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EFFECT OF FULVIC ACID EXTRACT AND CHEMICAL FERTILIZATION ON *Pancritium maritimum*

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ABSTRACT

The present investigation was carried out to evaluate the effect of foliar spray by fulvic acid extract at concentrations of 3.5 and 7cm/L on plants. Foliar spray was applied on plant leaves 3times. The first time was done after the complete Pancratium maritimum plants reached 15cm height. The second time was after one month from the first one. Finally, the third one was performed after cutting flowers. Beside that the chemical fertilizations were added as follows: urea (46.5%N), calcium superphosphate (15.5%P) and potassium sulphate (48.5%K) at different rates of 100, 75, 50and 25% from the recommended dosage on this plant. Data were recorded for the vegetative growth, flowering, bulbs yield and chemical composition and it was a matter of importance to conclude that for obtaining a healthy outdoor plants of *Pancratium maritimum* for long period with good vegetative and flowering traits, it is recommended to fertilize this plant with 75% NPK +3cm fulvic acid or 50%NPK+5cm fulvic acid under similar conditions of this investigation.

INTRODUCTION

Ornamental flowering bulbous plants are a group of great economic potential for their commercial importance in cut flowers and landscape, owing to their exquisite shape and fascinating color, as well as, the pleasant flowers odor and as a medicinal plant which contains alkaloids. *Pancratium maritimum* L. is a wild plant on costal zones and close sandy hills of Nile Delta especially at Balteim called sea daffodil. It belongs to family Amaryllidaceae a half-hardy, bulbous perennial perpetuating itself through the bulblets and seeds, the flowers have a funnel shaped white fragrant. The bulbus contain a new glucosyloxy phenolic metabolites as well as 14 known amryllidaceae alkaloids (Abou-Donia *et al.*, 1991) Two-oxyphenan thridinium alkalods were isolated from bulbs of *Pancratium maritimum* L. These alkaloids are known to have cytotoxic, antibiotic and plant growth regulator activities (Abou-Donia *et al.*, 1992).

Plant nutrition is one of the important factors which limits the growth and flowering of plants including bulbs. The most important major nutrients are nitrogen (N), phosphorus (P) and potassium (K) (Develin, 1975). Marine products are used as a foliar spray, so they are excellent source of trace minerals and hormones too.

Fulvic acid molecules have to be extracted form the humate material in order to create a fulvic acid solution. they have a role in promoting plant growth and flowering. The importance of fulvic acid lies its Ability to promote hormonal activity in plant. Humic substances are the most abundant organic constituents present in soil and aquatic environments those result from a

humification process that involves microbial and chemical transformation of organic debris (Das and Ram, 2006). A number of studies attributed a hormone-like activity to the humic substances (Cesco *et al.,* 2000 and 2002). So, using fulvic acid consider a cheap feasible alternative in comparing with chemical fertilizers or to minimize soil applied fertilization.

The objectives of this study is the evaluation of these treatments to choose the best of them with regard to their effect on plant.

MATERIALS AND MATHODS

This study was carried out during two successive seasons of 2008 /2009 and 2009/2010 at the Experimental farm in Sakha Horticultural Research Station, Kafr EL-Sheikh Governorate Egypt, in order to study effect of fulvic acid extracts with chemical fertilizer (NPK) at different doses from the recommended concentration on the vegetative growth, flowering, bulbs yield and chemical composition of *Pancratium maritimum* plants.

Chemical fertilizers were added in form of Urea (46.5% N), Calcium superphosphate(15% P_2O_5) and potassium sulphate (48.5% K_2O) at concentrations of 3.22, 6 and 4g/plant, respectively. Farmyard manure was applied at one dose before planting at rate of 3kg/plot while the doses of NPK were applied into three equal portions. The first dose after the bulbs planting and the second one was added after a month from the first addition. While the third dose was applied after cutting spikes.

fulvic acid (product of Sakh Agricultural Research Station, Branch of Nutrition) was applied as a foliar spray on plant leaves 3 times. The first was done when the plants reached 15cm in height, the second was after one month form the first spraying and The third one was applied after cutting flowers. fulvic acid was sprayed at rate of 3, 5, and 7ml/L water with addition of 1g/L Folck oil as a foliar material. Spraying was done to the run of point. Experiments soil was analyzed for its physical and chemical characteristics as shown in Table (A). Also, the chemical analysis of the fulvic acid (the content /liter) which used in the experiments was shown in Table (B). The experimental design was a simple experiment in a complete randomized block design contained 4 treatments each treatment contained 3 replicates.

Treatments of the first experiment were conducted as follows:,

1-"Control" as a full dose of 100%NPK+0 fulvic acid
2- 75% NPK +7cm fulvic acid.
3- 50% NPK+5cm fulvic acid.
4- 25% NPK+3cm fulvic acid.

Data were tested by analysis of variance (Little and hills, 1972) L.S.D test was used for comparisons among treatments mean. The vegetative growth data and flowering parameters were recorded at the flowering stage (when 75% of the total number of plants of each treatment were flowered), while those of bulbs productivity were estimated in the end of the season when the leaves became yellowish on 2 th and 4th October 2009-2010.

Table (A): physical and chemical analysis of soil before conducting the experiment:

Physical properties	**(%)**
Clay%	53.21
Silt%	25.14
Sand%	21.65
Chemical analyses:	
pH(1:2.5 soil: water suspension)	8.05
Ec dsm-1(soil paste extract)	2.1
Organic matter	1.7
Available-N mg-1(1MKCL extract)	36
Available-P mg-1(0.5N NaHCO3 extract)	6.1
Available-K mg-1(ammonium acetate extract)	280

Table (B): chemical analysis of fulvic acid (the content /liter):

Fe	2%
Mn	0.6%
Zn	0.3%
Cu	0.15%
B	0.1%
fulvic acid	15%

The vegetative growth parameters were recorded as follows: plant height (cm), number of leaves/plant, leaf area/plant (cm^2) and leaves dry weight/plant (g). On the other hand, the flowering characteristics were recorded for:, flowering date (weeks from planting to the first floret open), number of florets/stalk, spike diameter, spike length (cm), inflorescences fresh weight (g), inflorescences dry weight (g), pedicel length (cm), number of inflorescences/plant, floret diameter (cm) and the vaselife of inflorescences (number of days after opening the first floret), as 6 flowering spikes for each treatment (2 from each replicate) were cut by a sharp knife at 3cm from soil surface. Then, spikes were put in cold water immediately, then brought to laboratory and they were put in a distilled water which was changed at period of 24 hrs in vases at room temperature. Vaselife was calculated when the wilted florets reached more than 50% of the total number of florets on the flowering spike.

Bulbs production data were recorded for:, new mother bulb circumference (cm), number of bulbs/plant, bulbs fresh weight(g) and bulbs dry weight(g). on the other side, chemical composition were measured as follows:, chlorophyll A, b and total chlorophyll (mg/100g) was determined in fresh leaves samples of the fourth leaf from inflorescence during the growing season according to the method described by (Moran, 1982). Nitrogen and Phosphorus was determined in the plants leaves by modified microkjetdahet method as described by (Jackson, 1967). While Potassium was estimated using the flame-photometer according to (Cottenie *et al.,* 1982). Finally, total carbohydrates were determined according to (Herbert and Strange, 1971).

RESULTS AND DISCUSSION

Effect of fulvic acid and NPK treatments on the vegetative growth

Results in Table (1) show that plant growth is a function of nutrients supply providing, there were clear significantly positive trend in increasing plant height, number of leaves/plant and leaves dry weight/plant by increasing the concentration of foliar application. The highest plant height(48.56,50.10), number of leaves/plant(29.40,26.50), leaf area/plant(1580.23,1229.23) and leaves dry weight(19.50,21.66) were obtained when 75% NPK + 3 cm fulvic acid in both seasons were applied. These results may be due to hormone-like activity of fulvic acids from the vermicomposts or due to plant growth hormones adsorbed onto the humates. These results were in agreement with (Atiyeh *et al.,* 2002) on *Solanum lycopersicum* and *Cucumus sativas .*

Table (1):Effect of fulvic acid and NPK treatments on Plant height, number of leaves and Leaf area /plant (cm^2) of *Pancratium maritimum* during two seasons 2008 and2009

Treatments		Plant height (cm)		Leaves no./plant		Leaf area /plant (cm^2)		Leaves dry weight (g)	
NPK%	fulvic acid	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
100%	0cm	47.03	45.16	23.96	23.03	813.34	803	12.83	12.75
75%	3cm	48.56	50.10	29.40	26.50	1580.23	1574.16	19.50	21.66
50%	5cm	46.83	45.86	25.23	21.13	1244.22	1229.23	10.66	10.80
25%	7cm	43.36	44.50	16.53	17.03	776.26	766.20	10.93	11.30
LSD at 0.05		**1.05**	**1.12**	**0.41**	**1.14**	**22.57**	**11.91**	**2.01**	**0.80**

Effect of fulvic acid and NPK treatments on flowering characters:

It is appearing from data in Table (2) that, the earliest flowering significantly resulted from 25% NPK + 7 cm fulvic acid (29.24,32.19)weeks in both seasons followed by 75% NPK + 3 cm fulvic acid (30.18) in the first season, and the control 100% NPK(30.78)in the second season with non-significant differences between them. Also, the longest spikes resulted from the control plants (32.60)cm in the first season and plants received 75% NPK+ 3 cm fulvic acid (30.73)cmin the second season. The highest values of pedicel length were obtained from the control treatment (100% NPK) in the first season (14.53)cm and 50% NPK +5 cm fulvic acid in the second season(13.50)cm.

Data in table (3) showed that the significantly highest florets number /spike was obtained from the application of the control in both seasons (13.43,10.59) or 75% NPK + 3 cm fulvic acid in the second one (10.64). The thickest spike resulted from the control treatment (100% NPK)(0.99,1.01)cm when compared with most of the other cases. The highest number of inflorescences /plant was achieved with 100% NPK (2.79,2.73) the other used treatments resulted in intermediate values and the differences between them did not reach the significancy level in the first season. In the second

season the highest number of inflorescences /plant resulted from the treatment of 75% NPK + 3 cm fulvic acid followed by 100% NPK as recorded.

Table (2): Effect of fulvic acid and NPK treatments on flowering date, stalk length, and pedicel length of *Pancratium maritimum* during two seasons 2008 and 2009

treatments		Flowering date (weeks)		Spike length (cm)		Pedicel Length(cm)	
NPK%	fulvic acid	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
100%	0cm	30.95	32.78	32.60	28.56	14.53	13.46
75%	3cm	30.18	33.18	31.41	30.73	14.03	13.33
50%	5cm	31.52	34.61	30.00	27.15	13.80	13.50
25%	7cm	29.24	32.19	27.58	24.41	12.56	9.00
LSD 0.05		**1.49**	**0.76**	**1.88**	**1.47**	**0.49**	**N.S**

Table (3): Effect of fulvic acid and NPK treatments on number of florets, spike diameter (cm) and number of inflorescences/plant of *Pancratium maritimum* during two seasons 2008 -2009

treatments		Number of florets /spike		Spike diameter (cm)		Number of inflorescences /plant	
NPK%	fulvic acid	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
100%	0cm	13.43	10.59	0.99	1.01	2.79	2.73
75%	3cm	11.33	10.64	0.99	0.93	2.00	2.86
50%	5cm	8.83	8.20	0.96	0.89	1.75	1.77
25%	7cm	7.83	8.93	0.74	0.79	1.58	1.90
LSD 0.05		**0.85**	**0.71**	**0.19**	**0.12**	**0.72**	**0.37**

It is clear from data in table (4) that the widest floret diameter values were obtained from control treatment (100% NPK) (9.69)cm then 75% NPK + 3 cm fulvic acid (9.50)cm in the first season while the second season showed that there was no significant difference in floret diameter between the different treatments. The significantly heaviest dry(1.25)g and fresh weight(12.96,) of Inflorescences was recorded in the first season by the control treatments (100% NPK), and then the other treatments resulted in intermediate values without significant differences between them. In the second season, the significant heaviest weight resulted from the treatment of 75% NPK + 3 cm fulvic acid (1.46,14.67)g. The longest vaselife was obtained from the control treatment (100% NPK) (6.10,6.31) days followed by 75% NPK + 3 cm fulvic acid(5.96,6.14)days in both seasons. These results may be attributed to that flower bud initiation and development may depend so much on balanced amounts of the fertilizer and hormone like activity of fulvic acid and many authors referred to the importance of fertilization on accelerating flowering as (El-Bably, 2003) on *Antholyza aethiopica* and (Nikbakht, 2008) on *Gerbera jamsoni*.

Table (4): Effect of fulvic acid and NPK treatments on Floret diameter, Vase life, Inflorescences fresh and dry weight of *Pancratium maritimum* during two seasons 2008 and 2009

treatments		Floret diameter (cm)		Inflorescences dry weight (g)		Inflorescences fresh weight (g)		Vase life (days)	
NPK%	fulvic acid	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
100%	0cm	9.69	9.60	1.25	1.17	12.96	12.69	6.10	6.31
75%	3cm	9.50	9.66	0.94	1.46	11.53	14.67	5.96	6.14
50%	5cm	9.16	9.30	0.90	1.10	11.52	11.61	5.90	6.01
25%	7cm	8.96	9.10	0.91	0.96	10.55	9.59	4.80	5.50
LSD at0.05		**0.32**	**N.S**	**0.29**	**0.09**	**1.02**	**0.90**	**0.30**	**0.18**

Effect of fulvic acid and NPK treatments on bulbs productivity:

It is evident from Table (5) that no significant differences between the treatments in the first season. In the second season, the significantly highest diameter of mother bulb resulted from the treatment of 75% NPK + 3 cm fulvic acid(5.89))cm. The highest increment number of bulblets/plant(10.63,10.37) in both seasons was obtained from the treatment of 75% NPK + 3 cm fulvic acid, the significantly heaviest fresh(221.53,202.96)g and dry(45.90,40.46)g weights resulted from the treatment of 75% NPK + 3 cm fulvic acid in both seasons. These results may by due to hormone like activity in fulvic acid and role of NPK fertilization on increasing protein synthesis and carbohydrates content in plant organs which lead to increase the dry matter. These results are in agreement with those stated by (Nikabkht, 2008) on *Gerbera jamsoni* and (El-Saigh, 2010) on *Narcissus tazetta.*

Table (5): Effect of fulvic acid and NPK treatments on new mother diameter, Number of bulbs, Total bulbs fresh and dry weight of *Pancratium maritimum* during two seasons 2008 and2009

Treatments		New mother diameter (cm)		Number of bulblets/ plant		Bulbs fresh weight/plant (g)		Bulbs dry weight/plant (g)	
NPK%	fulvic acid	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
100%	0cm	5.60	5.72	6.16	5.97	156.86	153.90	35.43	35.86
75%	3cm	4.62	5.89	10.63	10.37	221.53	202.96	45.90	40.46
50%	5cm	4.32	5.74	6.73	4.76	126.68	130.16	30.20	26.56
25%	7cm	4.33	4.92	4.23	3.60	90.63	91.36	20.00	18.33
LSD at0.05		**N.S**	**0.07**	**1.19**	**0.61**	**4.69**	**2.98**	**1.70**	**1.15**

Effect of fulvic acid and NPK treatments on chemical composition: chlorophyll (mg/100g . leaves fresh weight)

As shown in Table (6), it is obvious that, the highest values of Chlorophyll a were obtained from the treatment of the control (100% NPK) followed by 25% NPK + 7 cm fulvic acid then 75% NPK + 3 cm(1.85,1.81and1.79) in the first season. In second season the highest values were resulted from the treatment of 50% NPK + 5 cm fulvic acid or 75% NPK+3cm fulvic acid(2.08,1.99). The superior increments in both seasons for chlorophyll b(1.65,1.63) and total) chlorophyll (3.52,3.53)

µg/100g.leaves fresh weight were recorded with the control treatment (100% NPK). The previous results may be due to the application of fertilization on treatments and the foliar application of fulvic acid might be attributed to the known function of some elements like nitrogen which was found in such important molecules as prophyrin. The prophyrin structure was found in metabolically important compounds in chlorophyll (Develin, 1979).

These results are parallel with those obtained by (El-Bably, 2003) on *Antholyza aethiopica.*

Table (6): Effect of fulvic acid and NPK treatments on Chlorophyll a, b and total (µg/100g.leaves fresh weight)

treatments		Chlorophyll a (µg/100g.leaves fresh weight)		Chlorophyll b(µg/100g.leaves fresh weight)		Total chlorophyll (µg/100g.leaves fresh weight)	
NPK%	fulvic acid	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
100%	0cm	1.85	1.91	1.64	1.63	3.52	3.53
75%	3cm	1.79	1.99	0.97	1.16	2.74	3.11
50%	5cm	1.64	2.08	1.23	1.38	2.94	3.32
25%	7cm	1.81	1.95	1.13	1.38	2.90	3.23
LSD 0.05		**0.14**	**0.05**	**0.16**	**0.08**	**0.23**	**0.17**

b. N,P and K% and total carbohydrates/bulbs (mg/g)

The highest values of total carbohydrates in the bulbs were obtained from the treatment of 50% NPK + 5 cm fulvic acid(10.15,10.01) m_g/g followed by the control (100% NPK)(9.32,3.22) in both seasons. As for nitrogen % in the first season the significantly highest resulted feom treatment of 75% NPK + 3 cm fulvic(4.62)%. In the second season, the significantly highest nitrogen percentage resulted from treatment of 50% NPK + 5 cm fulvic acid (4.32)% then 25% NPK + 7 cm fulvic acid(4.33,4.31)in both season . The significantly highest phosphorus % resulted from treatment of 25% NPK + 7 cm fulvic acid (0.307,0.290)% in both seasons, then 75% NPK +3 cm fulvic acid (0.267,0.280)% in the second season one.

Table (7): Effect of fulvic acid and NPK treatments on N, P and K percentage.

Treatments		N%		P%		K%		Total carbohydrates /bulbs m_g/g	
NPK%	fulvic acid	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
100%	0cm	3.34	3.43	0.257	0.240	2.43	2.48	9.32	9.22
75%	3cm	4.62	3.61	0.267	0.280	2.76	2.81	8.05	8.11
50%	5cm	4.32	4.32	0.263	0.267	2.87	2.98	10.15	10.01
25%	7cm	4.33	4.31	0.307	0.290	2.61	2.68	7.70	7.82
mean		**4.65**	**3.91**	**0.273**	**0.267**	**2.66**	**2.73**	**8.80**	**8.79**

The significantly highest potassium % values was obtained from the treatment of 50% NPK + 5 cm fulvic acid (2.87,2.98)% in both seasons. These results are in accordance with those of (Atiyeh, 2002) on cucumber and (Shaaban, 2009) on wheat. Finally, the increase in the N, P, K %, chlorophyll a and b and total carbohydrates contents could be resulted from

the increase in the uptake of the nutrients through the root system, which became more capable of absorbing more amounts of nutrients due to hormone-like activity of fulvic acid from the vermin composts or could have been due to plant growth hormones adsorbed onto the humates.

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تاثير استخدام الفلفيك اسيد والتسمبد الكيماوى على نبات البنكرشيم

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أجرى هذا البحث خلال موسمى 2008 /2009و 2010/2009 بمحطة البحوث الزراعية بسخا –محافظة كفر الشيخ- مصرلدراسة تاثير الرش بمستخلص الفلفيك اسد المستخدم بجرعات 5,3و7مل/لتر والذى تم اضافته كسماد ورقى علىالاوراق ثلاث مرات الاولى بعدما اكتمل النبات 15سم والثانيه بعد الاولى بشهر والثالثه بعد قطف الازهار وكذلك التسميد الكيماوى يوريا (46.5) وسوبر فوسفات الكالسيوم (15.5) وسلفات البوتاسيوم (48.5) بجرعات مختلفة 100(الكنترول)، 25,50,75% من الجرعة الموصى على ثلاث دفعات ايضا الاولى بعد شهرين من الزراعه والثانيه بعد الاولى بشهر والثالثة بعد الازهار بها على نبات البنكرشيم (نرجس بلطيم)على صفات النمو الخضرى والزهرى وانتاجية الابصال والتركيب الكيماوى حيث شملت الصفات الخضرية(طول النبات ،عدد الاوراق ،المساحة الورقية ،الوزن الطازج والجاف للاوراق) والصفات الزهرية(ميعادالتزهير عددالزهيرات/حامل نورى،قطر الحامل النورى وطولهالوزن الطازج والجاف للنورات طول عنق الزهره عدد النورات /نبات) وصفات انتاجية الابصال(قطر البصله الام الجديده عدد البصيلات /نبات الوزن الطازج والجاف للابصال) والقياسات الكيماوية(الكلوفيل ا،ب،والكلى وكذلك محتوى النبات من النتروجين والفوسفور والبوتاسيوم فى الاوراق والكربوهيدرات الكليه فى الابصال). ويمكن التوصيه للحصول على افضل النتائج من زراعه النبات تحت نفس الظروف باستخدام التسميد ب 75%من السماد الكيماوى + 3مل/لتر من الفلفيك اسيد و50%من السماد الكيماوى +5مل/لترمن الفلفيك اسيد للحصول على صفات خضريه وزهريه جيدة.

قام بتحكيم البحث

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