g	42.6e-g	41.0g	43.3e-g	42.2C
Mean		49.5A	47.4B	46.2C	43.8D	44.5D	
Grains/ear	S.C 3084	648.3a	588.3c	640.0ab	623.3b	590.0c	618.0A
	S.C 10	625.0ab	576.6cd	623.3b	623.3b	588.3c	607.3A
	T.W.C351	580.0cd	560.0d	569.3cd	571.6cd	573.3cd	570.8B
Mean		617.7A	575.0B	610.8A	606.1A	583.8B	
Grain N uptake kg/fed	S.C 3084	56.9a	39.7c-f	49.0b	44.6bc	39.4c-f	45.9A
	S.C 10	48.5b	40.7c-f	42.0c-e	38.5d-f	36.2ef	41.2B
	T.W.C351	40.7c-f	35.5f	42.5cd	39.7c-f	37.3d-f	39.2B
Mean		48.7A	38.6CD	44.5B	41.0C	37.6D	

Note: Means with different alphabets indicate significant difference between treatments by Duncan's multiple range test at p=0.05.

There were significant differences (P<0.05) among maize hybrids in number of ears/plant, number of grains/ear, 100-grain weight, ear weight, grain weight/ear and grain yield/fed in the first and second season. Moreover, it is clear from Table 5 that S.C 3084 significantly surpassed the other hybrids in number of ears/plant, number of grains/ear; ear weight; grain weight/ear and grain yield/fed. The increases in grain yield/fed for S.C3084 might be due to its superiority in yield components. These results are in harmony with those obtained by Abo-Shetaia *et al.* [2, 3] who mentioned that single crosses of maize significantly surpassed other cross hybrids in days to silking, growth, yield and yield components

Regarding the grain NPK uptake, S.C 3084 showed the highest values, followed by S.C 10 and T.W.C 351, with significant differences(P<0.05).However, the differences among the three maize varieties in GPC% were insignificant (Table 6).

Effect of Nitrogen Sources: Data presented in Tables 4, 5 and 6 show that 50% tasseling and silking, plant and ear height, ear leaf area, chlorophyll SPAD-units, number ears/plant, 100-grain weight, ear weight, grain yield/fed, GPC and grain NPK uptake were significantly affected (P<0.05) by N sources in both season. While, differences in number of grains and grain weight/ear were significant only in the 2nd season. Nitrogen sources caused a significant reduction (P<0.05) in the time to 50% tasseling and silking in both seasons. Application of 90kg N min. +30kg N org. significantly decreased tasseling and silking date (Table 4). However, the differences among 90kg N min.+30kg N org./fed and 120 kg N min/fed in both season were insignificant. These results might be due to the positive effect of N on tasseling and silking due to its role on C/N ration in maize plants. It was noticed that maximum values of plant and ear height, ear leaf area, chlorophyll SPAD-units (Table 4), number ears/plant, 100-grain weight, ear weight, grain yield/fed (Table 5), GPC and grain NPK uptake (Table 6)in both seasons were obtained from application of 120 kg N/fed as a mineral form. Whereas, there was no significant difference noticed between 90kg N min.+30kg N org./fed and 120 kg N min/fed in most characters studied in both seasons. This result may be due to that mineral nitrogen fertilizer form was easier and faster in absorption and utilization by plants. Also, these results indicate that the experimental soil was deficient in regard to available N and organic matter (Table1). The present results indicated clearly the vital role of N in plant life and its contribution in increasing the grain yield. Such results clarified that N is essential for cell division and elongation as well as the root growth and dry matter content of maize plants [19]. The obtained results are in good agreement with those reported by Loecke *et al*. [9] who reported that corn in the composted manure treatment produced 10% more grain than did corn in the fresh manure treatment. El-Gedwy [11] reported that application of 60kg N org. +120kg N min. /fed gave the highest values of grain yield and its components, GPC and N uptake.

Interaction Effects: Table 7 show that the effect of interaction between maize hybrids and nitrogen sources was significant (P<0.05) for ear leaf area, chlorophyll SPAD-units, number of grains/ear and grain N uptake in the 2nd season. S.C3084 with 120 kg N/fed gave the highest ear leaf area (648.3 cm^2), chlorophyll SPAD-units (56.6), number of grains/ear (648.3) and grain N uptake (56.9 kg/fed). This might be due to the well utilization of N fertilizer in metabolism and meristimic activity which improved these traits. These results are in agreement with those obtained by El-Gizawy [12].

CONCLUSION

It could be concluded that under the conditions of the current experiment, single crosses (S.C. 3084 and S.C. 10) of maize significantly surpassed T.W.C 351 in days to tasseling and silking, growth characters, yield and yield components. Also, there was no significant difference was noticed between 90kg N min. +30kg N org. /fed and 120 kg N min/fed in most studied characters in both seasons.

ACKNOWLEDGEMENT

The authors thank Prof. Dr. Salah A. Shafshak and Prof. Dr. Ali Abd El-Salam for reviewing and helpful comments regarding a previous draft of the manuscript. Mr. E. El-Gedwy for technical assistance in the laboratory. The filed staff of the Agric. Res. and Exp. Cent., Faculty of Agriculture at Moshtohor is gratefully acknowledged.

REFERENCES

1. El-Sheikh, F.T., 1998. Effect of plant population densities on nitrogen use efficiency of some maize varieties. Ann. Agric. Sci. Moshtohor, 36(1): 143-162
2. Abo-Shetaia, A.M.A., A.A. Abdel-Gawad, G.M.A. Mahgoub and M.B.A. El-Koomy, 2000a. Effect of inter and intra ridge distance between plants on canopy structure of four yellow maize hybrids (*Zea mays* L.). Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, 8(2): 619-645.
3. Abo-Shetaia, A.M.A., A.A. Abdel-Gawad, G.M.A. Mahgoub and M.B.A. El-Koomy, 2000b. Effect of inter and intra ridge distance between plants on yield and yield components of four yellow maize hybrids (*Zea mays* L.). Arab Univ. J. Agric. Sci., Ain. Shams Univ., Cairo, 8(2): 647-662.
4. Mehasen, S.A.S. and F.M. Al-Fageh, 2004. Evaluation of growth, yield and its component of six yellow maize hybrids at different planting densities. Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, 12(2): 569-583.
5. Sridhar, M.K.C. and G.O. Adeoye, 2003. Organ-mineral Fertilizers from urban wastes: The Nigerian Field, 68: 91-111
6. Negassa, W., T. Abera, D.K. Friesen, A. Deressa and B. Dinsa, 2001. Evaluation of compost for maize production under farmer's condition. 7th Conf. Eastern and Southern Africa Regional maize, 11th -15th February: 382-386.
7. Chang, C., T.G. Sommerfeldt and T. Entz, 1991. Soil chemistry after eleven annual applications of cattle manure. J. Environ. Qual., 20: 475-480.
8. Eghball, B., 2000. Nitrogen mineralization from field-applied beef cattle feedlot manure or compost. Soil Sci. Soc. Am. J., 64: 2024–2030.
9. Loecke, T.D., M. Liebman, C.A. Cambardella and T.L. Richard, 2004. Corn growth response to composted and fresh solid swine manures. Crop Sci., 44: 177-184.
10. Basso, B. and J.T. Ritchie, 2005. Impact of compost, manure and inorganic fertilizer on nitrate leaching and yield for a 6-year maize-alfalfa rotation in Michigan. Agriculture, Ecosys. Environ, 108: 329-341.
11. El-Gedwy, E.M., 2007. Maize yield potential as affected by organic and mineral nitrogen, crop residues and tillage. M.Sc. Thesis, Fac. Agric., Moshtohor, Benha Univ. Egypt.
12. El-Gizawy, N.Kh.B., 2009. Effects of nitrogen rate and plant density on agronomic nitrogen efficiency and maize yields following wheat and Faba bean. Am-Euras. J. Agric. Environ. Sci., 5(3): 378-386.
13. Black, C.A., 1965. Methods of soil analysis. Am. Soc. Agron. Madison, Wisc. USA.
14. Dwyer, L.M., M. Tollenaar and L. Houwing, 1991. A non-destructive method to monitor leaf greenness in corn. Can. J. Plant Sci., 71: 505-509.
15. A.O.A.C., 1990. Official Tentative Methods of Analysis of Association of Official Analytical Chemists. Washington. D.C., 15th Ed.
16. Frei, E., K. Payer and E. Schutz, 1964. Determination of phosphorus by ascorbic acid method. Schw. Landwirtsch-Forschung. Heft., 3: 318-328.
17. Gomez, A.K. and A.A. Gomez, 1983. Statistical Procedures for Agricultural Research. 2nd Ed. John Wiley and Sons, New York.
18. Michigan State University, 1983. MSTAT-C: Micro-Computer Statistical Program, Version 2. Michigan State University, East Lansing, USA.
19. Marschner, H., 1995. Mineral Nutrition of Higher Plants. Academic Press Inc. London LTD.