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Effect of Mineral and Bio- Fertilization on Vegetative Growth and Flowering of *Anthurium andreanum* L. Plants under Greenhouse Conditions

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ABSTRACT

The present study was designed to estimate the effect of mineral fertilizer NPK (19:19:19) at 0.0, 5.0, 10.0 and 15.0 g / plant, bio-fertilizer (active dry yeast) at levels 0.0, 2.0, 4.0, and 6.0 g/ l and their combination on growth, flowering and leaves chemical composition of Anthurium andreanum, L. plants. The experiment was carried out during 2010 and 2011 growing seasons in Alexandria university's nursery. The results indicated that planting Anthurium andreanum, L. under greenhouse conditions with applying 10 g / pot of mineral NPK monthly during the growing seasons, combined with active dry yeast at 6 g / l improved the vegetative growth and flowering parameters (plant height, number of leaves, leaf area, leaf dry weight, number of flowers / plant, flower dry weight and leaf chemical composition parameters [total chlorophyll and mineral content (N, P and K %)]. These results can be used for improving Anthurium fertilizing programs for economic production.

Key word: indoor plants, bio-fertilizers, active dry yeast, mineral fertilizer, *Anthurium andreanum.*

INTRODUCTION

Anthurium (*Anthurium andreanum*) is also called the "flamingo flower" and the "boy- flower." It is a tropical plant that originated in the New World jungles of Ecuador and Colombia. Anthurium andraeanum is a flowering plant species belongs to the Araceae family. The leaves are often clustered and are variable in shape. The inflorescence bears small flowers which are perfect, containing male and female structures. The flowers are contained in dense spirals on the spadix. The spadix is often elongated into a spike shape. Anthurium can be propagated by seed or vegetatively by cuttings. In the commercial scale, most propagation is viatissue culture. Many species of Anthurium can be grown as houseplants, or outdoors in mild climates in shady spots. Anthuriums are a popular addition to floral arrangements for their exotic forms and wide range of colors from white to pale green to bright red and many shades of pink and purple.

Mineral and bio-fertilization are considered two of the most important factors affecting ornamental plants. Several investigators studied the effects of mineral fertilization on ornamental plants where Hendawy (2008) studied the effect of mineral fertilizer (NPK) with 100: 100: 50 and 200: 200:50 ratios on yield and chemical constituents of Plantago arenaria. The results revealed the various fertilizers levels caused significant promotion for herb fresh and dry weight. Also, El-Naggar and El - Nasharty (2009) studied the effect of complete fertilizer of NPK (19: 19: 19) on the growth of Amaryllis (*Hippeastrum vittatum*) plants and they found that fertilizer treatments significantly increased number of leaves /plant; it increased with increasing fertilizer rate in both seasons, leaf length, leaf width, leaf fresh and dry weight / plant, the best result was obtained using 5.0 g / plant of NPK fertilizer compared to the control. Abbas niayzare et al. (2012) studied the effects of chemical fertilizers on growth indices of Spathiphyllum illusion. The results showed that chemical fertilizer treatments resulted height significant mean values for leaves number, dry and fresh weight of leaves and spadix size.

Active dry yeast is a natural safety biofertilizer causes various promoted effects on plants and it is a natural source of cytokinins which stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid and B-vitamin (Ezz El-Din and Hendawy, 2010a). The effect of various concentrations of active dry yeast (ADY) on growth yield of borage plants (Borago officinalis) was studied by Ezz EL-Din and Hendawy (2010b). The results pointed out that Adding dry yeast at the rate of 6 g / l was the most effective on growth parameters (plant height, fresh and

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dry weight of aerial parts, flowers, number of branches and suckers).

The objective of the present study was to investigate the effect of the application of NPK fertilizer with four rates four concentrations of active dry yeast under greenhouse conditions and their interaction on the vegetative growth and flowering parameters for economic production of Anthurium andreanum, cv "Bettine" plants.

MATERIALS AND METHODS

The present work was carried out during two successive seasons (2010 and 2011) at Alexandria university's nursery, Smouha, Alexandria, Egypt. Uniformed plants of *Anthurium andreanum*, cv "Bettine" with four leaves and 25 cm in hieght were used. One plant / pot was cultivated in clay pots of 30 cm diameter filled with mixed of sand, clay and leaves compost (2 : 2 : 1 v/v/v). The chemical analysis of the used medium indicated that it was containing 19, 770 and 295 ppm of N, P and K, respectively. The electrical conductivity (E.C.) was 2.7 ds m^{-1} with a pH value of 8.1.

The shading (plastic house) conditions of temperature and relative humidity measured during the growing seasons 2010 and 2011, are illustrated in Table (1).

The water soluble chemical fertilizer NPK (19:19:19) was used (Mizuta et al., 1998). The mineral fertilization (M.F.) doses 0.0, 5.0 , 10.0 and 15.0 g/plant were applied monthly as dressing application for six times throughout the growing seasons. The fertilization treatments started from 1stMarch 2010 and 5thMarch2011 for the first and second seasons, respectively until reaching the flowering stage. The experiment was terminated on 1stSeptember 2010 and 5thSeptember 2011 for the first and second seasons, respectively. Bio - fertilizer treatments (Bio.fer.) composed of active dry yeast was applied as dressing on the soil surface with concentrations of (0.0, 2.0, 4.0 and 6.0 g/l) as the mineral fertilizer mentioned above.

The experimental layout was split plot design for arrangement of pots with three replicates. Each replicate contained 16 treatments (4 M.F. × 4 Bio.fer.) and five plants were used as an experimental unit.Mineral fertilizer treatments were arranged in the main treatment, while, the bio- fertilizer levels were randomly distributed in the sub-treatment.

Morphological Measurements:

At the end of each growing season the following morphological measurements were carried out on the grown Anthurium plants:

1- Vegetative growth characteristics: Plant height (cm), number of leaves, leaf area (cm^2/plant) and leaf dry weight (g).

2- Flowering parameters: Number of flowers / plant and flower dry weight (g) / plant.

Plant Analysis:

1- At the flower bud initiation stage of each growing season, the total chlorophyll content was measured according to Yadava (1986) using Minolta SPAD Chlorophyll Meter model - 502.

2- Chemical analysis of oven - dried leaves (dried at 60^{o}C for 72 hrs) were carried to determine their N, P and K contents (%) according to the methods outlined by Westerman (1990).

The same steps and techniques of the first experimental year (2010) were followed in the second one (2011). Data were statistically analyzed according to the methods described by Snedecor and Cochran, (1981) using L.S.D. to compare between means of treatments.

Table 1. Average of monthly temperature (^{o}C) and (%) of relative humidity (R.H.) measured in the plastic house during the two growing seasons

Month	Season 2010		Season 2011	
	Temp. (^{o}C)	R.H. (%)	Temp. (^{o}C)	R.H. (%)
Feb.	24.2	76	23.8	75
March	27.6	76	27.9	76
April	28.0	74	28.6	73
May	33.5	75	30.6	75
June	34.4	78	32.5	77
July	37.0	80	36.5	79
August	37.6	79	37.9	78

RESULTS AND DISCUSSION

I-Vegetative growth

1- Plant height (cm)

The data illustrated in Table (2), showed that all the studied mineral fertilizer NPK levels (5.0, 10.0 and 15.0 g/ plant) had significant effect on plant height of Anthurium as compared with the untreated plants in both seasons. The highest significant increases of plant height resulted when adding 10.0 g/plant, compared with the other treatments with means of 52.91and 52.63cm in the first and second season ,respectively. Active dry yeast (ADY) recorded a significant effect on plant height of the treated Anthurium plants compared with the control in the two seasons. The highest significant mean values of plant height (50.99 and 50.73 cm) were recorded when adding 6.0 g / l of the ADY to the planting medium. Furthermore, there was not significant difference between the ADY concentration of 4.0 and 6.0 g / l in both seasons table (2). Concerning the interaction between mineral fertilizer NPK (19:19:19) treatment in combination with ADY concentrations (2.0, 4.0 and 6.0 g / l) highly significant differences were observed. The highest value of plant height was observed with mineral fertilizer NPK at10, 0 g / plant and 6.0 g / l of ADY in the first and second seasons. These treatment increased plant height 56.90 and 55.18cm against 35.96 and 36.88 cm resulted from the control in the first and second seasons, respectively. While the followed values were obtained by 10. 0 g / plant mineral fertilizer and 4.0 g / l ADY for both seasons. Hilman and Galston (1961) reported that the reason of growth increase was the role of nitrogen in forming important molecules of phospholipids, nucleotides, nucleic acid and certain co-enzymes, which play an important role in plant metabolism and shortage of N results in the reduction of auxin and thus growth, which was also confirmed by Kadu et al. (2009). Shalaby and El-Nady (2008) reported that the enhancement of plant height could be due to the role of NPK and ADY fertilizers by developing the cell division rate and cell enlargement.These results are in agreement with Bhaskar et al. (1998) on scented Geranium, Chauhan and Nautiyal (2005) on Palmarosa plants.

2- Number of leaves /plant

According the data showed in (Table 2), there were significant increases in the number of leaves by increasing NPK and ADY fertilization levels in the two growing seasons compared with control plants. The best results were obtained by treating plants with 10.0 and / or15.0 g / plant NPK in the two seasons. The highest number of leaves/ plant was obtained using 6.0 g / l ADY in the first and second seasons (13.72 and 13.68 leaf / plant, respectively). For the interaction between NPK fertilizer rates and ADY concentrations, the highest value of leaf number / plant was observed with 10.0 g / plant NPK plus 6.0 g / l ADY (15.93 and 15.77 cm for the two growing seasons) .Similar results were reported by EL- Gengaihi et al. (1995) on Glossostemon bruguieri, Badran and Safwat (2004) and Ahmed (2001) on Calendula officinalis plants.

3- Leaf area (cm^2/plant)

It was clear from data that all rats of mineral fertilizer NPK and active dry yeast fertilizers showed significant effect on leaf area compared with untreated plants in both seasons (Table 3). The greatest mean values of leaf area / plant were obtained by the dose of 10.0 g / plant NPK (1938.30 and 2022.41 cm^2/ plant, respectively). Also, among the tested active dry yeast levels (ADY), the highest significant value of leaf area was obtained using either 4.0 or 6.0 g / l of ADY compared to the control in both seasons. However, the highest concentration of 6.0 g/l ADY (2011.04 and 2037.44 cm^2) was effective than 4.0 g / l ADY (1929.45 and 1942.74 cm^2) for both seasons. The interaction between NPK and ADY fertilization treatment significantly affected leaf area/plant. Whereas the largest leaf area / plant was obtained by using NPK at 10.0 g/ plant combined with 6.0 g/l ADY as compared with the other treatment in the two growing seasons. Whereas, these treatment gave to 2259.93 and 2296.76 cm^2 in the first and second seasons, respectively.Nitrogen is the most important constituent of chlorophyll and is a component of amino acids and enzymes, thus it might have increased the meristematic activities, cell division, cell number and cell enlargement of the plant (Gajbhiye et al. 2013a).These results were in agreement with Singh and Ramesh (2002) on sweet basil, Abd El-Azeem (2003), Abd El - latif (2006) on Salvia officinalis and Mahmoodinezhadedezfully et al. (2012) on Polianthes tuberosa.

4- Leaves dry weight (g / plant)

Data presented in Table 3 reveals significant increase in total leaf dry weights as a result of NPK fertilizer treatment, it was found that adding either the levels of 10.0 g/ plant mineral fertilizer NPK resulted in the greatest total leaf dry weights compared to the control (27.79 and 28.21 g) in both seasons. The results indicated that, all bio- fertilizer treatments significantly increased total leaf dry weights compared to control.

Table 2. Means of plant height (cm) and number of leaves / plant of *Anthurium andreanum* cv "Bettine" plants as influenced by mineral, bio- fertilizer and their combination in the two seasons of 2010 and 2011

plant height (cm)										
	(1st) season					(2nd) season				
NPK(A)	Active Dry Yeast (ADY) g/ plant (B)									
g/ plant	0.00	2.00	4.00	6.00	mean	0.00	2.00	4.00	6.00	mean
0.00	35.96	38.36	44.66	43.87	40.71	36.88	38.98	46.36	46.00	42.05
5.00	44.19	48.10	52.66	53.75	49.68	45.50	49.51	47.10	49.55	47.91
10.00	48.76	51.26	54.73	56.90	52.91	49.55	52.78.	53.00	55.18	52.63
15.0	45.89	46.86	47.46	49.42	47.41	46.23	47.00	48.11	51.22	48.17
mean	43.70	46,15	49.88	50.99		44.54	47.07	49.39	50.73	
$LSD_{0.05}$	A = 2.23		B = 1.71	A×B = 3.42		A= 2.22		B =1.52	A×B = 3.25	
number of leaves/ plant										
	(1st) season					(2nd) season				
NPK (A)	Active Dry Yeast (ADY) g/ plant (B)									
g/ plant	0.00	2.00	4.00	6.00	mean	0.00	2.00	4.00	6.00	mean
0.00	7.29	9.80	10.23	11.13	9.61	7.72	9.64	10.53	11.98	9.97
5.00	9.23	11.53	12.00	13.66	11.60	9.22	11.13	12.35	12.67	11.34
10.00	11.06	12.98	13.37	15.93	13.33	11.83	13.19	13.96	15.77	13.69
15.00	11.76	12.79	13.74.	14.15	13.11	11.13	12.88	14.11	14.29	13.10
mean	9.84	11.78	12.35	13.72		10.66	11.71	12.74	13.68	
$LSD_{0.05}$	A= 0.91		B = 0.93	A×B = 1.32		A=1.83		B =1.33	A×B =2.79	

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 probability level.

Table 3. Means of leaf area / plant (cm^2) and leaves dry weight (g) of *Anthurium andreanum* cv "Bettine" plants as influenced by mineral, bio- fertilizers and their combination in the two seasons of 2010 and 2011

leaf area / plant (cm^2)										
	(1st) season					(2nd) season				
NPK(A)	Active Dry Yeast (ADY) g / plant (B)									
g/ plant	0.00	2.00	4.00	6.00	mean	0.00	2.00	4.00	6.00	mean
0.00	1473.96	1529.22	1664.67	1738.85	1601.68	1578.80	1620.15	1721.43	1799.53	1679.98
5.00	1574.28	1727.66	1928.26	2060.58	1822.70	1677.91	1728.91	1928.93	2055.89	1847.91
10.00	1660.08	1967.80	2160.46	2259.93	1938.30	1750.44	1896.38	2146.06	2296.76	2022.41
15.00	1654.66	1797.88	1964.87	1984.78	1850.55	1659.36	1787.47	1974.57	1997.57	1854.74
mean	1590.76	1755.64	1929.45	2011.04		1666.63	1758.23	1942.74	2037.44	
$LSD_{0.05}$	A= 61.0		B = 63.28	A×B = 120.85		A = 121.29		B = 99.39	A×B = 200.87	
leaves dry weight (g) / plant										
	(1st) season					(2nd) season				
NPK(A)	Active Dry Yeast (ADY) g / plant (B)									
g/ plant	0.00	2.00	4.00	6.00	mean	0.00	2.00	4.00	6.00	mean
0.00	22.23	23.14	23.98	24.18	23.38	22.00	23.12	23.96	24.20	23.32
5.00	23.19	24.00	25.74	25.99	24.73	23.33	24.18	25.76	26.11	24.85
10.00	23.98	26.09	29.54	31.56	27.79	24.00	26.17	29.73	32.93	28.21
15.00	23.77	24.23	24.87	25.35	24.55	23.55	24.13	24.91	25.99	24.64
mean	23.29	24.37	26.03	26.77		23.22	24.40	26.02	27.31	
$LSD_{0.05}$	A = 0.29		B = 0.41	A×B = 0.75		A = 1.68		B = 0.89	A×B = 2.13	

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 probability level.

The highest total leaves dry weight / plant were obtained by using 6.0 g / l ADY (26.77 and 27.31 g, respectively).The interaction between mineral fertilizer and bio- fertilizer treatments significantly affected total dry weights .whereas the highest weights was obtained by using NPK at 10.0 g/ plantcombined with 6.0 g / l of ADY as compared with the other treatment in the two growing seasons. These results are in agreement with those reported by Abd El-Azeem (2003) on *Salvia officinalis* plants.

II – flowering characteristics

1- Number of flowers / plant

Data in Table 4 showed that the NPK fertilizer application (5.0, 10.0 and 15.0 g / plant) produced significant increase in number of flowers / plant of Anthurium as compared with the control treatment of the two growing seasons. Generally, there was significant increase in number of flowers / plant by increasing the used rate of NPK fertilizer up to15.0 g / plant. It was evident from the obtained data in table 4 clear that plant height increased with increasing of bio-fertilizer at 4.0 and / or 6.0 g / l ADY in both seasons. For the interaction, data presented in table (4) clearly indicated that number of flowers/ plant was significantly increased with increasing mineral fertilizer rate (5.0, 10.0 and 15.0 g/ plant) in combined with any concentration of bio-fertilizer as compared with the untreated plants (control) in the two growing seasons . The highest values of flowers / plant were obtained using NPK fertilizer at level of 15.0 g / plant plus bio- fertilizer at concentration of 6.0 g / l ADY as compared with the other treatments in the two seasons. The values reached 14.78 and 14.77 against 4.94 and 4.65 flower / plant that resulted from the control treatment in the first and second seasons, respectively. These results may be related to the increase of the available nutrients which led to increase in number of flowers. This result agrees with that obtained by Parthiban and Khader (1991) on Polianthus tuberosa.

2- Flowers dry weight / plant (g)

Table 4 showed that supplying Anthurium plants with NPK and ADY fertilizers were caused significant increases in flower dry weight (FDW) in the two seasons compared with untreated plants. The best results were obtained with 10.0 and /or 15.0 g / plant NPK in the two seasons. Generally, the superior mean of flower dry weight was obtained using 15 g / plant in the two growing seasons (5.92 and 5.88 g, respectively).

Table 4. Means of flowers number/plant and flowers dry weight(g) of *Anthurium andreanum* cv "Bettine" plants as influenced by mineral and bio- fertilizers and their combinations in the two seasons of 2010 and 2011

number of flowers / plant										
	(1st) season					(2nd) season				
NPK(A)	Active Dry Yeast (ADY) g / plant (B)									
g / plant	0.00	2.00	4.00	6.00	mean	0.00	2.00	4.00	6.00	mean
0.00	4.94	5.22	6.61	7.80	6.14	4.65	5.35	6.65	7.77	6.11
5.00	5.24	7.66	9.26	10.58	8.18	5.39	7.81	9.22	10.14	8.14
10.00	6.08	9.82	12.46	12.93	10.32	6.11	9.79	12.45	12.87	10.31
15.00	8.66	11.81	12.87	14.78	12.03	8.78	11.90	12.85	14.77	12.07
mean	6.23	8.63	10.30	11.52		6.23	8.71	10.29	11.38	
$LSD_{0.05}$	A= 0.52		B= 0.65	A×B= 0.97		A=0.49		B=0.67	A×B=0.89	
Flowers dry weight (g) / plant										
	(1st) season					(2nd) season				
NPK(A)	Active Dry Yeast (ADY) g / plant (B)									
g / plant	0.00	2.00	4.00	6.00	mean	0.00	2.00	4.00	6.00	mean
0.00	2.84	2.89	3.95	4.17	3.46	2.95	2.97	3.99	4.23	3.35
5.00	3.47	4.24	4.67	5.75	4.53	3.50	4.29	4.72	5.81	4.58
10.00	3.99	5.90	6.35	5.79	5.55	3.97	5.86	6.36	5.55	5.43
15.00	4.18	6.02	6.19	7.28	5.92	4.12	5.98	6.13	7.30	5.88
mean	3.62	4.76	5.29	5.75		3.63	4.77	5.30	5.72	
$LSD_{0.05}$	A=1.12		B=1.31	A×B=1.75		A=1.68		B=0.89	A×B=1.13	

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 probability level.

The most effective concentration of bio-fertilizer was 6.0 g/l ADY. The interaction between NPK and ADY treatments was significantly affected the FDW in the two seasons as clearly indicated in table 4. The more effective treatment was 15 g / plant NPK with 6.0 g / l of ADY in the two seasons (7.28 and 7.30 g , respectively). With the increase in fertilizer rates and ADY an increase in the efficiency of available nutrients and photosynthetic products may occurred which affect inflorescence duration and dry weight of spike. These results are in accordance with those of El- Naggar (1999) on gladiolus.

III- Effect of NPK and active dry yeast fertilizers on chemical constituents of Anthurium andreanum plants

1-Total Chlorophyll content (SPAD)

Chemical analysis of fresh leaf samples has revealed that the total chlorophyll content (SPAD) was considerably affected by the addition of mineral fertilizer NPK (19:19:19). In both seasons, untreated (control) plants had lower mean chlorophyll content than plants receiving any level of NPK fertilizer (Table 5). The highest significant increase in the total chlorophyll content was obtained from the plants that treated with NPK at 15.0g / plant as compared with the control. Concerning bio-fertilizer treatments, a gradual increase was observed in total chlorophyllscontent with increasing bio-fertilizer concentration from low (2.0g / l) to high (6.0g / l) concentrations of ADY compared to the control. For the interaction, mineral fertilizer NPK in combination with different concentration of bio-fertilizer treatments (ADY) resulted the highest content of the total chlorophyll compared with the control in both seasons. Furthermore, the highest significant increase in the total chlorophyll content was obtained using 15.0 g / plant of NPK fertilizer plus bio- fertilizer at 6.0 g / l (ADY) as compared with the control.Such increase in photosynthetic pigments formation could be attributed to the role of yeast cytokinins delaying the aging of leaves by reducing the degradation of chlorophyll and enhancing the protein and RNA synthesis (Castelfranco and Beale 1983).These results were agreement with Hellal et al. (2011) on dill plants.

2- Leaf content of Nitrogen (N), Phosphorus (P) and Potassium (K)

Results obtained from leaves chemical analysis for their N, P and K content are listed in table 5. Statistical analysis of these results revealed that all fertilizer treatments significantly increased leaf N, P and K contents of Anthurium in both seasons.

Nitrogen content (%)

Data in table 5 indicated that all the studied treatments of NPK as well as ADY fertilizer resulted significant increase in the percentage of N in first and second seasons. Among NPK treatments, the highest percentages were recorded by 15.0 g / plant NPK (2.13 % and 2.14 %, respectively) Also among ADY treatments, the highest values were obtained by 6.0 g / l of ADY (2.16 and 2.19 % for the two seasons, respectively). For the interaction among the combination of NPK and ADY treatments, there was significant effect in the two seasons .The best result obtained with 15.0 g / plant of NPK + 6.0 g / l of ADY with N percentages of 2.59 and 2.61%for the first and the second seasons, respectively. These results were in agreement with Abd El-Azeem (2003) on Salvia officinalis

Phosphorus content (%)

Data in table 5 showed that there was significant effect of NPK treatment on phosphorus leaves content. The best result was obtained by 10.0 or 15.0 g / plant NPK. In addition, there was significant effect of ADY treatment on phosphorus percentage in leaves. There was significant effect between 2.0, 4.0 and 6.0 g / l of ADY and control .The interaction between mineral and bio-fertilizer showed significant differences in leaves phosphorus content. The highest values were recorded with 15.0 g / plant of NPK combined with bio-fertilizer at 6.0 g / l in the two growing seasons (0.57 and 0.59 %, respectively). While the followed values were obtained by 10, 0 g/ plant mineral fertilizer NPK and 4.0 g / l of ADY for both seasons (0.52 and 0.53%, respectively). However, the control treatment gave the lowest values of phosphorus % in both seasons (0.17 and 0.16 % respectively) Abd El-Azeem (2003) obtained the same results on Salvia officinalis plants.

Potassium content (%)

Data in table 5 showed that there was significant effect in the two growing seasons for potassium leaves content due to supplying plants by NPK fertilizer. The best result was obtained by treating the plants with 15.0 g/plant of NPK(2.65%). Moreover, there was significant effect of bio-fertilizer on potassium leaves content in the two seasons and the highest values were obtained using 6.0 g/ l of ADY (2.59and 2.60 respectively). The interactions among the NPK and ADY treatments were observed significant effects in both seasons.

The highest percentage was obtained using the high level of NPK fertilizer (15.0 g/ plant) with 6.0 g / l ADY recording values of 2.97% and 3.00 % in the first and second seasons, respectively. These results were in harmony with Salman (2006) on *Ocimum basilicum*, Khaled*et al.* (2014) on Majoram andAbd El-Azeem (2003)on *Salvia officinalis*.

Table 5. Means of total chlorophyll (SPAD), N, P and K content (%) in leaves of *Anthurium andreanum* cv "Bettine" plants as influenced by mineral, bio- fertilizer and their combination in the two seasons of 2010 and 2011

total chlorophyll

	(1st) season					(2nd) season				
NPK(A)	**Active Dry Yeast (ADY) (B) g / plant**									
g / plant	**0.00**	**2.00**	**4.00**	**6.00**	**mean**	**0.00**	**2.00**	**4.00**	**6.00**	**mean**
0.00	37.21	40.73	38.94	40.86	39.43	34.55	38.21	39.10	42.16	38.51
5.00	38.17	41.47	40.88	43.06	40.90	42.01	45.01	47.65	48.24	45.73
10.00	39.56	45.10	45.32	48.31	44.57	43.02	50.22	49.39	50.23	48.21
15.00	43.41	52.11	52.51	52.20	50.05	47.27	51.22	51.80	52.54	50.71
mean	39.59	44.41	44.85	46.11		41.71	46.16	46.98	48.29	
$LSD_{0.05}$	A = 2.52		B = 2.64	A×B = 3.11		A = 2.22		B = 2.70	A×B = 2.95	

N (%)

	(1st) season					(2nd) season				
NPK(A)	**Active Dry Yeast (ADY) (B) g / plant**									
g / plant	**0.00**	**2.00**	**4.00**	**6.00**	**mean**	**0.00**	**2.00**	**4.00**	**6.00**	**mean**
0.00	0.63	0.79	1.22	1.67	1.08	0.62	0.77	1.24	1.69	1.08
5.00	0.82	1.52	1.86	1.92	1.53	0.83	1.52	1.87	1.96	1.55
10.00	1.29	1.95	2.27	2.47	2.00	1.27	1.96	2.26	2.49	2.00
15.00	1.51	2.06	2.34	2.59	2.13	1.53	2.05	2.35	2.61	2.14
mean	1.06	1.58	1.92	2.16		1.06	1.58	1.93	2.19	
$LSD_{0.05}$	A= 0.13		B = 0.07	A×B = 0.19		A= 0.15		B = 0.08	A×B = 0.19	

P (%)

	(1st) season					(2nd) season				
NPK(A)	**Active Dry Yeast (ADY) (B) g / plant**									
g / plant	**0.00**	**2.00**	**4.00**	**6.00**	**mean**	**0.00**	**2.00**	**4.00**	**6.00**	**mean**
0.00	0.17	0.24	0.33	0.39	0.28	0.16	0.24	0.32	0.37	0.49
5.00	0.21	0.29	0.38	0.44	0.33	0.22	0.28	0.38	0.45	0.33
10.00	0.27	0.37	0.48	0.52	0.41	0.28	0.38	0.47	0.53	.041
15.00	0.31	0.41	0.50	0.57	0.48	0.31	0.43	0.52	0.59	0.46
mean	0.24	0.33	0.42	0.48		0.24	0.33	0.42	0.49	
$LSD_{0.05}$	A= 0.12		B = 0.07	A×B = 0.19		A= 0.14		B = 0.06	A×B = 0.18	

K (%)

	(1st) season					(2nd) season				
NPK(A)	**Active Dry Yeast (ADY) (B) g/ plant**									
g/ plant	**0.00**	**2.00**	**4.00**	**6.00**	**mean**	**0.00**	**2.00**	**4.00**	**6.00**	**mean**
0.00	1.70	1.83	1.98	2.29	1.96	1.72	1.82	2.01	2.27	1.96
5.00	1.90	2.29	2.42	2.52	2.28	1.92	2.31	2.44	2.53	2.30
10.00	2.17	2.44	2.53	2.59	2.43	2.20	2.42	2.54	2.61	2.44
15.00	2.31	2.49	2.82	2.97	2.65	2.30	2.48	2.81	3.00	2.65
mean	2.02	2.26	2.44	2.59		2.04	2.26	2.45	2.60	
$LSD_{0.05}$	A= 0.16		B = 0.10	A×B = 0.23		A = 0.15		B = 0.09	A×B = 0.19	

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 probability level.

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الملخص العربي

تأثير الأسمدة المعدنية والحيوية على النمو الخضري والزهري لنباتات الأنتوريم المزهر تحت ظروف الصوب

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أجريت هذه الدراسة في موسمي 2010 و2011 في مشتل جامعة الاسكندرية على نباتات الأنتوريم المزهر صنف "Bettine" النامي تحت ظروف الصوب البلاستيكية لدراسة تأثير أربع معدلات من السماد المعدني المركب ١٩:١٩:١٩ بمعدل ٠,٠، ٥,٠، ١٠,٠ و١٥,٠ جم / نبات وأربع تركيزات من السماد الحيوي (الخميرة الجافة النشطة) بمعدل ٠,٠ ، ٢,٠، ٤,٠ و ٦,٠ جم/ لتر وتأثيرهم المشترك على صفات النمو الخضري والزهري والمحتوى الكلى للاوراق من الكلوروفيل وعناصر النتروجين والفوسفور والبوتاسيوم. وقد أظهرت نتائج الدراسة أنه لم تكن هناك فروقا معنوية بين استخدام السماد المعدنى NPK بمعدل ١٠,٠أو ١٥,٠ جم/ نبات شهريا وكذلك اضافة السماد الحيوى بمعدل ٤,٠ أو ٦,٠ جم/ لتر شهريا منفردا. ونتج عن استخدام أي من تلك المعدلات السابقة أعلى القيم معنويه وذلك لصفات النمو الخضرى(إرتفاع النبات، عدد الأوراق على النبات، المساحة الورقية والوزن الجاف للأوراق) والزهري(عدد الأزهار على النبات والوزن الجاف لها) وكذلك زيادة معنوية في المحتوى الكلى للأوراق من الكلوروفيل.

وتحققت أعلى زيادة معنوية في محتوى الأوراق من عناصر النتروجين والفوسفور والبوتاسيوم عند استخدام معدل ١٠,٠ جم / نبات بالسماد معدنى NPK مع إضافة السماد الحيوي بتركيز أي من تركيزى ٤,٠ أو ٦,٠ جم/ لتر وذلك خلال موسمى النمو.