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THE APPLICATION OF SOME CHEMICAL SUBSTANCES AS PROMOTORS FOR ENHANING GROWTH, YIELD AND ITS SOME NUTRITIONAL VALUES OF OKRA PLANT (*Hibiscus esculentus*, L.)

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ABSTRACT

Two field experiments were conducted out during the two successive seasons of 2002 and 2003 at the experimental station of National Research Centre at Shalakan to study the effect of some chemical substances, i e. GA, IAA and urea as a promotion materials by two methods of the applications (seeds soaking and plant foliar application) on the growth, yield and its some physical and chemical constituents. The important obtained results could be summarized as following

- In spite of the no significant effect of the application method of GA, IAA and urea on some vegetative growth characters, but it could be concluded that, the foliar spraying (3 times by 10 days interval) gained the best okra plant growth. Moreover, the using urea caused the best results, followed in descending order by using GA, but the poorest plant growth was obtained by IAA.
- The total pods yield of okra plants recorded its higher no significant values by the application of urea and/or GA if compared by the using of IAA.
- There are no great effect of the application method of the studied chemical substances on the total pods yield and its components
- Using GA, IAA and urea as seeds soaking and/or foliar application for okra plant had no significant effect on N, P, K, Fe, Mn, Zn, Cu and total protein Generally, using GA and/or IAA gave the better nutritional value if compared to urea application.
- The interaction within using GA, IAA and urea as two methods of application, i.e. seeds soaking or vegetative foliar spraying resulted no significant effect on okra plant growth, pods yield and its some physical and chemical propertied.

INTRODUCTION

Okra is one of the important popular vegetable crop grown in Egypt for the local consumption and/or for the foreign exporting market. The total growing area increased during the few last years, but its yield did not rise by the same trend. However, the pods yield could be enhanced by two main ways, i.e. Horizontally or vertically, where the 1st is difficult, but the 2nd could be expected by improving the agricultural treatments, i.e., following the better system of fertilization, irrigation, date and method of cultivation and/or using some chemical substance for promotion the metabolism processes. The previous reviews in this view indicated that, Gibberellic acid and Indole acetic acids as chemical substances had an enhancement in plant growth parameters of okra plant as well as pods yield and its compound (Omran, *et al.*, 1980; Bharat, Singh *et al.*, 1998; Carrera, *et al.*, 2000; Stolyarov, 2000 and Rizk, Fatma, 2002). Also, many investigators obtained a better plant growth and higher pods yield of okra plant as affected by the application of urea as foliar and/or as seeds soaking (Deore, *et al.*, 1987;Gulshan, *et al.*, 1998; Singh *et al.*, 1999-a). The aim of this study is to investigate the

behavior of okra plant to seed soaking and/or foliar application of GA, IAA as well as urea treatments.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Station of National Research Centre, Shalakan, (Kalubia Governorate), during the two successive seasons of 2002 and 2003 to study the effect of GA_3, IAA and urea application as a chemical substances promoter, by two method of applications, i.e. seeds soaking and vegetative foliar spray on growth, yield and its components. Table (1) presented the physical and chemical analysis of the experimental soils.

Seeds of okra cv. Eskandarani were sown on 21st and 26th March of 2002 and 2003 seasons, respectively. The experimental design used in the two growing seasons was split plot design with three replicates. The methods of application, i.e. soaking and foliar were arranged at random in the main plots while, the chemical substance GA, IAA, urea as well as water were arranged within the sub-plots. Seeds of okra were soaked at different substance materials 24 hours before sowing where, GA and IAA used at a concentrate rate of 100 ppm, but urea concentration was 4000 ppm. The normal cultural practices commonly used for growing and irrigation of okra were followed.

Table (1): Physical and chemical analysis of the experimental soil (2002 and 2003 seasons).

Analysis of the experimental soil	2002	2003
Physical properties :		
Soil texture	Clay	Clay
Clay (%)	43.76	47 84
Silt (%)	25.30	28.72
Fine sand (%)	23.46	22 16
Coarse sand (%)	2.75	2 64
Chemical analysis :		
Available K (mg/100 g soil).	0.53	0.57
Available P (mg/100 g soil)	6.31	6 18
Total nitrogen (mg/100 g soil)	137.62	148.43
Cl (meq/L).	1.76	1.80
Na_2CO_3 (meq/L).	5.27	5.12
$CaCO_3$ (meq/L).	3.04	3 22
Organic matter (%)	1.68	1.63
SO_4 (ppm)	1.77	1.58
EC (mmhos/cm/25°C)	2.33	2.46
pH	7.62	7.81

Each sub-plot consisted of three ridges 70 cm apart and 5 m long and two plants per hill spaced 30 cm apart on one side of the ridge. At 45 days after sowing the chemical substances were sprayed 3 times by 10 days intervals. The concentration of GA and IAA as foliar was 50 ppm, but for urea was 2000 ppm. Samples of okra plants were taken at 75 days old randomly from each sub-plot to estimate the plant height (cm.), number of shoots and leaves per plant, fresh and dry weight of shoots, leaves and whole plant (g.).

The pods were harvested every 3 days by intervals. Total yield as tons/fed. and its components (number of pods per plant, pod length and diameter (cm)., average weight of pods (g./plant) were recorded. Samples of pods were taken for chemical analysis, i.e., N, P and K contents according to the methods of Pregl (1945), Troug and Mayer (1939), and Brown and Lilleland (1946), respectively. Also, Fe, Mn, Zn and Cu contents were determined using flame ionization atomic absorption spectrometer model 1100 B of Perkin Elemer according to the method of Champman and Pratt (1978). The protein percentages in pods were accounted by multiplying nitrogen content by 6.25.

All the obtained data were statistically analyzed according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

A. Plant growth :

Table (2) shows clearly that, the foliar application of the used chemical substances, i.e. GA, IAA and urea for okra plant resulted the better plant growth characters if compared with seeds soaking. Whereas, the higher, plants, outnumber of leaves and/or shoots, the heavier fresh and dry weight of whole plant and its different organs recorded the higher values when the chemical substances are used as foliar spray. Moreover, the statistical analysis of the obtained data showed that, the differences within the two methods of application were significantly at 5 % level only for fresh and dry weight of whole plant and its leaves fresh weight in both two seasons. However, the height of plant and fresh weight of whole plant in 1st season as well as fresh weight of shoots in 2nd season recorded also a significance variation.

Generally, in spite of the no significant effect of the application method of GA, IAA and urea on some vegetative growth characters, but it could be conducted that, the foliar spraying (3 times by 10 days interval) gained the best okra plant growth. The obtained results are in good accordance with those obtained by Ramu and Muthuswamy, 1964; Bharat, Singh *et al.*, 1998; Gulshan-Lal, 1998; and Singh, *et al.*, 1999-a.

The presented data in Table (2) also indicated that, the application of GA and IAA and urea caused an increase in values of plant vegetative growth if compared with control treatment (water). Moreover, the using urea as chemical promoter substance caused an enhancement in plant growth, followed in descending order by using GA. These were true for most plant growth parameters, and these indication was more clear in 2nd season. However, the statistical analysis of the obtained data showed that, the variation was not great enough to be significant as 5 % level. These finding were true in 1st and 2nd seasons. It could be concluded that, the best plant growth of okra was resulted with that plants treated by urea and/or GA. The superiority of plant growth which resulted by GA application may be attributed to the foliar application of GA substituted the chilling and photoperiodic requirements for flowering in plant (Malash, 1988; Galmarini, *et al.*, 1995; El-Balla and Gantliffe, 1997 and Ghoname, *et al.*, 2004). For concern to the foliar application of urea, in spite of the limited literature regarding its effect

on the metabolism processes, but many investigators reported that, generally, where dry urea function successfully, the fluid urea should perform equally well may have the advantage of better uniformity over some dry urea sources. The investigation which were studied by Verma, *et al.*, 1974 and Bharat, Singh, *et al.* 1998, are in good accordance with the obtained data. Wnereas the urea as nitrogen fertilization increased plant growth and its components could be attributed to nitrogen role in enhancing plant growth characters.

The interation treatments between the application methods and the source of plant growth substances used in this study, i.e. GA, IAA, urea and water obtained no signficant data in both two seasons, for all plant growth charachters (Table 2). This data revales that, each factor of the interactioin act independant at least under the condition of this study.

Table (2): **Effect of some chemical substances on okra plant growth characters during seasons 2002 and 2003.**

Treatments		Plant height (cm)	Nos. / plant		Fresh wt. (g. / plant)			Dry wt (g. / plant)		
			Leaves	Shoots	Leaves	Shoots	Whole	Leaves	Shoots	Whole
2002										
Soaking	GA	78.53	21.45	3.58	147.45	157.56	305.01	31.64	30.70	62.34
	IAA	68.10	16.37	3.15	103.28	125.23	228.51	19.99	20.52	40.50
	Urea	86.23	24.03	4.05	167.10	135.04	302.14	30.17	27.52	57.69
	Water	73.67	18.81	3.29	101.98	138.47	240.45	17.74	22.01	39.75
Average		76.63	20.17	3.52	129.95	139.08	269.03	24.89	25.19	50.07
Foliar	GA	94.80	22.44	3.93	179.81	169.67	349.48	39.00	36.67	75.67
	IAA	84.00	18.03	3.27	96.97	119.95	216.91	17.36	21.25	38.61
	Urea	95.80	26.56	4.33	191.45	142.63	334.08	37.09	32.70	69.80
	Water	84.07	23.06	3.44	111.75	141.51	253.26	23.11	25.11	48.22
Average		89.67	22.52	3.74	144.99	143.44	288.43	29.14	28.93	58.07
Mean	GA	86.67	21.95	3.75	163.63	163.61	327.24	35.32	33.68	69.00
	IAA	76.05	17.20	3.20	100.12	122.59	222.71	18.67	20.89	39.56
	Urea	91.02	25.29	4.19	179.27	138.83	318.11	33.63	30.11	63.75
	Water	78.87	20.94	3.37	106.87	139.99	246.86	20.43	23.56	43.98
L.S.D. 5%	Applying	7.46	N.S	N.S	10.22	N.S	14.07	N.S	N.S	6.39
	Treatment	4.49	2.68	0.44	14.58	N.S	30.39	6.86	5.08	8.32
	Interaction	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
2003										
Soaking	GA	82.31	21.88	4.55	154.84	129.70	284.54	28.00	29.89	57.89
	IAA	61.33	17.75	3.49	103.58	90.72	194.30	19.74	17.25	36.99
	Urea	81.47	21.94	4.67	162.98	147.11	310.09	31.96	28.96	60.93
	Water	71.29	21.15	3.89	112.91	90.93	203.84	21.14	20.56	41.69
Average		74.10	20.68	4.15	133.58	114.62	248.19	25.21	24.17	49.38
Foliar	GA	93.87	22.45	4.52	166.83	140.13	306.96	34.41	30.23	64.64
	IAA	63.73	18.08	4.09	109.80	119.66	229.47	20.21	24.64	44.85
	Urea	85.87	24.11	4.53	176.31	158.83	335.14	37.17	32.11	69.28
	Water	76.70	18.54	3.67	138.18	127.89	266.07	25.00	25.07	50.07
Average		80.04	20.80	4.20	147.78	136.63	284.41	29.20	28.01	57.21
Mean	GA	88.09	22.17	4.54	160.84	134.92	295.75	31.21	30.06	61.27
	IAA	62.53	17.91	3.79	106.69	105.19	211.88	19.98	20.95	40.92
	Urea	83.67	23.03	4.60	169.64	152.97	322.61	34.57	30.54	65.10
	Water	73.99	19.84	3.78	125.55	109.41	234.96	23.07	22.82	45.88
L.S.D. 5%	Applying	N.S	N.S	N.S	10.01	9.24	13.62	N.S	N.S	6.08
	Treatment	4.88	N.S	N.S	42.16	32.88	69.59	10.38	N.S	12.44
	Interaction	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

B-Total pods yield and its quality :

Effect of the application methods of some chemical promoters substance, i.e., GA. IAA, Urea and water as vegetative foliar and/or seeds soaking are shown in Table (3). Neither soaking nor foliar application of chemical substances affected significantly the total pods yield of okra plant as well as its components, except average pods weight as g./plant in both two seasons and average pods number/plant in 1st season which resulted the significant response by the method of application.

It could be concluded that, the obtained data revealed a slow response of total pods yield and its components of okra plant to the application methods of GA, IAA and urea at least under this investigation.

Within plant growth substances which used in this study, and their effects on total pods yield of okra as well as its components, the obtained data fluctuated within the two experimental seasons (Table 3). Whereas, In 1st season, the application of urea as promoter substance resulted the best pods quality expressed by average number and weight of pods/plant as well as the highest values of pod dimension, i.e. pod length and diameter. But in 2nd season, the highest values of the above mentioned parameters were recorded with the application of GA as growth promoters. More addition, the tonnage of okra pods yield in both seasons were obtained when GA was applied. The statistical analysis of the obtained data showed no significant variation within the application both urea and/or GA concerning the total pods yield and its components. These findings are true in 1st and 2nd seasons. On the contrary, the presented data in Table (3) showed that, the lowest pod yield and least pods quality were resulted with using IAA.

Generally, it could be concluded that, the application of urea and/or GA for okra plant are more useful to enhancement the plant growth characters, and hence it reflected to rise the pods yield as well as its quality. It is noteworthy to mentioned that urea as a nitrogen fertilizer is essential for plant growth as it is a constituent of all proteins and nucleic acids and hence of all protoplasm, and consequently to have a larger surface available for photosynthesis (Russel, 1973). Many other studies were reported by other investigators such as Ramu and Muthuswamy, 1964; Maurya, *et al.*, 1985 ; Gulshan- Lal, 1998; and Singh, *et al.*, 1999-b. But with concerning to GA and its roles in plant growth as well as yield where it caused an enlargement and number of plant tissue cells, hence gave a big vegetative growth which turn rising total yield and its components (Omran, *et al.*, 1980; Deore, *et al.*, 1987; Sexena, *et al.*, 1987 and Singh, *et al.*, 1999-a).

The interaction treatments between both two methods of application with the different chemical substances as plant growth promoters had no great differences, enough to reach the 5 % level of significant. These were true in both experiments. It indicated that, both two factors act independent on okra pods yield and its components.

Table (3): Effect of some chemical substances on okra pods yield and its some physical quality during seasons of 2002 and 2003.

Treatments		2002					2003				
		Pod				Yield ton/fed.	Pod				Yield ton/fed.
		No. /plant	Length (cm)	Diameter	Average wt. (g)		No. /plant	Length (cm)	Diameter	Average wt. (g)	
Soaking	GA	103.23	4.18	2.33	361.63	3.411	113.28	2.46	2.45	339.17	3.387
	IAA	84.59	3.43	2.12	208.51	1.599	81.12	1.77	1.91	275.57	1.523
	Urea	104.60	4.28	2.36	371.50	3.010	108.67	2.34	2.48	396.31	3.312
	Water	82.09	3.16	2.21	234.36	1.831	97.70	1.94	2.25	288.42	1.993
Average		93.62	3.76	2.26	294.00	2.463	100.19	2.13	2.27	324.87	2.554
Foliar	GA	113.56	4.26	2.37	476.64	4.704	108.35	2.40	2.47	438.64	4.265
	IAA	70.85	3.70	1.87	253.70	1.793	96.52	1.86	1.94	277.63	1.716
	Urea	108.22	4.43	2.45	477.98	3.708	104.19	2.47	2.40	421.31	3.780
	Water	92.57	3.46	2.21	275.26	1.900	109.61	2.11	2.24	317.72	2.648
Average		96.30	3.96	2.23	370.90	3.026	104.67	2.21	2.26	363.83	3.102
Mean	GA	108.40	4.22	2.35	419.14	4.058	110.81	2.43	2.46	388.91	3.826
	IAA	77.72	3.56	2.00	231.11	1.696	88.82	1.82	1.93	276.60	1.620
	Urea	93.62	4.35	2.41	424.74	3.359	106.43	2.41	2.44	408.81	3.546
	Water	87.33	3.31	2.21	254.81	1.865	103.65	2.03	2.24	303.07	2.321
L.S.D. 5 %	Applying	N.S	N.S	N.S	15.57	N.S	N.S	N.S	N.S	15.44	N.S
	Treatment	13.85	N.S	N.S	92.34	0.647	10.26	N.S	0.22	N.S	0.554
	Interaction	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

C. Some nutritional values of okra pods:

Table (4) presented the obtained data of some nutritional values (Protein, N, P, K, Fe, Mn, Zn and Cu) of okra pods as responded to the application of GA, IAA, urea and water by using two methods, i.e. as seeds soaking and/or foliar in both seasons of 2002 and 2003. Application of the above mentioned chemical substances as a foliar or seeds soaking caused no significant effect on the nutritional values of okra pods. These response was similar in two experimental seasons.

Table (4) : Effect of some chemical substances on chemical contents of okra pods during seasons of 2002 and 2003.

Treatments		Total protein	%			ppm			
			N	P	K	Fe	Mn	Zn	Cu
2002									
Soaking	GA	7.17	1.15	0.15	0.42	6 84	0.14	0.22	0 22
	IAA	6.17	0.99	0.15	0.35	6.14	0.13	0 19	0.21
	Urea	6.67	1.07	0.14	0.40	6.43	0.13	0.21	0.20
	Water	5.08	0.81	0.11	0.37	6.04	0.12	0.20	0.19
Average		6.27	1.00	0.14	0.38	6.36	0.13	0.21	0.21
Foliar	GA	7.65	1.22	0.16	0.41	7.07	0.15	0.22	0.22
	IAA	3.90	0.62	0.10	0.38	5.59	0.11	0.19	0.17
	Urea	8.56	1.37	0.16	0.44	7.37	0.15	0.23	0.23
	Water	6.04	0.97	0.13	0.39	6.31	0.13	0.21	0.20
Average		6.54	1.05	0.14	0.41	6.58	0.13	0.21	0 21
Mean	GA	7.41	1.19	0.16	0.42	6.96	0.14	0.22	0.22
	IAA	5.03	0.81	0.12	0.36	5.87	0.12	0.19	0.19
	Urea	7.61	1.22	0.15	0.42	6.90	0.14	0.22	0 22
	Water	5.56	0.89	0.12	0.38	6.18	0.13	0.21	0.19
L.S.D. 5 %	Applying	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
	Treatment	0.74	0.12	N.S	0.02	0.72	N.S	0.01	N.S
	Interaction	1.05	0.17	N.S	N.S	N.S	N S	N.S	N S
2003									
Soaking	GA	5.90	0.94	0.15	0.39	6.94	0.14	0 21	0.21
	IAA	6.05	0.81	0.15	0.37	6.52	0.14	0.21	0.21
	Urea	5.85	0.94	0 14	0.56	7.13	0 13	0 20	0.22
	Water	5.21	0.83	0.10	0.36	6.84	0.12	0.20	0.19
Average		5.50	0.88	0.13	0.42	6.86	0.14	0 21	0.21
Foliar	GA	5.77	0.92	0.13	0.36	6.82	0.12	0.20	0.18
	IAA	4.17	0.67	0.07	0.35	6.11	0.12	0.20	0.17
	Urea	6.10	0.98	0.14	0.40	7.21	0 14	0 20	0 22
	Water	4.90	0.78	0.10	0.35	6.00	0.12	0 19	0.17
Average		5.23	0.84	0.11	0.36	6.54	0.12	0.20	0.18
Mean	GA	5 83	0.93	0.14	0.37	6.88	0.13	0.20	0.20
	IAA	4.61	0.74	0.11	0.36	6.32	0.13	0.20	0.19
	Urea	5.98	0.96	0.14	0.48	7.17	0.13	0.20	0.22
	Water	5.05	0.81	0.10	0.36	6.42	0.12	0.20	0.18
L.S.D. 5 %	Applying	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
	Treatment	0.48	0.08	N.S	N.S	N.S	N.S	N.S	N.S
	Interaction	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N S

In spite of the no-statistical analysis of resulted data, but behavior of all elements of nutritional values to the method of application recorded a fluctuation within the two experimental seasons. Whereas, in 1st experiment, foliar spraying of the GA, IAA and urea gave the better nutritional value compared with seeds soaking, but in 2nd season, the opposite occurred. The literature regarding the response of nutritional values of vegetable fruits to the method of application of GA, urea and IAA are very limited.

Concerning to the material of chemical substances which used as a plant growth promoters, application urea caused an increment in total protein, N values in both seasons, as well as the content of K, Fe and Cu in 2nd one. It could be concluded that, the highest nutritional values expressed by the protein and nitrogen of okra pods were recorded with urea application, followed by no significant variation by GA application. On the contrary, the application of IAA caused an inhibition in nutritional values as shown in Table (4).

Many authors reported that, nutritional values of vegetable fruits responsed no significantly by GA, urea and/or IAA (Nandpuri, *et al.*, 1969; Omran, *et al.*, 1980).

The interaction within the treatments of GA, IAA, urea and water as an external promoters and by using two methods for application, i.e. foliar and/or seeds soaking, all of the interaction treatments affected the nutritional values of okra pods and the obtained data presented in Table (4). The statistical analysis of the resulted data for the two experiments indicated that, there is no enough variation within different treatments to reach the 5 % level of significant. These findings were true in both experiments, except protein and nitrogen content only in 1st season. In spite of the no significant effect of the interaction treatments on most of the nutritional elements, but the recorded data reveals that using urea at rates of 2000 ppm as a foliar application (3 times by 10 days interval),gained the best values .

Generally, it could be stated that, the two factors of the interaction treatments act independently on the chemical constituents of okra pods.

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المعاملة ببعض المنشطات الكيميائية وتأثيرها على النمو والمحصول وبعض العناصر الغذائية فى الباميا

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قسم بحوث الخضر – المركز القومى للبحوث – الدقى – القاهرة

اجريت تجربتان حقليتان بمزرعة المركز القومى للبحوث بشلقان خلال موسمى ٢٠٠٢ ، ٢٠٠٣ لدراسة تأثير نقع البذور والرش الورقى ببعض المنشطات الكيميائية (حمض الجبريليك – اندول حمض الخليك – اليوريا بتركيز ١٠٠ جزء/مليون لكل من حمض الجبرلين و اندول حمض الخليك ، ٤٠٠٠ جزء/مليون لليوريا) على صفات النمو الخضرى والمحصول ومكوناته – وتضمنت اهم النتائج مايلى :

- الرش الورقى لكل من اليوريا واندول حمض الخليك والجبرلين ٣ مرات بفاصل زمنى ١٠ يوم بين كل رشة والاخرى ادى الى الحصول على افضل قيم لصفات النمو الخضرى .
- ادى استعمال اليوريا كمنشط كيماوى الى الحصول على افضل قيم لصفات النمو الخضرى وجاء فى الترتيب التالى مباشرة استعمال حمض الجبرليك بينما ادى استعمال اندول حمض الخليك الى الحصول على اقل قيم لصفات النمو الخضرى .
- لم تسجل اى فروق مؤكدة لاستعمال المنشطات الكيميائية سواءابطريقة نقع البذور او الرش الورقى على محصول قرون الباميا .
- ادى استعمال اندول حمض الخليك وحمض الجبرلين الى الحصول على افضل قيم للعناصر الغذائية مقارنة باستعمال اليوريا .
- التفاعل بين طرق استعمال المنشطات الكيميائية ونوع هذه المنشطات لم يسجل اى فروق مؤكدة على المحتوى الكيماوى لمحصول قرون الباميا .