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Influence of Nitrogen Fertilizer Sources on Yield and Its Components of Some Maize Varieties.

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ABSTRACT

Two field experiments were carried out in the new land at Wadi El-Rayan, Fayoum governorate, Egypt during 2014 and 2015 seasons to study the influence of nitrogen fertilizer sources on yield and its components of some Maize varieties. The results could be summarized as follows: Significant differences were obtained in growth parameter at 80 and 100 days after sowing between maize varieties (plant height, total dry weight, LA, LAI, LAR). It was noticed that the maximum values of growth analysis were obtained with sowing Pioneer3062, whereas the differences between varieties in yield and its components were significant at all characters except grain yield/fed., and harvest index% in both seasons. Pioneer3062 variety out yielded T.W.353 in all characters except shelling %. The four nitrogen sources were significantly differed in growth characters at the two growth stages in both seasons where urea surpassed other sources of nitrogen. Highly significant differences were found in yield and its components between nitrogen sources, where urea also surpassed the other nitrogen sources except harvest index% and shelling %, the differences was not significant between urea and slow-release N. Pioneer 3062 variety surpassed T.W. 353 variety significantly in carbohydrate percentage and fiber percentage, while the second one was super in ash percentage. It was noticed that there were significant differences between nitrogen sources at chemical analysis. Harvested maize yield can be increased by growing Pioneer 3062 with application of urea fertilizer.

Keywords: nitrogen fertilizer, maize, chemical analysis.

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INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in the summer season in Egypt. It ranks the third position among cereal crops after wheat and rice, its contains; starch 78%, oil 4.8%, protein 10%, fiber 8.5%, sugar 3.1% and ash 1.7% (Waseem *et al* 2007). Increasing maize production is the most important goals in Egypt which achieved by growing new high yielding varieties under favorable cultural practices with application of the needed nutrients. Regarding maize varieties Abo-Shetaia *et al* (2000 a and b) reported that single crosses of maize significantly surpassed other cross hybrids in yield and yield component. El-Gizawy and Salem (2010) mentioned that there were significant differences between maize varieties.

Nitrogen fertilizer is major nutrient for obtaining target yield. Nitrogen plays a paramount and dominant role in growth process of plants, it is an integral part of chlorophyll molecule and constituent of enzyme molecules (Power and Schepers, 1989).

Maize cultivation was recently expanded in the newly reclaimed sandy soils, which characterized with low fertility, high pH value and low organic matter content. The objective of this experiment was to study the influence of nitrogen fertilizer sources on yield and its components on some maize varieties.

MATERIALS AND METHODS

Table (1): Physical and Chemical analysis of the experimental site at Wadi El-Rayan, fayoum

Physical analysis										
Sand %			Silt %		Clay%		Organic matter %		NH ₄ ⁺ (meg /L)	Texture class
53.70			28.00		18.30		0.93		2.1	Sandy loam
Chemical analysis										
Soluble anions (meg /L)			Soluble cations (meg /L)				Available nutrients (ppm)	EC. (mmhos /cm)		PH
HCO ₃ ⁻	Cl ⁻	So ₄ ⁻	Ca ⁺⁺	Mg ⁺⁺	Na ⁺	K ⁺	N			
3.25	2.80	0.92	2.42	1.15	3.19	0.16	21	0.53		7.32

Two field experiments were conducted in the new land at Wadi El-Rayan, Fayoum governorate, Egypt during 2014 and 2015 summer seasons to study the influence of nitrogen fertilizer sources on yield and its components of some maize varieties. The physical and chemical properties of the experimental soil were determined according to Chapman and Pratt (1978) are shown in Table (1). Each experiment contains 8 treatments which were the combination of two maize varieties i.e. (Pioneer 3062 and T.W. 353), and four nitrogen sources i.e. (Ammonium nitrate, Urea, Ammonium sulfate, Slow-release N) with four replications. Nitrogen fertilizer was at rate of 120 kg N/fed. as follows :

- 1- Ammonium nitrate 33.5% at rate of 360 kg/fed.
- 2- Urea 46% at rate of 260 kg/fed.
- 3- Slow release N 40% at rate of 300 kg/fed.
- 4- Ammonium sulfate 20.6% at rate of 580 kg/fed.

A split plot design with four replications was used maize varieties as a main plots and nitrogen fertilizer sources as subplots. The plot area was 21 m² (5 x 4.20) with 6 ridges of 5 m in length and 70 cm in width. Sowing date was 20th and 18th May in 2014 and 2015 seasons, respectively. Phosphorus fertilizer was added before sowing at rate of 150 kg calcium super phosphate (15.5% P₂O₅/fed.). In each hill there were two kernels, before the first irrigation plots were thinned to one plant per hill. All cultural practices such as irrigation and pest control were carried out as recommended. Two samples of five plants were taken at random for growth measurements at 80 and 100 days from sowing. The following growth characters were

recorded, plant height (cm), total dry weight/plant (g), L.A. (dm)² according to Bremner and Taha (1966), L.A.I according to Watson (1952) and L.A.R.

At harvest, ten guarded plants were taken at random from the middle of each plot to determined yield characters as plant height (cm), ear length (cm), ear diameter (cm), grain index (g), grain yield (g)/plant, straw yield (g)/plant, grain yield (ton) /fed., straw yield (ton)/fed., biological yield (ton) /fed., harvest index % and shelling %.

Grain protein content was estimated as N % x 5.75 on dry weight basis where nitrogen % was determined by the micro – kjeldahl methods according to A.O.A.C (1988). Carbohydrate % was determined according to Dubois *et al* (1956), also fiber % and ash % were determined.

Combined analysis was made for the two growing seasons as results followed similar trend according to Snedecor and Cochran (1989). For comparison between means, L.S.D. test at 5% level was used.

RESULTS AND DISCUSSIONS

Varietal Differences

All growth characters under study in both seasons differed significantly among the two maize varieties.

Data in Table (2) showed that Pioneer 3062 variety surpassed T.W. 353 variety in plant height (cm), total dry weight (g)/plant, L.A (dm)² and LAI at 80 and 100 days after sowing. Data also indicated that T.W. 353 variety gave the highest value of LAR at 80 and 100 days after sowing in both seasons. Data in Table (3) revealed that Pioneer 3062 variety gave the highest values of yield and its components (plant height (cm), ear length (cm), ear diameter (cm), grain index (g), grain yield (g)/plant, straw yield (g)/plant, straw yield (ton)/fed., and biological yield (ton)/fed., while T.W. 353 variety gave the highest value of shelling % in both seasons. The differences between the two maize varieties in grain yield (ton)/fed., and harvest index % was not significant.

It is also clear from Table (4) that maize variety Pioneer 3062 surpassed T.W. 353 variety in carbohydrate and fiber percentages, while T.W. 353 variety gave the highest value of ash % in both seasons. Such results could be attributed to differences in genetic constitution of the two varieties . Similar findings were reported by Hassanien (1996), Zaki *et al* (1999), Mehasen and Alfageh (2004), Waseem *et al* (2007) and El-Gizawy and Salem (2010). Also these results are in a harmony with those obtained by Abo-Shetaia *et al* (2000 a and b).

Effect of nitrogen sources

Data in Table (2) showed that all growth characters were significantly affected by nitrogen sources , it is clear from data that urea surpassed other sources of nitrogen followed by slow release nitrogen in plant height (cm), total dry weight (g)/plant, LA (dm)², LAI and LAR at 80 and 100 days from sowing in both seasons.

Data in Table (3) indicated that yield and its components were affected significantly by nitrogen sources in both seasons. Data revealed that urea surpassed other nitrogen sources followed by slow-release N in plant height (cm), ear length (cm), ear diameter (cm), grain index (g), grain yield (g)/plant and (ton)/fed., straw yield/plant and (ton)/fed., and biological yield (ton)/fed. , whereas the differences between urea and slow-release N were not significant for harvest and shelling per percentage in both season . The superiority of urea and slow-release N on the vegetative growth or yield may be attributed to continuous and slow release of N to maize plants as a results of transforming of NH₄ to NH₃ form and this means, extended NH₄ nutrition (Olson *et al*, 1986).

Similar findings were obtained by Hassanien (1996) and Waseem *et al* (2007) . These results indicated 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

(Marschner, 1995). These results were also obtained by El-Gedwy (2007), Ahmed *et al* (2007) , El-Gizawy and Salem 2010 and Amin (2011).

Data in Table (4) showed that the urea N gave the highest protein percentage, slow-release N gave the highest carbohydrate percentage, ammonium nitrate gave the highest fiber percentage and ammonium sulfate gave the highest ash percentage in both seasons.

Table 2: Effect of cultivars and nitrogen fertilizer sources on growth characters of maize hybrids plant at 80 and 100 days after sowing. (Average of 2014 and 2015 seasons).

Characters Treatments	Plant height		Total dry weight/plant (g)		LA (dm) ²		LAI		LAR	
	80	100	80	100	80	100	80	100	80	100
Cultivars										
Pioneer 3062	245.22	253.67	305.37	331.31	45.22	48.28	2.153	2.299	14.78	14.56
T.W. 353	236.49	245.98	274.12	284.29	41.76	44.77	1.988	2.133	15.22	15.73
L.S.D. at 5%	2.62	2.29	2.37	2.86	0.55	0.26	0.024	0.004	0.11	0.16
Nitrogen Fertilizer Sources										
Ammonium nitrate	237.94	246.35	286.52	303.52	41.54	44.30	1.978	2.112	14.52	14.64
Urea	257.42	264.92	307.87	336.65	48.36	52.29	2.303	2.488	15.71	15.63
Slow-release N	248.26	255.54	297.66	312.71	45.24	47.75	2.153	2.273	15.21	15.30
Ammonium sulfate	219.79	232.48	266.93	278.33	38.83	41.76	1.848	1.990	14.56	15.02
L.S.D. at 5%	1.80	1.11	1.54	1.82	0.29	0.10	0.021	0.006	0.14	0.09

Table 3: Effect of cultivars and nitrogen fertilizer sources on yield and its components of maize hybrids. (Average of 2014 and 2015 seasons).

Characters Treatments	Plant height (cm)	Ear length (cm)	Ear diameter (cm)	Gain index (g)	Grain yield (g)/plant	Straw yield (g)/plant	Grain yield (ton/fed.)	Straw yield (ton/fed.)	Biological yield (ton/fed.)	Harvest index %	Shelling %
Cultivars											
Pioneer 3062	258.60	19.50	5.46	21.62	132.23	242.05	2.891	5.327	8.218	35.17	54.50
T.W. 353	250.51	18.35	5.25	19.20	127.87	231.48	2.814	5.093	7.907	35.58	55.28
L.S.D. at 5%	1.69	0.29	0.04	0.31	0.52	1.76	n.s	0.100	0.133	n.s	0.54
Nitrogen Fertilizer Sources											
Ammonium nitrate	247.70	18.29	5.14	19.32	127.77	231.46	2.775	5.111	7.885	31.19	55.00
Urea	270.06	20.75	5.78	23.38	139.76	251.85	3.075	5.541	8.616	35.69	55.65
Slow-release N	259.69	19.84	5.63	21.51	133.46	240.20	2.936	5.266	8.202	35.81	55.59
Ammonium sulfate	240.77	16.83	4.87	17.44	119.21	223.54	2.624	4.922	7.546	34.80	53.34
L.S.D. at 5%	1.29	0.09	0.02	0.19	1.43	1.31	0.062	0.047	0.094	0.43	0.57

Table 4: Effect of cultivars and nitrogen fertilizer sources on chemical constituent of maize hybrids. (Average of 2014 and 2015 seasons).

Characters Treatments	Protein %	Carbohydrate %	Fiber %	Ash %
Cultivars				
Pioneer 3062	10.67	80.69	6.34	2.30
T.W. 353	10.70	80.56	6.12	2.62
L.S.D. at 5%	n.s	0.03	0.09	0.22
Nitrogen Fertilizer Sources				
Ammonium nitrate	10.84	80.42	6.55	2.19
Urea	11.39	80.83	6.36	1.42
Slow-release N	11.10	81.17	6.09	1.62
Ammonium sulfate	9.41	80.08	5.91	4.61
L.S.D. at 5%	0.06	0.06	0.04	0.07

Effect of interaction

Results in Table (5) showed that there were significant differences between maize varieties and nitrogen sources on growth characters (plant height (cm) and LA (dm)² at 80 and 100 days from sowing, total dry weight/ plant (g), LAI and LAR at 100 days from sowing in both seasons, respectively. The best treatment for growth characters was Pioneer 3062 maize variety with urea fertilizer followed by Pioneer 3062 variety with slow-release nitrogen .Table (6) indicate that the effect of interaction between maize varieties and nitrogen sources was significant for plant height, ear length, ear diameter, grain index, grain yield/plant, straw yield/plant and shelling percentage in both seasons.

It is clear from data that the best treatment for yield and its components was Pioneer 3062 maize variety with urea fertilizer in both seasons followed by slow-release nitrogen. This might be due to the well utilization of N fertilizer in metabolism and meristemic activity which improved these treats. These results are in agreement with those obtained by El-Gizawy 2009 and El-Gizawy and Salem 2010.

Data in Table (7) showed that there were significant between maize varieties and nitrogen sources chemical content (protein %,fiber % and ash %)in both seasons .T.W. 353 variety with urea and ammonium sulfate gave the highest protein% and ash % in both seasons, respectively .While ,Pioneer 3062 maize variety with urea and ammonium nitrate gave the highest fiber percentage in both seasons.

Table 5: Effect of interaction between cultivars x nitrogen fertilizer sources on growth characters of maize hybrids plant at 80 and 100 days after sowing. (Average of 2014 and 2015 seasons).

Characters Treatments		Plant height		Total dry weight/plant (g)		LA (dm) ²		LAI		LAR	
		80	100	80	100	80	100	80	100	80	100
Cultivars x Nitrogen Fertilizer Sources											
Pioneer 3062	Ammonium nitrate	243.01	250.54	301.13	324.14	42.84	45.24	2.040	2.157	14.23	13.96
	Urea	263.24	272.65	324.04	374.19	50.31	55.32	2.397	2.633	15.51	14.78
	Slow-release N	251.30	260.28	313.88	337.54	47.26	49.30	2.250	2.347	15.06	14.82
	Ammonium sulfate	233.31	231.19	282.44	294.37	40.46	43.24	1.927	2.060	14.33	14.69
T.W. 353	Ammonium nitrate	232.88	242.16	271.91	282.89	40.24	43.26	1.917	2.067	14.80	15.33
	Urea	251.59	257.20	291.69	299.10	46.40	49.26	2.210	2.343	15.91	16.47
	Slow-release N	245.23	250.79	281.44	292.88	43.21	46.20	2.057	2.200	15.35	15.77
	Ammonium sulfate	216.27	233.76	251.42	262.29	37.20	40.27	1.770	1.920	14.80	15.34
L.S.D. at 5%		2.54	1.57	n.s	2.58	0.40	0.14	n.s	0.008	n.s	0.13

Table 6: Effect of interaction between cultivars x nitrogen fertilizer sources on yield and its components of maize hybrids.(Average of 2014 and 2015 seasons).

Characters Treatments		Plant height (cm)	Ear length (cm)	Ear diameter (cm)	Gain index (g)	Grain yield (g)/plant	Straw yield (g)/plant	Grain yield (ton/fed.)	Straw yield (ton/fed.)	Biological yield (ton/fed.)	Harvest index %	Shelling %
Cultivars x Nitrogen Fertilizer Sources												
Pioneer 3062	Ammonium nitrate	250.50	19.31	5.26	20.21	130.91	235.51	2.807	5.218	8.025	34.97	55.20
	Urea	278.19	21.21	5.93	25.31	141.26	256.25	3.108	5.638	8.745	35.53	55.12
	Slow-release N	262.90	20.24	5.73	22.43	136.21	248.23	2.997	5.423	8.420	35.59	54.87
	Ammonium sulfate	242.81	17.24	4.92	18.55	120.54	228.19	2.652	5.029	7.681	34.57	52.82
T.W. 353	Ammonium nitrate	244.89	17.27	5.02	18.43	124.64	227.41	2.742	5.003	7.745	35.41	54.80
	Urea	261.92	20.28	5.63	21.45	138.26	247.45	3.042	5.444	8.486	35.85	56.18
	Slow-release N	256.48	19.43	5.52	20.59	130.71	232.18	2.876	5.108	7.984	36.02	56.30
	Ammonium sulfate	238.72	16.42	4.82	16.34	117.88	218.89	2.596	4.815	7.411	35.03	53.85
L.S.D. at 5%		1.83	0.13	0.03	0.28	2.02	1.86	n.s	n.s	n.s	n.s	0.80

Table 7: Effect of interaction between cultivars x nitrogen fertilizer sources on chemical constituent of maize hybrids. (Average of 2014 and 2015 seasons).

Characters Treatments		Protein %	Carbohydrate %	Fiber %	Ash %
Cultivars x Nitrogen Fertilizer Sources					
Pioneer 3062	Ammonium nitrate	10.85	80.49	6.83	1.84
	Urea	11.25	80.94	6.39	1.42
	Slow-release N	11.05	81.21	6.17	1.56
	Ammonium sulfate	9.52	80.12	5.96	4.41
T.W. 353	Ammonium nitrate	10.83	80.35	6.26	2.56
	Urea	11.53	80.72	6.32	1.43
	Slow-release N	11.15	81.14	6.02	1.68
	Ammonium sulfate	9.29	80.04	5.86	4.80
L.S.D. at 5%		0.08	n.s	0.06	0.10

CONCLUSION

It could be concluded that under the condition of the current experiments, Pioneer 3062 maize variety significantly surpassed T.W. 353 maize variety in most of growth characters and yield and its components in both seasons, it is also clear that adding urea followed by slow-release nitrogen was the best treatment for nitrogen sources.

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