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EVALUATION OF SOME ORGANIC ACIDS AS FOLIAR APPLICATON ON GROWTH, YIELD AND SOME NUTRIENT CONTENTS OF WHEAT

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ABSTRACT

Two field experiments were carried out during the two growing seasons of 2001/2002 and 2002/2003 at Mansoura, Dakahlia Governorate to evaluate the effects of some organic acids i.e. oxalic, citric and ascorbic acids at two levels (750 and 1500 ppm) on growth, yield and some nutrient contents of wheat. The most important findings indicated that:

Organic acids at 1500 ppm increased plant height, leaf area, spike length, number of grains/spike, 1000-grain weight, grain and straw yield. The contents of N, P, K, Fe, Zn, and Mn except Cu in the leaves and grains were also increased. Ascrobic acid gave a high values in this respect.

High levels of organic acids (1500 ppm) used increased grains and straw yields by 22.44 and 43.71% over the recommended doses. Moreover, the concentrations and uptake of N, P, K, Fe, Zn and Mn in leaves and grains of wheat were increased by comparison without foliar application.

INTRODUCTION

Wheat is the major cereal crop in the world. The properties of its kernel make it the leading cereal for human food. To meet the demands of the fast growing population in Egypt, increasing grain yield of wheat has been and still becoming a national necessity. This goal could be achieved through growing the cultivars of high yield potentiality and following appropriate agronomic management.

Organic acids are known as a growth factor influenced many physiological processes such as the synthesis of enzymes, nucleic acids, proteins and act as co-enzymes in different plants (Abdel-Halim, 1995 and Tarraf *et al.*, 1999).

El-Greadly (2002) found that the plants treated with ascorbic acid alone or in combined with ethrel increased main stem length and the highest early yield.

Root exudates, particularly low molecular weight organic acids, are capable of forming complexes with metal ions (Stevenson and Fitch, 1994; Robert and Berthelin, 1994) and affect on their fixation, mobility and availability to the plants. Metal-organic acids interactions in the soil plant system are found to be very important for solubilising the metals from highly insoluble phase in the soil (Cieslinski *et al.*, 1998) and this has become an area of sustained research.

Montasser (1990) found that spraying of tomato plants with ascorbic acid gave the best plant growth. Arisha (2000) found that spraying of potato plants with ascorbic acid gave significantly increase in total dry weight of plant and total yield with increasing ascorbic acid.

The present investigation aimed to evaluate the effects of some organic acid as foliar application on growth, yield and some nutrient contents of wheat plants.

MATERIALS AND METHODS

Two field experiments were carried out at the Agric. Exp. Stat. located in Mansoura, Dakahlia Governorate during the two growing seasons 2001/2002 and 2002/2003. Some chemical and physical characters of the studied soil are presented in Table 1 and were obtained according to the standard procedures described in Black (1965) and Jackson (1973).

Table 1: Some chemical, physical and available nutrients of the experimental soil (average of the two growing seasons).

Soil physical properties %		Soil chemical properties (meq/100 g soil)										Available nutrients (ppm)	
				Cations				Anions					
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO^{=}_3$	HCO^{-}_3	CL^{-}	$SO^{=}_4$		
Sand	10.72	EC dsm^{-1}	1.17	1.3	2.8	5.8	1.8	--	2.6	5.4	3.7	N (3)	17.0
Silt	41.2	pH	8.2									P (4)	12.6
Clay	43.9	SAR	2.84									K (5)	232.6
		ESP	8.86									Fe(6)	2.39
O.M	1.6	Soil	Silty									Zn	0.91
$CaCO_3$	2.58	texture	clay									Mn	0.97
												Cu	0.33

1- 1 : 5 Extract **2- 1 : 2.5 suspension**
3- Extracted by 1% K_2SO_4 **4- Extracted by 1M sodium by carbonate**
5- Extracted by 1M ammonium acetate **6- Using DTPA**

Wheat (*Triticum aestivum*, L.) variety Sakha 69 grains was used and sowing at 14th November 2001 and 2002 in an experiment plots (3 x 4 m).

The experiments were design in randomized complete blocking design involved 7 treatments. Each treatment was replicated three times. The treatments were spraying with organic acids i.e. oxalic, citric and ascorbic acids each at two levels 750 and 1500 ppm, in addition to the control using (water). The recommended doses of N, P and K were added. Spraying till dripping was tock place using Tween-20 as a wetting agent. Two samples were taking; the leaves were collected from each plot at booting stage and grains at harvest (6 months from sowing).

The samples were prepared for the determination of N, P, K, Fe, Zn, Mn and Cu according to Jackson (1973).

All data were subjected statistical analysis according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1. Growth and yield components:

Data in Table 2 show that there are a high significant differences effect between the two levels of the organic acids used on plant height (at 70 and 110 days), spike length, 1000 grain weight, grain and straw yield.

Table 2: Plant height (cm), leaf area (cm^2), spike length (cm), number of grains /spike, 1000-grain weight (g), grain yield (ard fed^{-1}) and straw yield (t fed^{-1}) of wheat plants as affected by some organic acids (average of the two growing seasons).

Characters / Treatments		Plant height (cm)		Leaf area (cm^2)		Spikes length (cm)	No. of grain/ spike	1000-grain weight (g)	Grain yield (ard fed^{-1})	Straw yield (t fed^{-1})
		70 days	110 days	70 days	110 days					
Control		65.03	98.78	27.02	29.03	9.95	71.5	51.33	18.72	3.18
750 ppm	Oxalic acid	65.23	107.33	27.24	28.30	9.95	73.0	55.27	20.17	3.79
	Citric acid	65.33	106.78	27.19	28.18	10.55	73.0	58.53	21.69	3.83
	Ascorbic acid	65.90	107.40	29.83	30.21	10.90	76.0	58.33	22.08	3.92
Mean		65.49	107.17	28.09	28.90	10.47	74.0	57.38	21.31	3.65
1500 ppm	Oxalic acid	68.03	108.15	29.95	29.99	11.20	75.0	57.53	21.59	4.33
	Citric acid	69.53	114.03	29.22	29.25	11.35	75.0	57.67	22.35	4.63
	Ascorbic acid	69.80	115.03	30.15	30.65	13.80	84.5	59.30	22.92	4.75
Mean		69.12	112.40	29.94	29.96	12.12	78.17	58.17	22.29	4.57
F-test		**	**	N.S	N.S	**	N.S	**	**	**
LSD (5%)		3.57	1.67	-	-	1.57	-	2.75	1.34	0.49
LSD (1%)		-	2.29	-	-	5.16	-	3.77	1.84	0.68

However, the values between treatments regarding to the leaf area and number of grains/spike were non significant.

Data also indicate that increasing of the foliar organic acids levels were increased plant height, leaf area, spike length, number of grains/spike, 1000-grain weight, grain and straw yield. Ascorbic acid treatment at 1500 ppm was the best treatments in this respect.

The highest values of plant height (69.8 and 115.03 cm), leaf area (30.15 and 30.65 cm^2) at 70 and 110 days, spike length (13.8 cm), number of grains/spike (84.5), 1000-grain weight (59.3 gm), grain and straw yield (22.92 ard fed^{-1} and 4.75 t fed^{-1}) respectively, were achieved at 1500 ppm ascorbic acid treatment.

The percentage of increasing between the mean of two levels for organic acids were (5.54 and 4.88 %), (6.6 and 3.67 %) for plant height and leaf area at 70 and 110 days, but in spike length, number of grains/spike, 1000-grain weight, grain yield and straw yield were (15.76, 5.64, 1.38, 4.6 and 18.7 %), respectively.

These results are in harmony with those reported by Wang *et al.* (1995) who found that 1 % ascorbic acid and some organic acids increased 1000-grain yield and grain yield. Tarraf *et al.* (1999) mentioned that organic acid is known as a growth factor that influence many physiological process. Similar results were obtained by Montasser, 1990 and Arisha, 2000.

2- Macro and micro nutrients concentrations in leaves:

Data in Table 3 illustrate that there are a significant differences among concentrations of macro and micronutrients for leaves.

Table 3: N, P, K (mg/g) and Fe, Zn, Mn & Cu (ppm) concentrations in leaves of wheat as affected by some organic acids spraying (average of the two growing seasons).

Treatments		Leaves (mg/g)			Leaves (ppm)			
		N	P	K	Fe	Zn	Mn	Cu
Control		22.4	3.31	21.00	100.07	44.9	52.40	13.12
750 ppm	Oxalic acid	20.6	2.90	16.00	108.7	31.6	47.70	9.93
	Citric acid	22.9	3.90	19.10	123.60	61.80	49.40	11.62
	Ascorbic acid	25.4	4.10	20.40	113.88	49.1	52.50	9.38
Mean		22.9	3.63	18.67	115.40	47.50	49.87	10.31
1500 ppm	Oxalic acid	22.2	3.20	18.00	122.00	65.10	66.40	9.97
	Citric acid	28.3	4.20	19.80	111.50	55.50	59.40	12.70
	Ascorbic acid	29.2	4.40	22.10	136.60	73.60	76.80	15.80
Mean		26.6	3.93	19.97	123.37	64.73	67.53	12.82
F-test		**	**	*	**	**	**	**
LSD (5%)		2.46	0.46	1.26	54.3	14.26	8.44	2.23
LSD (1 %)		3.38	0.63	1.73	74.41	19.54	11.57	3.05

Organic acids at the high dose led to an increasing in N, P and K concentrations in the leaves. These increase reached to 16.16, 8.26 and 6.96 % as the mean value, respectively. Moreover, it was found that using 1500 ppm ascorbic acid was the best treatment on increasing these elements and reached to 30.36, 32.93 and 5.24% for N, P and K over the control,

Table 4: N, P, K (mg/g) and Fe, Zn, Mn & Cu (ppm) concentrations and uptake in grains of wheat as affected by *some organic acids* spraying (average of the two growing seasons).

Treatments		Grains (mg/g)			Grains (ppm)				Uptake (kg fed^{-1})			Uptake (gm fed^{-1})			
		N	P	K	Fe	Zn	Mn	Cu	N	P	K	Fe	Zn	Mn	Cu
Control		13.74	2.06	6.85	84.43	71.75	87.75	8.30	29.58	4.43	14.75	21.34	18.13	22.18	2.10
750 ppm	Oxalic acid	16.37	2.08	6.60	93.16	67.50	89.32	9.10	35.97	4.82	15.31	25.37	18.38	24.32	2.48
	Citric acid	15.21	2.84	6.78	105.9	57.90	93.05	10.3	35.94	7.08	16.91	31.02	18.95	27.25	3.02
	Ascorbic acid	18.43	3.03	6.37	96.78	82.20	97.82	8.94	42.80	7.69	16.17	28.85	24.50	29.16	2.66
Mean		16.67	2.65	6.58	98.62	69.20	93.4	9.45	38.24	6.53	16.13	28.41	20.61	26.91	2.72
1500 ppm	Oxalic acid	17.30	2.20	6.60	99.40	65.90	94.78	6.79	42.95	5.46	16.39	28.97	19.21	27.63	1.98
	Citric acid	19.30	3.10	6.60	94.00	85.50	100.2	7.95	45.61	7.97	15.94	28.36	25.80	30.23	2.40
	Ascorbic acid	21.70	3.20	7.04	115.3	92.90	107.2	11.85	47.20	8.43	18.56	35.68	28.75	33.17	3.67
Mean		19.77	2.83	6.61	102.9	81.43	100.73	8.86	45.25	7.29	16.96	31.00	24.59	30.34	2.68
F-test		**	**	**	**	**	**	**	**	**	**	**	**	**	**
LSD (5%)		0.37	0.28	0.17	26.39	19.67	25.11	2.60	6.31	0.36	0.27	1.46	2.11	2.15	0.18
LSD (1 %)		0.51	0.38	0.23	36.17	26.96	34.41	3.56	10.11	0.59	0.42	2.38	3.13	3.28	0.28

respectively. Rajpal *et al.* (2001) reported that increased ascorbic acid caused an increase in NPK. While in the status of Mn, Zn, Cu and Fe the high levels gave the same trend which the increases the mean values were 69.06, 36.27, 35.41 and 42.35 % in leaves, respectively. Using ascorbic acid gave the high values by about 36.50, 63.92, 46.57 and 20.43 % in leaves respectively. These results are in agreement with those obtained by Ibrahim *et al.* (1987) and Awad *et al.* (1999), they mentioned that foliar application is controlled by fertilizer solubility, rate of penetration and chemical composition of plant leaves.

4- Macro and micro nutrients concentrations and uptake in grains:

Data in Table 4 show that using organic acids with high dose caused an increase between the mean values in N, P and K concentrations and their contents in the grains, reached to 18.6, 6.97, 0.46, 18.33, 11.64 and 5.15%, respectively. These results are agreement with Rajpal *et al.* (2001). In grains the increases reached to 4.34, 17.67, 7.85, 9.12, 19.31 and 12.75% for Fe, Zn and Mn, respectively.

On the other hand, data show that Cu concentration and its uptake decreased with an increase the level of organic acid. The best treatment was 1500 ppm ascorbic acid. It increased over control N, P, K, Fe, Zn, Mn and Cu concentrations by about 36.56, 55.34, 2.77, 65.21, 29.48, 22.17 and 42.77, respectively. Corresponding to 59.57, 90.29, 25.83, 67.20, 58.58, 49.55 and 74.76% for N, P, K, Fe, Zn, Mn and Cu uptake, respectively. These results are in agreement with Wang *et al.* (1995)

It can be concluded that spraying with ascorbic acid by 1500 ppm increased wheat growth and improved its yield.

REFERENCES

Abdel-Halim, S.M. (1995). Effect of some vitamins as growth regulators on growth, yield and endogenous hormones of tomato plants during winter. Egypt, J. Appl. Sci., 10(12): 322-334.

Arisha, H.M.E. (2000). Effect of vitamin C on growth, yield and tuber quality of some potato cultivars under sandy soil conditions. Zagazig, J. Agric. Res., 27(1): 91-104.

Awad, Y.H.; S.A.M. Maussa and A.O. Abdel-Nabi (1999). Effect of application rates of nitrogen with different methods on growth some macronutrients uptake and yield of string bean plants in sandy soil. J. Agric. Sci. Mansoura Univ., 24(6): 3203-3211.

Cieslinski, G.; K.C.J. Van Rees; A.M. Szmigielska; G.S.R. Krishnamurti and P.M. Huang (1998). Low molecular-weight organic acids in rhizosphere soils of durum wheat and their effect on cadmium bioaccumulation. Plant Soil, 203: 109-117.

El-Greadly, Nadia H.M. (2002). Effect of foliar application of ascorbic acid, ethrel and their combinations on growth, yield and endogenous hormones in cucumber plants. J. Agric. Sci. Mansoura Univ., 27(8): 5269-5281.

Gomez, K. and A.A. Gomez (1984). Statistical Procedures for Agricultural Research. John Waliy & Sons, Inc. New York.

Ibrahim, S.A.; A.M. Selim and El-Neklawy (1987). Effect of foliar application on Mn under different levels of N fertilization on growth, yield and nutrient contents of cotton plants. Egypt. J. Soil Sci., 27 (2): 157-170.

Jackson, M.L. (1973). Soil chemical Analysis. Printic-Hall of Indian, Private limited, New Delhi.

Montasser, S.A. (1990). Efficiency of certain vitamins in controlling the root knot nematode, *Meloidogyne incognita* on tomato. Pakistan, Journal of Nematology, 8(2): 101-105.

Rajpal Singh; N.R. Godara; V.P. Ahlawat and S.S. Dahiya (2001). Mineral Composition of Ber (*Zizyphus mauritiana* Lamk.) leaves as affected by foliar application of growth regulators and nutrients. Haryana J. Hort. Sci., 30 (1/2): 10-11.

Robert, M. and J. Berthelin (1994). Role of biological and biochemical factors in soil mineral weathering. In Huang, P.M. and M. Schnitzer (ed.). Interaction of soil minerals.

Stevenson, F.J. and A. Fitch (1994). Chemistry of complexation of metal ions with soil solution organics. In: Huang, P.M, and M. Schnitzer (ed.). Interaction of soil minerals with natural organics and microbes, PP. 29-50 SSSA Special Publ. 17, SSSA Madison, WI.

Tarraf, Sh.A.; Karima, M. Gamal El-Din and Laila K. Balbaa (1999). The response of vegetative growth, essential oil of lemon grass (*Cymbopogon citrates* Hort) to foliar application of ascorbic acid, nicotimide and some micronutrients. Arab Univ. J. Agric. Sci., Ain-Shams Univ., Cairo, 7(1): 247-259.

Wang, X.Y. W.B. Peng; J.M. Cui and H.J. Zhao (1995). The effect of organic acids, boron and zinc on the metabolism of active oxygen during grain weight of wheat. Sinica Agric., 28(1): 69-74.

تأثير رش بعض الأحماض العضوية على النمو والمحصول وبعض المغذيات لمحصول القمح

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قسم تغذية النبات ــ معهد بحوث المياه والأراضى والبيئة ــ الجيزة ــ مصر

أقيمت تجربتان حقليتان خلال موسمى ٢٠٠١/ ٢٠٠٢ و ٢٠٠٢/ ٢٠٠٣ بالمنصورة بمحافظة الدقهلية لدراسة تأثير استخدام بعض الأحماض العضوية (الأوكساليك ــ الستريك ــ الأسكوربيك) بمعدل ٧٥٠ و ١٥٠٠ جزء فى المليون على النمو والمحصول وبعض المغذيات لمحصول القمح وقد أظهرت البيانات:

ــ عند استخدام الأحماض العضوية بتركيز ١٥٠٠ جزء فى المليون أدى إلى زيادة طول النبات ومساحة الورقة وطول السنبلة وعدد الحبوب فى السنبلة ووزن ١٠٠٠ حبة ومحصول القمح والقش.

ــ أيضا زاد محتوى الأوراق والحبوب من عناصر النيتروجين والفسفور والبوتاسيوم والحديد والزنك والمنجنيز ماعدا النحاس ويتضح أن حمض الأسكوربيك أعطى أعلى القيم.

ــ الأحماض العضوية ذات التركيز الأعلى أعطى زيادة فى محصول للقمح والقش بمقدار ٢٢,٤٤ و ٤٣,٧١% مقارنة بالكنترول، علاوة على ذلك المحتوى من عناصر النيتروجين والفسفور والبوتاسيوم والزنك والمنجنيز فى الأوراق والحبوب كانت أعلى مع حمض الأسكوربيك (١٥٠٠ جزء فى المليون) بالمقارنة بالمعاملة بدون رش.