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Maize productivity as influenced by foliar fertilizer Stimufol Amino

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Abstract: Two field experiments were carried out in Wadi El-Rayyan region El-Fayoum governorate, Egypt in summer seasons of 2013 and 2014 to study two maize hybrids productivity as influenced by foliar fertilizer Stimufo Amino.
The results could be summarized as follows: The results showed that there were significant differences between maize cultivars in growth characters at two stages of growth (80 and 110 days from sowing) except L.A.R at 80 days. Increasing concentration of Stimufol Amino from zero to 450 g/fed., accompanied with significant increase in all growth characters. Interaction between maize cultivars and foliar fertilizer caused significant increase in all growth characters except plant height. There were significant differences between maize cultivars in yield, its components and chemical composition except harvest index and Ash %. S.C. 128 cultivar surpassed T.W. Nefertiti in yield and yield components. Increasing concentration of Stimufol Amino from zero to 450 g/fed., caused significant increase in yield and its components (plant height, No. of rows/ear, ear length (cm), ear diameter (cm), grain index, grain and straw yields/plant, grain and biological yields/fed. The highest value of protein % and carbohydrate were obtained from S.C. 128. Cultivars, while the highest fiber percentage was obtained from T.W. Nefertiti cultivar.
The response of maize cultivars was raising under higher concentration of foliar fertilizer than the lower ones or control (without foliar fertilizer.S.C. 128 cultivar with 450 g/fed.,Stimufol Amino gave the highest values in all characters of yield,yield components and chemical composition except harvest index and shelling percentage, while the highestash percentage and fiber percentage were obtained from T.W. Nefertiti cultivar with control (without foliar fertilizer).
Keywords: Maize productivity, foliar fertilizer Stimufol Amino.

Introduction

Maize (*zea mays* L.)as the third international cereal crops, is one of the important national food and feed crops. In Egypt, during last two decades, actual and significant improvement of maize productivity have been achieved by using high yielding varieties and hybrids suited to summer environmental conditions at different governorates planting during the period from mid-May to mid-June under recommended improved cultural practices.

Egyptian maize cultivars may differ in their assimilating capacity and distribution of photosynthates between the various plant organs which could be referred to as "source and sink relation"[1]. Maize plant is considered as one of the most important cereal crops used in human consumption,animal feeding , starch industry and oil production. Therefore, continuous attempts were carried out for increasing its productivity to face urgent demands of increasing population especially in through the last period. This can be obtained

through breeding programs to produce highly productive and qualitative gene formsas well as foliar fertilizer in respect to arrive to that strategy. Maize as one of grain crop belonging to grasses, is highly responding to nutrient fertilization especially with nitrogen which is considered as limiting factor for maize production[2]. Maize needs highly nutrient especially highly rate of N applied reached to 300 kg. urea/fed., in normal soils[3]. These large quantities of the mineral N-fertilizer cause environmental pollution through drainage water and other N-contaminated water[4]. Maize can be grown as a supplementary crop to decrease the gap between the import and the local production of oil in Egypt. Hence, its cultivation was recently expanded in the newly reclaimed sandy soils which characterized with low fertility, high pH value and low organic matter content. Meanwhile high demand of N-fertilizer requirement which led to high leaching of nitrogen and other fertilizers (P,K) through its high filtration rates. However, application of N.P.K. fertilizer as a foliar spray may decrease such losses[5]. mentioned that N-losses in summer crops are very high and efficiency of N-fertilizers used is very low. Thus foliar feeding as a supplement or a partial substitution to soil fertilizer application was studied, in this connection, efficient and positive response of some filed crops due to foliar feeding combined with soil application were recorded.[6-8] . The beneficial effect of foliar nutrition of N, P and K as a supplemental or a partial substitution to soil application were reported[9-11].

The objective of the present study was to investigate response of two maize cultivars to foliar fertilizer Stimufol Amino.

Materials and Methods

Two field experiments were carried out in Wadi El-Rayyan region, Fayoum governorate, Egypt, during the two successive seasons of 2013 and 2014 to study the response of two maize cultivars to foliar fertilizer Stimufol Amino. Each experimental included 8 treatments which were the combination of two white maize cultivars (i.e. S.C. 128 and T.W. Nefertiti) and three concentrations of Stimufol Amino fertilizer beside the control (250, 350 and 450 g/fed.), with 200 L-water/fed. The chemical composition of foliar fertilizer were : N 25%, P 16%, K 12%, Amino acids 2%, Boron 0.044%, Fe 0.17%, Molybdenum 0.001%, Zink 0.03%, Copper 0.085, Cobalt 0.01%, Mg 0.02%, Manga 0.085% and EDTA. The physical and chemical properties of the experimental soil site (30 depths) were as follows: sand 52.5%, silt 20%, clay 27.5%, pH 8.02, OM 0.84%, $CaCO_3$ 20.9%, EC. 2.9 mm has/cm^3, soluble N 74 PPm according to[12].Theexperiments were laid in a spilt-plot design with six replication, where white maize cultivars occupied the main plots and foliar fertilizer treatments were allocated at random in sub-plots. The experimental unit consisted of seven ridges 5 meters in length and 60 cm width (21 m^2 = 1/200 fed.). Grains of maize cultivarswere sown in 23rd and 22nd May in 2013 and 2014, respectively, in hills, spaced 25 cm along, three kernels per hell. Thinning to one plant per hill was done at 21 days after planting. Nitrogen fertilizer as ammonium nitrate (33.5% N) was applied at the rate of 120 kg N/fed., in two equal doses, before the first and the second irrigation. Pest control and other cultural practices were carried out as recommended. The plants were sprayed two times during the elongation stage (30 and 50 days from sowing). The following growth attributes were recorded on two samples of five guarded plants, each was taken randomly at milky ripe stage (80 days from sowing) and ripe stage (110 days from sowing) i.e. plant height (cm), total dry weight/plant (g), No. of ear/plant, LA (dm^2) were calculated according to[13], meanwhile, leaf area index (LAI) cm^2 according to[14] and LAR.At harvest ten guarded plants were taken randomly from the middle two ridges of each plot to determine plant height (cm), No. of row/ear, ear length (cm), ear diameter (cm), grain index (g) (100-grain weight), grain yield (g)/plant, straw yield (g)/plant, harvest index and shelling percentage. In addition, grain yield ton /fed., straw yield ton/fed., and biological yield ton/fed., were determined from the other three middle rows of each plot. Crude protein, ash and fiber were determined to the methods described in[15], total carbohydrate were also determind according to[16].

Statistical analysis was performed according to[17]. Treatment means were compared by L.S.D. test. Combined analysis was made for the two growing seasons as results followed similar trend.

Results and Discussion

Growth characters:

1- **Cultivars Differences:**

Data in Table (1), revealed that there were significant differences between maize cultivars in all growth characters under study except LAR at 80 days from sowing. S.C. 128 cultivar surpassed the other one T.W. Nefertiti in all growth characters,i.e.plant height, total dry weight /plant (g),No of ear / plant ,LA (dm^2) and LAI at 110 days after sowing,while T.W. Nefertiti cultivar gave the highest value of LAR at 110 days after sowing. It was noteworthy mention cultivars differences in growth parameter are in a harmony with the results obtained by[18-24]. In addition, varietal differences in growth parameter in this study may be due to the differences in genetic structure and to varietal differences in photosynthates partitioning[25]. On the other hand, the inconstant line of maize hybrids in dry weight/ plant in their variation with advancing plant age could be attributed to the hybrid differences in migration of dry matter from vegetative organs to ears and also to hybrids differences in photosynthates partitioning[19].

Table 1: Effect of cultivars and stimufol foliar fertilizer on growth characters of maize hybrids at 80 and 110 days after sowing. (Average of 2013and 2014 seasons).

Characters	Plant height(cm)		Total dry weight/plant(g)		No. of ear/plant		LA $(dm)^2$		LAI		LAR	
Treatments	80	110	80	110	80	110	80	110	80	110	80	110
Cultivars												
S.C. 128	285.71	301.07	343.56	408.46	-	1.36	47.12	56.47	2.25	2.69	13.73	13.82
T.W. Nefertiti	279.26	289.74	319.07	363.07	-	1.25	44.27	54.26	2.11	2.58	13.88	14.95
L.S.D. at 5%	2.03	0.97	5.30	2.89	-	0.01	0.20	0.13	0.01	0.01	NS	0.12
Stimufol Foliar Ferilizer												
Control	268.56	286.66	303.00	367.66	-	1.10	41.99	51.67	2.00	2.46	13.85	14.12
250 "g"/feddan	280.67	291.64	318.43	377.24	-	1.18	44.69	54.71	2.13	2.61	14.05	14.54
350 "g"/feddan	286.42	297.09	344.87	392.91	-	1.41	46.84	56.29	2.23	2.68	13.58	14.35
450 "g"/feddan	294.29	306.24	358.95	405.25	-	1.52	49.26	58.78	2.36	2.80	13.73	14.53
L.S.D. at 5%	1.82	1.73	1.74	1.42	-	0.01	0.25	0.06	0.02	0.02	0.11	0.06

2- **Effect of foliar fertilizer:**

Data in Table (1) show that increasing concentration of foliar fertilizer from zero to 450 g/fed. accompanied with significant increase in all growth characters under study (except LAR at 110 days after sowing 250 g/fed. was equal 450 g/fed. surpassed all the concentrations of foliar fertilizer.) i.e. plant height (cm), total dry weight g/plant, No. of ear/plant, LA and $(dm)^2$, LAI. [5,11]It is mentioned that N and other nutrient losses in summer crops such as maize are very high and efficiency of N-fertilizers used is very low. Thus, foliar feeding as a supplement or a partial substitution to soil fertilizer application was studied[26,27] on mingbean and on maize[11].

3- Effect of interaction :

Effect of interaction between maize cultivars and foliar fertilizer (Stimufol Amino) are presented in table (2). Data show that total dry weight/plant at 80 and 110 days, No. of ear/plant at 110 days, LA at 80 and 110 days, LAI at 80 and 110 days and LAR at 80 and 110 days after sowing significantly responded for the interaction between maize cultivars and foliar fertilizer, while the interaction at plant height at 80 and 110 days after sowing was not significant in both seasons. The best treatment for all growth character except LAR was S.C. 128 cultivar + 450 g/fed., foliar fertilizer, while the best value for LAR was T.W. Nefertiti cultivar + 250 g/fed.,foliar fertilizer.

Table 2: Effect of interaction between cultivars x stimufol foliar fertilizer on growth characters of maize hybrids at 80 and 110 days after sowing. (Average of 2013 and 2014 seasons).

Characters / Treatments		Plant height(cm)		Total dry weight/plant(g)		No. of ear/plant		LA $(dm)^2$		LAI		LAR	
		80	110	80	110	80	110	80	110	80	110	80	110
Cultivars x Stimufol Foliar Fertilizer													
S.C. 128	Control	272.85	292.18	311.16	398.17	-	1.13	43.82	53.16	2.09	2.53	14.08	13.35
	250 "g"/feddan	284.16	298.12	335.86	401.00	-	1.24	46.15	56.17	2.20	2.68	13.74	14.01
	350 "g"/feddan	288.51	302.33	355.81	412.00	-	1.47	48.29	57.18	2.30	2.72	13.57	13.88
	450 "g"/feddan	297.34	311.67	371.40	422.67	-	1.58	50.19	59.35	2.41	2.83	13.51	14.04
T.W. Nefertiti	Control	264.28	281.14	294.84	337.16	-	1.06	40.16	50.18	1.91	2.39	13.62	14.88
	250 "g"/feddan	277.18	285.17	301.00	353.49	-	1.12	43.23	53.25	2.06	2.54	14.36	15.07
	350 "g"/feddan	284.32	291.85	333.92	373.82	-	1.36	45.38	55.39	2.16	2.64	13.59	14.82
	450 "g"/feddan	291.24	300.80	346.50	387.82	-	1.46	48.33	58.21	2.30	2.77	13.59	15.02
L.S.D. at 5%		NS	NS	2.47	2.01	-	0.02	0.36	0.09	0.03	0.03	0.16	0.08

Yield and its components:

1- Cultivars differences :

Data in table (3) indicated that there were significant differences among maize cultivars i.e. S.C. 128 and T.W. Nefertiti in all characters under study except harvest index was not significant. S.C. 128 cultivar surpassed T.W. Nefertiti in plant height, No. of rows/ ear, ear length (cm), ear diameter (cm), grain index, grain yield/plant and /fed., straw yield/plant and /fed., biological yield/fed. and shelling %. The differences between maize cultivars in yield and its components might reflected the differences between maize cultivars in dry matter. The superiority of S.C. 128 cultivar in grain yield over the other one might be due to the increase in growth characters. Varietal differences in yield and its component in this study may be due to the differences in genetic structure and to varietal differences in photosynsates partitioning. Cultivars differences in yield and its components in this study are in harmony with the results obtained[19,28,29,1,20,30,31,21,11,23,32,24].

2- Effect of foliar fertilizer:

Data in table (3) clearly show that there are significant marked stimulatory effect on plant height (cm), No. of rows/ear, ear length (cm), ear diameter (cm), grain yield/plant and /fed., straw yield/plant, biological yield/fed. and grain index, while straw yield/fed., harvest index and shelling percentage was insignificant affect in treated with foliar fertilizer Stimufol Amino. Concerning the effect of the relatively high concentration of foliar fertilizer 450 g/fed., this caused significant increament in yield and its components in comparison with control in this connection. This increase in yield attributes might be due to on increased rate of assimilate transport from the source to the developing grains a decrease the aborting of reproductive organs. This possibility is supported by the finding that exogenous the grain number per ear by up to 30% in maize[33,34,21]. However, increase yield might be due to more grains per spike and increased assimilate partitioning from leaves to grains as suggested by the 1000-grain weight[35,11]**.** The data reveal also that spraying maize cultivars with foliar fertilizer concentrations significantly increased chemical composition (table 5).

3- Effect of interaction :

Data in table (4) indicated that plant height, No. of rows/ear, ear length (cm), grain index, grain yield/plant and /fed., and biological yield/fed., were significantly affected by the interaction between maize cultivars and the different concentration of foliar fertilizer. However, straw yield/plant and /fed., harvest index and shelling percentage were not significantly affected by the interaction between maize cultivars and the different concentration of foliar fertilizer. The best treatment for yield and its components was S.C. 128 cultivar + 450 g/fed., foliar fertilizer.

Table 3: Effect of cultivarsandstimufol foliar fertilizer on yield and its components of maize hybrids.(Average of 2013 and 2014 seasons).

Characters / Treatments	Plant height (cm)	No. of rows/ear	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												
S.C. 128	305.07	22.24	21.46	6.66	27.66	143.30	256.02	3.583	6.390	9.973	35.84	56.06
T.W. Nefertiti	297.21	18.41	19.67	5.67	25.65	136.00	245.08	3.400	5.875	9.525	35.62	55.51
L.S.D. at 5%	0.73	0.03	0.09	0.02	0.05	0.95	3.63	0.024	0.042	0.047	NS	0.44
Stimufol Foliar Ferilizer												
Control	291.75	20.20	20.31	5.84	26.33	134.62	242.51	3.365	6.063	9.428	35.69	55.50
250 g/feddan	298.13	20.31	20.50	6.07	26.53	137.98	247.01	3.450	6.175	9.624	35.70	55.86
350 g/feddan	302.75	20.37	20.68	6.30	26.78	141.58	253.48	3.539	6.333	9.872	35.86	55.89
450 g/feddan	311.93	20.44	20.79	6.46	26.96	144.43	259.20	3.611	6.459	10.070	35.69	55.90
L.S.D. at 5%	0.56	0.03	0.05	0.04	0.04	0.80	2.58	0.020	NS	0.067	NS	NS

Table 4: Effect of interaction between cultivars x stimufol foliar fertilizer on yield and its components of maize hybrids.(Average of 2013 and 2014 seasons).

Characters / Treatments		Plant height (cm)	No. of rows/ear	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 %
S.C. 128	Control	295.20	22.13	21.29	6.31	27.37	139.06	247.77	3.477	6.194	9.671	35.95	56.13
	250g/feddan	302.04	22.24	21.37	6.57	27.50	140.94	251.86	3.524	6.297	9.820	35.88	55.96
	350g/feddan	306.16	22.27	21.57	6.79	27.78	144.88	257.95	3.622	6.449	10.071	35.98	56.17
	450g/feddan	316.88	22.33	21.62	6.98	27.97	148.31	266.51	3.708	6.621	10.329	35.56	56.00
T.W. Nefertiti	Control	288.30	18.26	19.32	5.36	25.29	130.18	237.24	3.254	5.931	9.185	35.43	54.87
	250g/feddan	294.23	18.37	19.63	5.57	25.56	135.01	242.15	3.375	6.054	9.429	35.51	55.75
	350g/feddan	299.34	18.46	19.79	5.81	25.78	138.27	249.02	3.457	6.217	9.673	35.73	55.61
	450g/feddan	306.97	18.54	19.95	5.94	25.95	140.54	251.90	3.514	6.297	9.811	35.81	55.79
L.S.D. at 5%		0.79	0.05	0.07	NS	0.06	1.13	NS	0.028	NS	0.067	NS	NS

Chemical Composition :

Data in table (5) and (6) revealed that there were significant differences among maize hybrids, i.e. S.C. 128 and T.W. Nefertiti in protein percentage, carbohydrate percentage and fiber percentage, while in ash percentage was insignificant. Data indicated that S.C. 128 maize hybrid gave the highest values of protein percentage and carbohydrate percentage, also T.W. Nefertiti hybrid gave the highest value of fiber percentage. Data also show that there are significant marked stimulatory effect on protein, carbohydrate, Ash and fiber percentage with adding foliar fertilizer. It is clear from data that increasing foliar fertilizer up to 450 g/fed.,increased protein and carbohydrate percentage, while decreased fiber and ash percentage compared with the control. This may be due to the stimulation and enhancement of cell division and chlorophyll accumulation and enhancement of maize growth and increase protein and soluble sugar accumulation in maize grain[36,24]. Data in table (6) indicated that the interaction between maize hybrids and foliar fertilizer was significant in all characters under this study. It is worthy to mention that the best treatment for protein and carbohydrate percentage was S.C. 128 maize cultivars with 450g/fed., foliar fertilizer, while T.W. Nefertiti maize hybrid with control (without foliar fertilizer) was the best treatment for fiber and ash percentage.

Table 5: Effect of cultivars and stimufol foliar fertilizer on chemical constituent of maize hybrids.(Average of 2013and 2014 seasons).

Characters Treatments	Protein %	Carbohydrate %	Fiber %	Ash %
Cultivars				
S.C. 128	11.84	80.78	4.40	2.97
T.W. Nefertiti	11.58	80.58	4.75	3.08
L.S.D. at 5%	0.04	0.11	0.09	NS
Stimufol Foliar Ferilizer				
Control	11.22	80.20	5.22	3.36
250 "g"/feddan	11.68	80.62	4.71	3.00
350 "g"/feddan	11.92	80.91	4.17	3.01
450 "g"/feddan	12.03	80.99	4.21	2.75
L.S.D. at 5%	0.03	0.05	0.06	0.07

Table 6: Effect of interaction between cultivars x stimufol foliar fertilizer on chemical constituent of maize hybrids. (Average of 2013and 2014 seasons).

Characters Treatments		Protein %	Carbohydrate %	Fiber %	Ash %
Cultivars x Stimufol Foliar Fertilizer					
S.C. 128	Control	11.31	80.31	5.00	3.39
	250 "g"/feddan	11.91	80.80	4.31	3.00
	350 "g"/feddan	12.00	80.97	4.01	3.01
	450 "g"/feddan	12.15	81.02	4.29	2.49
T.W. Nefertiti	Control	11.12	80.08	5.43	3.33
	250 "g"/feddan	11.45	80.44	5.11	3.00
	350 "g"/feddan	11.84	80.84	4.32	3.00
	450 "g"/feddan	11.92	80.96	4.12	3.00
L.S.D. at 5%		0.05	0.07	0.09	0.10

From the above mentioned results, it can be concluded that the application of different concentration of foliar application on maize hybrids result in pronounced increase in growth characters, yield, its components and some biochemical constituents in grains. However, most of the previous characteristics were increased by increasing foliar fertilizer (Stimufol Amino) treatment from control (zero) to 450 g/fed.

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