J. Agric. Sci. Mansoura Univ., 31 (11): 6825 - 6837, 2006

RESPONSE OF GRAIN SORGHUM TO FOLIAR SPRAY WITH ASCORBIC AND CITRIC ACIDS UNDER DIFFERENT RATES OF NITROGEN FERTILIZER IN SANDY SOIL

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ABSTRACT

Two field experiments were carried out at Ismailia Agricultural Research Station, during 2002 and 2003 seasons to study the response of short grain sorghum variety (Dorado) to foliar spray with 500 ppm from ascorbic acid (A. A.), citric acid (C.A.) and mixture of (A.A. + C.A.) as well as control (without spraying) under different rates of nitrogen fertilizer i.e. 80, 100, 120 and 140 kg N/fed. in sandy soil conditions.

The results in these trials show that:

1. Increasing nitrogen fertilization rates from 80 to 120 kg N/fed. significantly increased plant height, head weight, grain weight/head, number of kernels per panicles and grain yield/fed. Whereas, adding 140 kg N/fed. recorded insignificant decrease in these characters compared with plants received 120 kg N/fed. Total chlorophyll in leaves, as well as protein, phosphorus and potassium percentages in grains were increased gradually with increasing nitrogen rates from 80 to 140 kg N/fed.
2. The foliar spray of grain sorghum plants with ascorbic and citric acids gave the highest values in plant height, head weight, grain weight/head, green weight/fed. , grain yield/fed. , total chlorophyll in leaves as well as protein, phosphorus and potassium percentages in grains, whereas number of kernels/head gave maximum value by spraying 500 ppm citric acid only.
3. The interaction effect between nitrogen fertilizations and ascorbic & citric acids recorded significant effect on plant height, LAI, head weight, grain weight/head, 1000 kernel weight and grain yield/fed. Most of these characters gave the highest values by adding 120 kg N/fed. and sprayed with mixture of A.A. and C.A. Also, 1000 kernel weight gave the highest value by adding 140 kg N/fed. without spray of organic acids. Maximum values percentage of protein, phosphorus and potassium in grains as well as total chlorophyll in leaves were extracted by adding 140 N/fed. with spraying (A.A. + C.A.) mixture.

INTRODUCTION

Dorado is short variety of grain sorghum [*Sorghum bicolor* (L.)Moench], which is successfully grown and high yielding in the newly reclaimed soils (sandy and calcareous) in Egypt, such as Ismailia Governorate. Dorado variety is considered a dual purpose crop grown for grains and fodder. Nitrogen largely affects grain yield and quality of Dorado variety especially under sandy soils conditions. The optimum dose of nitrogen is very important to obtain the high yield without luxury consumption of nitrogen fertilizers. Response of grain sorghum to nitrogen fertilization was studied by many workers, *Saba et al. (1990)* at Kom Ombo Research Station, achieved maximum grain yield of grain sorghum by using the highest nitrogen rate of 100 kg N/fed. *Eweis et al. (1992)* at Nubaria Research Station, found that the growth characters and yield components of Dorado variety were significantly increased by increasing nitrogen fertilizer rates from 60 up 100 kg N/fed. *Bashir et al. (1994)* found that at Ismailia Research Station on

Dorado variety, increasing nitrogen rates from 80 to 100 kg N/fed. increased significantly grain weight per head, 1000 grain weight, grain yield / fed. as well as protein yield per fed. *Eweis et al. (1998)* reported that increasing nitrogen fertilization on grain sorghum up to 100 kg N/ fed. significantly increased leaf area index, fodder yield, grain weight/head, and 1000 grain weight, number of grains/head, and grain yield/fed.

Ascorbic acid is synthesized in most of higher plants, and affects plant growth and development. The precise steps in the biosynthesis of ascorbic acid for glucose have been determined. *Grun et al. (1982)* reported that ascorbic acid is a product of D-glucose metabolism which affects nutritional cycle's activity in higher plants. They added that ascorbic acid plays an important role in the electron transport system. It is a powerful reducing agent and is reversible converted to dehydroascorbic acid, the oxidized product:

Ascorbic acid $\rightleftharpoons$ dehydroascorbic acid + $2H^{+}+2e^{-}$

A plant enzyme that catalyzes this reaction is the copper- containing enzyme ascorbic acid oxidase.

Rabie and Negm (1992) found that grain yield of wheat plant was slightly affected by ascorbic acid. *Mohmoud, Mona (1994)* reported that both wheat and faba bean plants sprayed with 500 ppm ascorbic acid showed significant positive effects on most of growth characters and yields. *Mousa et al. (1994)* showed that the foliar application of ascorbic acid significantly increased grain and straw yield of wheat. *Hanna et al. (2001)* concluded that the foliar spray with 500 or 1000 ppm ascorbic acid significantly increased plant height, number of tillers /m^2, number of grains / spike, grains weight/ spike, 1000 grain weight, straw weight / plant, number of spikes/ m^2, spike length, straw and grain yield/fed. of wheat plants compared with untreated plants.

Citric acid is one of the organic acids presented in tri-carboxylic acid cycle and synthesized either from acetyl-CoA, glycine and ∞-keto-glutaric, or malic acid conversion to citric acid (*Miernyk and Trelease, 1981*). Growth of cotton, corn, lettuce, bean, pea and sunflower increased by organic acids of external treatments especially succinic, citric and malic acids (*Malik and Singh, 1982 and Nofal et al, 1990*).

The objective of this study is to evaluate the response of grain sorghum to foliar spray of ascorbic and citric acids with different levels of nitrogen fertilization under sandy soil condition.

MATERIALS AND METHODS

Two field experiments were carried out at Ismailia Agricultural Research Station, during the two growing seasons 2002 and 2003 to study the response of short grain sorghum variety (Dorado) to ascorbic acid (A.A.), citric acid (C.A.) and nitrogen fertilization under sandy soil conditions. The experiment was preformed under surface irrigation system in split plot design with four replicates. The main plots were devoted to nitrogen fertilization levels while the sub-plots included ascorbic and citric acids treatments. The experimental treatments were as follows:-

I. Nitrogen fertilization (main -plots):
1. 80 kg N/ fed.
2. 100 kg N/fed.
3. 120 kg N/ fed.
4. 140 kg N/fed.

II. Ascorbic and Citric acids (sub-plots):

A. Untreated plants (control).
B. Foliar spray with 500 ppm ascorbic acid (A.A.).
C. Foliar spray with 500 ppm citric acid (C.A.).
D. Foliar spray with mixture of 500 ppm A.A. + 500 ppm C.A.

Sub-plot area was 3 X 3.5 m (1/400 fed.), each plot included five ridges 60 cm apart. Sowing dates were in 17th and 28th June in 2002 and 2003 seasons, respectively. Planting was in hills spaced 20 cm apart. Seedlings were thinned into two plants /hill after 20 days from sowing. Agricultural practices were completed according to the usual methods being adopted for grain sorghum plant. Nitrogen fertilizer levels in the form of ammonium nitrate (33.5% N) were split into four equal doses, the first one was added after thinning (20 days after sowing), while the other three doses were added every 10 days. Phosphorus and potassium fertilizers at the rate of 30 kg P_2O_5 /fed and 24 kg K_2O/fed in the form of calcium super-phosphate (15.5% P_2O_5) and potassium sulphate (48% K_2O), respectively, divided into two equal doses, the first dose was added immediately after thinning and the second after 10 days later. Ascorbic and Citric acids were sprayed two times 30 and 45 days after sowing with the volume of 400 liter/ fed. Some physical and chemical properties of the experimental sites are shown in Table 1 and were done according to *Ryan et al (1996).*

Table 1: Some physical and chemical properties of the experimental site during the two growing seasons.

Properties	Seasons	
	2002	2003
Particle size distribution		
Coarse sand %	83.20	82.90
Fine sand %	10.30	15.60
Silt %	1.45	1.44
Clay %	5.05	5.06
Texture class	Sandy	Sandy
Organic matter%	0.22	0.25
$CaCO_3$ %	0.47	0.49
pH (Soil paste)	7.70	7.50
EC (m mhos/cm at 25° C)	0.12	0.11
Available nutrients (ppm)		
N	31.1	25.5
P	5.3	7.1
K	85.0	69.0

At first and second seasons, after 60 days from sowing a fresh sample was taken to determine total chlorophyll in leaves (mg/g) by using Spectrophotometer according to Arnon as cited by *Bruinsama (1963)* using the following equation:-

Total chlorophyll= 27.8 x A_{652}
Where as:-
A_{652}= absorbance at 652 nm
27.8= constant.

Number of days to 50% flowering was recorded at flowering stage. At harvest time (110 days after sowing), ten random guarded plants were taken from certain row (the second row from the north in each plot) to evaluate the following characters:-

1. Plant height (cm).
2. Leaf area index.
3. Head weight (g)
4. Grain weight /head (g)
5. Number of kernels /head.
6. 1000 kernel weight (g).
7. Green yield ton/fed.
8. Grain yield ard./ fed.

Mature grains of two seasons were subjected to chemical analysis to determine protein, phosphorus and potassium content. The standard micro-Kjeldahl method as described by *Pregl (1945)* was used to determine total nitrogen for calculating protein percentage in grains. Phosphorus was determined colourmetrically according to *Jackson (1973).* Potassium was estimated in digest material by flame-photometer (*Chapman and Pratt, 1961*). Data were subjected to proper statistical analysis and the averages were compared by L.S.D. as mentioned by *Snedecor and Cochran (1967).* Data were discussed on the basic of combined analysis of the two seasons.

RESULTS AND DISCUSSION

1. Growth characters:-

a. Effect of Nitrogen fertilization: Results in Table 2 show that increasing nitrogen fertilizer rates from 80 to 120 kg N/fed. increased plant height significantly. Whereas adding 140 kg N/fed. recorded insignificant decrease compared with plants received 120 kg N/fed. In this respect Latif et al (2000) found that increasing nitrogen fertilizer rates up to 100 kg N/fed. to grain sorghum significantly increased plant height. It is worthy to mention that nitrogen fertilization recorded insignificant effect on leaf area index and number of days to 50% flowering.

b. Effect of ascorbic and citric acids: Data presented in Table 2 show that foliar spray of grain sorghum plants with ascorbic acid or citric acid increased significantly plant height compared with untreated plants. Such positive response of sorghum plant to A.A. treatments may be due to its activations of some enzymes which are important for regulating photosynthetic carbon reduction (Helsper et al., 1982). Also, Miernyk and Trelease (1981) found that citric acid as an organic acid presented in tri-carboxylic acid cycle and synthesized either from acetyl- CoA, glycine and ∞-ketoglutaric, or malic acid conversion to citric acid. It can be mention that plant height reached its maximum when plants sprayed with (C.A.).

Table 2: Response of some growth characters for Dorado variety to Ascorbic and Citric acids under deferent levels from nitrogen fertilizer rstes in sandy soil.

Treatments		Plant height (cm)			Leaf area index			Days to 50% flowering		
Nitrogen	Ascorbic & citric	2002	2003	Comb.	2002	2003	Comb	2002	2003	Comb.
80 kg N/feddan	Without spray	84.32	79.32	81.82	5.22	6.36	5.79	98.70	87.30	93.00
	500 ppm A.A.	84.00	76.80	80.40	5.00	7.41	6.20	96.70	88.70	92.70
	500 ppm C.A.	83.68	80.80	82.24	5.11	7.12	6.11	95.00	86.00	90.50
	A.A.+C.A.	88.50	79.10	83.80	5.50	6.65	6.07	96.00	84.30	90.20
Mean		**85.15**	**79.01**	**82.07**	**5.21**	**6.89**	**6.05**	**96.60**	**86.60**	**91.60**
100 kg N/feddan	Without spray	83.32	76.22	79.78	5.85	7.10	6.47	98.30	87.70	93.00
	500 ppm A.A.	98.68	73.20	85.94	5.50	7.82	6.66	95.70	88.30	92.00
	500 ppm C.A.	95.68	89.13	92.40	5.57	6.73	6.15	98.30	82.70	90.50
	A.A.+C.A.	90.32	78.80	84.56	5.62	7.30	6.46	95.00	90.70	92.80
Mean		**92.00**	**79.34**	**85.67**	**5.64**	**7.23**	**6.44**	**96.80**	**87.30**	**92.10**
120 kg N/feddan	Without spray	89.50	76.78	83.14	6.38	8.09	7.23	93.70	86.30	90.00
	500 ppm A.A.	97.68	81.47	89.57	5.71	5.83	5.77	95.30	84.30	89.80
	500 ppm C.A.	101.00	75.53	88.26	6.76	8.89	7.82	98.00	84.30	91.20
	A.A.+C.A.	96.68	88.43	92.55	4.92	7.36	6.14	95.00	91.30	93.20
Mean		**96.22**	**80.55**	**88.38**	**5.94**	**7.54**	**6.74**	**95.50**	**86.60**	**91.00**
140 kg N/feddan	Without spray	90.32	79.80	85.06	4.29	7.82	6.05	95.00	85.70	90.30
	500 ppm A.A.	91.32	82.43	86.88	5.89	7.12	6.51	95.70	87.70	91.70
	500 ppm C.A.	93.32	80.47	86.90	6.20	5.93	6.06	95.30	84.00	89.70
	A.A.+C.A.	96.32	78.68	87.50	6.11	8.75	7.43	98.00	85.00	91.50
Mean		**92.82**	**80.34**	**86.58**	**5.62**	**7.40**	**6.51**	**96.00**	**85.60**	**90.80**
Mean of Ascorbic and Citric	Without spray	**86.87**	**78.03**	**82.45**	**5.44**	**7.34**	**6.39**	**96.40**	**86.80**	**91.60**
	500 ppm A.A.	**92.92**	**78.47**	**85.70**	**5.52**	**7.04**	**6.28**	**95.80**	**87.30**	**91.50**
	500 ppm C.A.	**93.42**	**81.48**	**87.45**	**5.91**	**7.17**	**6.54**	**96.70**	**84.30**	**90.50**
	A.A.+C.A.	**92.82**	**81.25**	**87.10**	**5.54**	**7.51**	**6.53**	**96.00**	**87.80**	**91.90**
Nitrogen		3.01	N.S.	2.43	N.S.	N.S.	N.S	N.S.	N.S.	N.S.
A.A. & C.A.		3.42	N.S.	2.65	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
N x A.A. x C.A.		6.86	8.35	5.31	0.91	1.43	0.83	2.87	N.S.	N.S.

Sprayed plants with mixture of (A.A. + C. A.) increased plant height compared with untreated plants or plants received (A.A.) only. These results are in harmony with those reported by Anton et al (1999) on barley. Whereas, such treatments recorded insignificant effect on leaf area index and number of days to 50% flowering.

d.Effect of interaction: Data presented in Table 2 indicate that the interaction between nitrogen fertilization and ascorbic & citric acids recorded significant effect on plant height and leaf area index. Whereas, insignificant effect was noticed on number of days to 50% flowering. The maximum value of plant height was gained when plants treated with 120 kg N/fed. and sprayed with mixture of (A.A. + C.A.). Whereas, the maximum value of leaf area index was obtained when sorghum plants received 120 kg N/fed. and sprayed with (C.A.).

2. Yield components:

Data presented in Table 3 show that the characters of yield components such as head weight, grain weight /head, number of kernels/head and 1000 kernel weight.

a. **Effect of nitrogen fertilization:** Results of Table 3 show that adding nitrogen at any rate recorded significant effect on head weight, grain weight/ head and number of kernels/head. It can be noticed that the addition of 100, 120 or 140 kg N/fed. significantly increased head weight and grain weight/head compared with plants received 80 kg N/fed., with maximum value in the case of 120 kg N/fed. Whereas, treated grain sorghum plants with 120 kg N/fed. significantly increased number of kernels/head compared with plants treated with 80 kg N/fed. In this connection, Latif et al. (2000) found that yield and yield components of grain sorghum were improved by increasing nitrogen rate in the newly reclaimed sandy soils.

b. **Effect of ascorbic and citric acids:** Results in (Table 3) indicate that foliar spray of grain sorghum plants with (A.A.) and (C.A.) recorded significant effects on grain weight/head and number of kernels/head. The presented data show that spraying grain sorghum plants with (C.A.) or mixture of (A.A. + C.A.) significantly increased grain weight/head compared with untreated plants. Whereas, spraying plants with C.A. only significantly increased number of kernels/head compared with control one. In this respect, Hanna et al. (2001) found that the foliar spray with 500 or 1000 ppm ascorbic acid significantly increased number of grains/ spike and grains weight/spike of wheat plants compared with untreated plants. Also, Malik and Singh (1982) and Nofal et al. (1990) reported that yields of cotton, corn, lettuce, bean, pea and sunflower increased by organic acids of external treatments especially succinic, citric and malic acids.

c. **Effect of interaction:** Results of Table 3 show that the interaction between nitrogen fertilization and ascorbic& citric acids recorded a significant effect on head weight, grain weight/head, number of kernels /head and 1000 kernel weight. It is worthy to mention that, the maximum values of head weight and grain weight /head were obtained from adding 120 kg N/fed. and spraying mixture of (A.A. + C.A.).

Table 3: Response of some yield components characters for Dorado variety to Ascorbic and Citric acids under deferent levels from nitrogen fertilizers in sandy soil.

Treatments		Head weight (gm)			Grain weight/head (gm)			Number of kernels /head			1000 kernels weight (gm)		
Nitrogen	Ascorbic & citric	2002	2003	Comb.	2002	2003	Comb.	2002	2003	Comb.	2002	2003	Comb.
80 kg N/feddan	Without spray	45.13	46.85	45.99	32.63	29.68	31.15	1014.50	898.55	956.53	32.13	33.07	32.60
	500 ppm A.A.	44.33	35.43	39.88	37.33	29.01	33.17	1266.90	795.31	1031.11	29.60	36.67	33.13
	500 ppm C.A.	54.58	41.33	47.95	39.50	29.22	34.36	1176.05	1093.37	1134.71	32.93	28.00	30.46
	A.A.+C.A.	51.56	40.43	46.00	36.98	32.66	34.82	1237.03	944.41	1090.72	29.88	34.53	32.20
Mean		**48.90**	**41.01**	**44.96**	**36.61**	**30.14**	**33.38**	**1173.62**	**932.91**	**1053.27**	**31.31**	**33.07**	**32.10**
100 kg N/feddan	Without spray	51.88	47.69	49.79	38.03	39.36	38.70	1193.13	1601.09	1397.11	31.88	26.13	29.00
	500 ppm A.A.	55.25	59.96	57.61	31.93	31.22	31.58	968.60	883.26	925.93	33.33	35.47	34.40
	500 ppm C.A.	65.93	48.41	57.17	51.10	35.41	43.26	1528.50	1048.91	1288.70	33.33	33.73	33.53
	A.A.+C.A.	60.01	42...97	51.49	47.70	30.34	39.02	1397.93	787.29	1092.61	34.13	38.27	36.20
Mean		**58.27**	**49.76**	**54.01**	**42.19**	**34.08**	**38.14**	**1272.04**	**1080.14**	**1176.09**	**33.16**	**33.40**	**33.28**
120 kg N/feddan	Without spray	58.10	52.03	55.06	45.40	33.92	39.66	1378.50	962.20	1170.35	32.93	35.33	34.13
	500 ppm A.A.	58.03	46.95	52.49	43.48	41.90	42.69	1394.20	1475.73	1434.97	31.20	31.33	31.27
	500 ppm C.A.	56.43	54.75	55.59	42.98	47.70	45.34	1402.83	1279.59	1341.21	30.68	37.33	34.00
	A.A.+C.A.	59.88	74.39	67.14	40.93	56.37	48.65	1186.90	1586.09	1386.49	34.93	35.33	35.13
Mean		**58.11**	**57.03**	**57.57**	**43.19**	**44.97**	**44.09**	**1340.61**	**1325.90**	**1333.25**	**32.43**	**34.83**	**33.63**
140 kg N/feddan	Without spray	63.46	49.64	56.55	47.20	33.98	40.59	1333.25	889.98	1111.62	35.33	38.27	36.80
	500 ppm A.A.	49.26	51.21	50.23	37.40	37.33	37.37	1213.80	1030.76	1122.28	30.80	36.53	33.67
	500 ppm C.A.	59.05	41.93	50.49	44.10	30.06	37.08	1332.93	886.67	1159.80	33.08	33.73	33.40
	A.A.+C.A.	58.11	53.56	55.84	42.03	33.14	37.59	1319.28	903.00	1111.14	32.00	36.80	34.40
Mean		**57.47**	**49.08**	**53.28**	**42.68**	**33.63**	**38.16**	**1299.81**	**927.60**	**1113.71**	**32.80**	**36.33**	**34.57**
Mean of Ascorbic and Citric	Without spray	**54.64**	**49.05**	**51.85**	**40.81**	**34.24**	**37.53**	**1229.84**	**1087.96**	**1158.90**	**33.06**	**33.20**	**33.13**
	500 ppm A.A.	**51.72**	**48.39**	**50.05**	**37.53**	**34.87**	**36.20**	**1210.88**	**1046.27**	**1128.57**	**31.23**	**35.00**	**33.12**
	500 ppm C.A.	**58.99**	**46.60**	**52.80**	**44.42**	**35.60**	**40.01**	**1360.08**	**1077.13**	**1218.60**	**32.50**	**33.20**	**32.85**
	A.A.+C.A.	**57.39**	**52.84**	**55.11**	**41.91**	**38.13**	**40.02**	**1285.28**	**1035.20**	**1170.24**	**32.73**	**36.23**	**34.48**
Nitrogen		N.S.	N.S.	7.68	N.S.	N.S.	3.91	N.S.	262.25	149.33	N.S.	N.S.	N.S.
A.A. & C.A.		N.S.	N.S.	N.S.	4.15	N.S.	2.70	105.83	N.S.	51.51	N.S.	N.S.	N.S.
N x A.A. x C.A.		14.61	11.43	9.12	N.S.	6.42	5.15	211.65	334.56	194.44	3.21	5.63	3.18

Whereas, number of kernels/head reached its maximum by using 120 kg N/fed. and foliar spray of A.A. While, 1000 kernel weight gave the maximum value when plants treated with 140 Kg N /fed. without spray of organic acids.

3. **Yield:**

Data presented in Table 4 indicate that grain yield/fed. recorded a significant affect whereas green weight /fed. recorded insignificant affect.

a. **Effect of nitrogen fertilization:** From data of Table 4, it can be noticed that the application of 120 or 140 kg N/fed. increased significantly grain yield /fed. compared with plants received 80 kg N /fed. with the maximum value in the case of the addition120 kg N/fed. Also, it can be observed a significant decrease in grain yield /fed. when plants treated with 140 kg N/fed. compared with using 120 kg N/fed. Such finding may be attributed to that 120 kg N/fed. is essential to grain sorghum to maximize grain yield under sandy soils conditions. In this respect, Eweis et al. (1998) reported that increasing nitrogen fertilization for grain sorghum up to 100 kg N/fed. significantly increased grain yield /fed.

b. **Effect of ascorbic and citric acids:** Results of Table 4 show that spray grain sorghum plants with ascorbic and citric acids recorded significant effect on green weight/fed. and grain yield/fed. The results revealed that the foliar spray with C.A. or mixture of (A.A. + C.A.) significantly increased green weight/fed and grain yield/fed. compared with plants treated with A.A. or control one, with the maximum values in the case of using mixture of (A.A. + C.A.). In this respect, Anton et al. (1999) reported that the foliar spray of 500 ppm ascorbic acid on barley plants significantly increased straw, grain and biological yields/ fed. compared with untreated plants. Also, Abdel-Messih and Eid(1999) show that the foliar spray of 500 ppm ascorbic acid on wheat plants significantly increased grain yield /fed .

c. **Effect of interaction**: Table 4 show that interaction between nitrogen fertilizations and ascorbic & citric recorded a significant effect on grain yield/fed. The maximum value of such character was gained when sorghum plants received 120 kg N/fed. and foliar spray with mixture of (A.A. + C.A.)

4. **Chemical composition:-**

a. **Total chlorophyll of leaves:** Results of Table 5 indicate that after 60 days from sowing total chlorophyll of grain sorghum leaves was increased gradually with increasing nitrogen rates from 80 to 140 kg N/fed. Such results due to that nitrogen play an important role in chlorophyll synthesis. Regarding the effect of foliar spray of ascorbic and citric acids, total chlorophyll in leaves was increased when plants sprayed with (C.A.) compared with plants sprayed with (A.A.) or control treatment. Whereas, the highest value of chlorophyll content was obtained when plants sprayed with (A.A. + C.A.). In this respect, Hanna et al. (2001) found that total chlorophyll of wheat leaves was increased with spraying 500 or 1000 ppm ascorbic acid compared with control. The maximum value of total chlorophyll was gained when grain sorghum plants treated with 140 kg N/fed. and sprayed with (A.A. + C.A.).

Table 4: Response of green weight and grain yield per fed. for Dorado variety to Ascorbic and Citric acids under deferent levels from nitrogen fertilizer rates in sandy soil.

Treatments		Green weight ton/fed.			Grain yield ard./fed.		
Nitrogen	Ascorbic&citric	2002	2003	comb.	2002	2003	comb
80 kg N/fed.	without spray	4.58	4.08	4.33	11.43	5.95	8.69
	500 ppm A.A.	5.35	4.63	4.99	13.10	8.05	10.58
	500 ppm C.A.	5.30	2.75	4.02	13.83	5.11	9.47
	A.A.+C.A.	5.33	6.69	6.01	12.93	9.76	11.34
Mean		5.14	4.54	4.84	12.82	7.22	10.02
100 kg N/fed.	without spray	5.68	2.79	4.23	13.33	7.95	10.64
	500 ppm A.A.	5.10	3.26	4.18	11.18	5.82	8.50
	500 ppm C.A.	6.40	4.08	5.24	17.90	8.75	13.32
	A.A.+C.A.	6.23	5.52	5.87	16.70	8.60	12.65
Mean		5.85	3.91	4.88	14.78	7.78	11.28
120 kg N/fed.	without spray	5.28	3.51	4.39	15.88	7.08	11.48
	500 ppm A.A.	5.98	3.26	4.62	15.20	10.78	12.99
	500 ppm C.A.	5.65	8.28	6.97	15.08	16.06	15.57
	A.A.+C.A.	6.28	5.17	5.72	14.33	17.97	16.15
Mean		5.79	5.05	5.42	15.12	12.97	14.05
140 kg N/fed.	without spray	6.08	5.05	5.56	16.53	10.26	13.39
	500 ppm A.A.	5.43	3.21	4.32	13.10	7.32	10.21
	500 ppm C.A.	6.18	3.92	5.05	15.45	7.18	11.31
	A.A.+C.A.	6.30	6.14	6.22	14.73	10.86	12.79
Mean		5.99	4.58	5.29	14.95	8.90	11.93
Mean of Ascorbic and Citric	without spray	5.40	3.86	4.63	14.29	7.81	11.05
	500 ppm A.A.	5.46	3.59	4.53	13.14	7.99	10.57
	500 ppm C.A.	5.88	4.76	5.32	15.56	9.27	12.42
	A.A.+C.A.	6.03	5.88	5.96	14.67	11.80	13.23
Nitrogen		N.S.	N.S.	N.S.	2.10	N.S.	1.31
A.A. & C.A.		N.S.	1.52	0.77	1.46	1.61	1.01
N x A.A. x C.A.		N.S.	2.72	N.S.	N.S.	2.89	2.02

b. Protein content of grains: Data of Table 5 show that protein content in grains was increased with raising N rate form 80 up to 140 kg N/fed. Such result can be ascribed to the function of nitrogen in plant metabolism, i.e. constituent of amino and nucleic acids, many cofactors and cellular compounds. Similar results were found by Eweis et al. (1992) and Bashir et al. (1994).

Concerning the effect of foliar spray with ascorbic and citric acids on protein content in grains, Table 5 show that the maximum value was obtained when plants sprayed with (A.A.+ C.A.) compared with plants received A.A. or C.A. alone or non-sprayed plants. Such results may be due to the role of ascorbic acid in higher plants (Givan, 1979). Also, Miernyk and Trelease (1981) found that citric acid is one of organic acids presented in tri-carboxylic acid cycle and synthesized either from acetyl-CoA, glycine and ∞-Ket-glutaric, or malic acid conversion to citric acid.

Table 5: Response of some chemical composition for Dorado variety to Ascorbic and Citric acids under deferent levels from nitrogen fertilizer rates in sandy soil.

Treatments		Total chlorophyll (mg/g)			Protein % of grains			Phosphorus % of grains			Potassium % of grains		
Nitrogen	Ascorbic&citric	2002	2003	Comb.	2002	2003	Comb.	2002	2003	Comb.	2002	2003	Comb.
80 kg N/feddan	Without spray	16.55	15.91	16.23	7.76	7.95	7.86	0.187	0.194	0.191	0.137	0.141	0.139
	500 ppm A.A.	19.69	18.52	19.11	7.25	8.07	7.66	0.215	0.222	0.219	0.164	0.17	0.167
	500 ppm C.A.	19.96	18.63	19.3	8.57	8.83	8.7	0.278	0.285	0.282	0.189	0.204	0.197
	A.A.+C.A.	21.7	21.93	21.82	9.78	9.88	9.83	0.281	0.292	0.287	0.204	0.218	0.211
Mean		**19.48**	**18.75**	**19.12**	**8.34**	**8.68**	**8.51**	**0.24**	**0.248**	**0.245**	**0.174**	**0.183**	**0.179**
100 kg N/feddan	Without spray	17.82	16.54	17.18	8.28	8.56	8.42	0.212	0.226	0.219	0.152	0.161	0.157
	500 ppm A.A.	20.66	19.46	20.06	7.71	7.99	7.85	0.244	0.251	0.248	0.177	0.189	0.183
	500 ppm C.A.	20.27	19.4	19.84	9.32	9.61	9.47	0.312	0.324	0.318	0.203	0.216	0.21
	A.A.+C.A.	21.93	22.09	22.01	10.7	10.89	10.8	0.335	0.346	0.341	0.227	0.239	0.233
Mean		**20.17**	**19.37**	**19.77**	**9**	**9.26**	**9.14**	**0.276**	**0.287**	**0.282**	**0.19**	**0.201**	**0.196**
120 kg N/feddan	Without spray	19.22	18.31	18.77	8.97	9.07	9.02	0.236	0.245	0.241	0.179	0.178	0.179
	500 ppm A.A.	20.91	19.72	20.32	8.34	8.86	8.6	0.291	0.298	0.295	0.193	0.207	0.2
	500 ppm C.A.	21.68	20.51	21.1	9.95	10.08	10.02	0.345	0.253	0.299	0.234	0.245	0.24
	A.A.+C.A.	22.85	22.91	22.88	11.16	11.36	11.26	0.341	0.396	0.369	0.248	0.254	0.251
Mean		**21.17**	**20.36**	**20.77**	**9.61**	**9.84**	**9.73**	**0.303**	**0.298**	**0.301**	**0.214**	**0.221**	**0.218**
140 kg N/feddan	without spray	19.63	18.5	19.07	10.06	10.23	10.15	0.257	0.259	0.258	0.186	0.198	0.192
	500 ppm A.A.	22.85	22.61	22.73	9.03	9.28	9.16	0.326	0.334	0.33	0.197	0.206	0.202
	500 ppm C.A.	22.98	22.84	22.91	10.75	10.96	10.86	0.384	0.389	0.387	0.246	0.251	0.249
	A.A.+C.A.	23.09	22.98	23.04	11.33	11.67	11.5	0.388	0.39	0.389	0.252	0.257	0.255
Mean		**22.14**	**21.73**	**21.94**	**10.29**	**10.54**	**10.41**	**0.339**	**0.343**	**0.341**	**0.22**	**0.228**	**0.225**
Mean of Ascorbic and Citric	Without spray	**18.31**	**17.32**	**17.82**	**8.77**	**8.95**	**8.86**	**0.223**	**0.231**	**0.227**	**0.164**	**0.17**	**0.167**
	500 ppm A.A.	**21.03**	**20.08**	**20.56**	**8.08**	**8.55**	**8.32**	**0.269**	**0.276**	**0.273**	**0.183**	**0.193**	**0.188**
	500 ppm C.A.	**21.22**	**20.35**	**20.79**	**9.65**	**9.87**	**9.76**	**0.33**	**0.313**	**0.322**	**0.218**	**0.229**	**0.224**
	A.A.+C.A.	**22.39**	**22.48**	**22.44**	**10.74**	**10.95**	**10.85**	**0.336**	**0.356**	**0.347**	**0.233**	**0.242**	**0.238**

In this respect, Anton et al. (1999) found that spraing barley plants with 500 ppm ascorbic acid increased protein content of grains compared with spraying 500 ppm citric acid or untreated plants. It is worthy to mention that the maximum value of protein content of grains was obtained when plants received 140 kg N/fed. and sprayed with (A.A. + C.A.).

c. **Phosphorus and potassium contents of grains:** Results of Table 5 show that increasing nitrogen rate from 80 up to 140 kg N/fed. increased gradually phosphorus and potassium contents of grains. Such finding can be explained on the basis that high N rates enhanced sorghum plants growth, thereby increased P and K uptake which can be accumulated in grains. Similar results were obtained by Eweis et al. (1998).

Regarding the effect of foliar spray with ascorbic and citric acids, Table 5 indicated that spraying grain sorghum plants with (A.A.+ C. A.) increased P and K contents of grains compared with plants treated with 500 ppm ascorbic acid or 500 ppm citric acid alones or untreated plants. The maximum P and K contents of grains were gained when plants treated with 140 kg N/fed. and sprayed with (500 ppm A.A.+ 500 ppm C.A.).

CONCLUSION

Adding 120 Kg N/fed. To grain sorghum and foliar spray plants with mixture of 500 ppm ascorbic and 500 ppm citric acids gave maximum grain yield/fed.

REFRANCES

Abdel-Messih, S.G. and M.A.M. Eid (1999). Response of wheat crop to different levels of nitrogen fertilizer and foliar spray with ascorbic acid. Egypt. J. Appl. Sci., 14(2):132-142.

Anton; N.A.; A.Sh. Abdel-Nour and El-Set A. Abdel- Aziz (1999). Response of barley to ascorbic, citric acids and micronutrients mixture under sandy soil conditions. Zagazig J. Agric. Res., 26(6):1553-1563.

Bashir; M. I., N.A. Anton and S.J. Latif (1994). Effect of different levels of N,P and K fertilizers on grain sorghum in sandy soils condition. Egypt J. Appl. Sci.; 9(10):597-605).

Bruinsama, J. (1963). The quantitative analysis of chlorophylls a and b in plant extracts. Photochem. Photobiol. , 2:241-249.

Chapman, H.D. and P.F. Rratt (1961). Method of analysis of soil, plant and water. Univ. Clas. Divesion Agric. Sci.

Eweis, E.O.; M.L. Bashir; Z. H. Darweesh and S.M.M. Abd-El-Salam (1992). Effect of plant density and nitrogen fertilization on growth , yield and chemical composition of grain sorghum. Egypt. J. Appl. Sci., 7(12): 700-708.

Eweis, E. O.; S.J. Latif and N.A. Anton (1998). Response of grain sorghum to different nitrogen and phosphorus fertilization rates. Egypt. J. Appl. Sci., 13(10):62-69.

Givan, G. V. (1979). Metabolic detoxification in tissues of higher plants. Phytochemistry , 18:375-382.

Grun, M.; B. Renstorm and F.A. Loewus(1982). Loss of hydrogen from carbon 5 of D- glucose to L-Ascorbic acid in pelargonium cripium L.(c.f. Proc. of Soil Fertility and Foliar Fertilization Conf. Giza, Egypt. 14-15 Jan.1990. Paper No. 3, PP. 25-34).

Hanna, Fardoas R. ; Fatma A. Abdo and N.A. Anton (2001). Response of wheat plant to foliar application with ascorbic acid, copper and boron. J Agric. Sci. Mansoura Univ. 26(10):5971-5983.

Helsper, J.P. ; L. Kagan; C.L. Hilby; J.M. Maynard and F. A. Loewas (1982). L-Ascorbic acid biosynthesis in Ochromonas danica. Plant Physiol., 69: 465-468.

Jackson, M.L. (1973). Soil chemical analysis 2nd India. Reprint.

Latif, S.J.; A.E.A.A. Mourad and M. EL-Kady (2000). Effect of different irrigation intervals and nitrogen fertilizer rates on growth and yield of the new grain sorghum hybrid (Shandaweel-2). Egypt. J. Appl. Sci; 15(2): 105-115.

Malik, R. K. and C. Singh (1982). Influence of organic acids and Cycocel on cotton growth. Zanco Series A, 8:59-75.

Mahmoud, Mona A.A. (1994). Physiological studies on the nutrition of some economic plants. M.Sc. Thesis, Fac. of Agric, Cairo Univ.

Miernyk, J.A. and R.N. Trelease(1981). Role of malate syntheses in citric acid synthesis by maturing cotton embryos. A Prosal. Plant Physiol., 68:875-881.

Mousa, I.A.I.; A.Y. Negm; A.Y. El-Bashbishy and Hanyiat M.El-Nember (1994). Effect of different levels and sources of nitrogen fertilizers and foliar application of ascorbic acid and some micronutrients on wheat production in sandy soil. Fayoum J. Agric. Res. and Dev., 8(1):73-84.

Nofal, M.A.; M.H. Rabie; K.M. Khalil and A.F. Mohamed (1990). Growth and some micronutrients content of lettuce plants as applied by seed soaking and foliar spray of ascorbic and citric acids. Proc. of Soil , Soil Fertility and Foliar Fertilization Conf. , Giza,Egypt. 14-15 Jan. Paper No. 3.

Pregl, F. (1945). Quantitative organic analysis. 4th Ed.J. and Churchill Ltd,London.

Rabie, M.H. and A.Y. Negm (1992). Effect of ascorbic acid and nickel on wheat production. Proc. 5th Conf. Agron., Zagazig, 13-15 Sept., 1992, Vol(1):29-36.

Ryan, J. ; S. Garabet; K. Harmsen and A. Rashid(1996). A Soil and plant analysis. Manual adopted for the West Asia and North Africa Region. Icarda, Aleppo, Syria, pp. 140.

Saba, M.F.I. ; E.O. Eweis; A.M. El-Kady and M.I. Bashir (1990). Effect of different levels and modes of nitrogen application on growth and yield of two grain sorghum cultivars. Egypt. J. Appl. Sci., 7(6):226-237.

Snedecor G.W. and W.G. Cochran (1967).. Statistical methods. Iowa State Univ. Press. Ames, Iowa,USA.

J. Agric. Sci. Mansoura Univ., 31 (11), November, 2006

استجابة الذرة الرفيعة للرش الورقي بحمضي الاسكوربيك والستريك تحت معدلات مختلفة من السماد الأزوتى في الأرض الرملية

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أقيمت تجربتان حقليتان بمحطة بحوث الإسماعيلية (محافظة الإسماعيلية) خلال موسمي الزراعة ٢٠٠٢ و ٢٠٠٣ لدراسة استجابة الذرة الرفيعة للرش الورقي بحمض الاسكوربيك (٥٠٠ جزء في المليون) والستريك (٥٠٠ جزء في المليون) وخليط من الستريك والإسكوربيك (٥٠٠ جزء في المليون اسكوربيك + ٥٠٠ جزء في المليون ستريك) ومعاملة الكنترول (بدون رش) تحت معدلات مختلفة من التسميد الأزوتى (٨٠ ، ١٠٠ ، ١٢٠، ١٤٠ كجم نيتروجين للفدان) في الأرض الرملية وقد أوضحت النتائج مايأتى:-

١. أدت إضافة السماد الأزوتى إلى زيادة معنوية في كل من طول النبات ووزن النورة ووزن الحبوب للنورة وعدد الحبوب في السنبلة ومحصول الحبوب للفدان وكانت أفضل معاملة والتي أعطت أعلى القيم في كل هذه الصفات ١٢٠ كجم نيتروجين للفدان بينما أدت إضافة السماد الأزوتى حتى المعدل ١٤٠ كجم نيتروجين للفدان إلى زيادة مستمرة لوزن الألف حبة ومحتوى الكلوروفيل بالأوراق وكذلك نسبة البروتين والفوسفور و البوتاسيوم في الحبوب .
٢. تم الحصول على أعلى القيم في طول النبات ووزن حبوب النورة والوزن الأخضر ووزن المحصول وعدد الحبوب في النورة عند رش النباتات بحمض الستريك و خليط من حمض الاسكوربيك و حمض الستريك. وكان أعلى محتوى للكلوروفيل في الأوراق وكذلك نسبة البروتين والفوسفور والبوتاسيوم بالحبوب عند رش النباتات بخليط من الإسكوربيك والستريك.
٣. توضح نتائج التفاعل بأن كل من طول النبات ووزن النورة ووزن حبوب النورة ووزن الألف حبة ووزن المحصول للفدان وصلت إلى أقصى قيمة لها وذلك بإضافة ١٢٠ كجم نيتروجين للفدان والرش بخليط من الاسكوربيك والستريك بينما كانت أعلى قيمة لدليل مساحة الأوراق بإضافة ١٢٠ كجم نيتروجين للفدان والرش بحمض الستريك ونتج محتوى من الكلوروفيل في الأوراق ونسبة البروتين والفوسفور والبوتاسيوم في الحبوب بإضافة ١٤٠ كجم نيتروجين للفدان والرش بخليط من الاسكوربيك والستريك .

التوصية

توصى الدراسة بأن اضافة ١٢٠ كجم نيتروجين للفدان فى الاراضى الرملية حديثة الاستصلاح والرش الورقى بخليط من٥٠٠ جزء فى المليون من الاسكوربيك و٥٠٠ جزء فى المليون من الستريك تعطى أعلى محصول حبوب للفدان.