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EFFECT OF NITROGEN SOURCE, RATIO OF AMMONIUM TO NITRATE AND pH VALUE ON GROWTH CHARACTERS OF *Syngonium podophyllum Pl* SCHOTT PLANTS

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ABSTRACT

This study was carried out at Horticulture Research Institute, Giza and Ornamental Horticulture Department, Faculty of Agriculture, Cairo University during the two years of 2004 and 2005. The aim of this work is to study the effect of nitrogen source, ratio of ammonium to nitrate and pH values on growth characters of *Syngonium podophyllum*. The plants were treated every two weeks with ammonium sulphate and calcium nitrate at rate and ratio of (0, 100:0, 75:25, 50:50, 25:75 and 0:100). The results showed that treated *Syngonium* plants with ammonium sulphate: calcium nitrate at the ratio of 25:75 caused in the best vegetative growth such as plant height and number of leaves. Treatment of calcium nitrate without ammonium sulphate led to the increase in fresh and dry weights of vegetative growth and better results were obtained at pH 6 in comparison to pH 5.

INTRODUCTION

Syngonium podophyllum Schott (syn. *Nephthytis triphylla*) which belongs to family Araceae is an ornamental tender foliage plant native to Mexico and to Brazil. Juvenile leaves, 7-14 cm (3-5½ in) long are ovate with heart-shaped bases; when mature they are arrow-shaped, later pedate, each with 5-11 elliptic leaflets, the largest leaflet 16-40 cm(6-16 in) long; all are dark green above, sometimes with grey-green markings, paler beneath. (Brickell, 1998).

This is a vining type plant that is prefect for covering ground or for hanging in a basket.

The production of high quality foliage plants need an efficient knowledge of their requirements which vary greatly among species and varieties. Besides environmental conditions, an appropriate fertilization programme is essential for producing high quality plants. Numerous studies have shown that nitrogen is generally considered as the most important nutrient for ornamental foliage plants.

The source of nitrogen also has an influence on certain foliage plants. Ammonium nitrogen was found to increase plant height of *Dieffenbachia maculate* cv. Camille compared with urea nitrogen (Conover and Poole, 1986). Ammonium nitrate increased the plant height and number of leaves/plant of *Ficus benjamina* (Saleh *et al.*, 1998).

The balance between ammonium and nitrate forms has an effect on some indoor plants. Agloanema and philodendron required high NH_4-N and low NO_3-N for producing good quality plants (Wiedenfeld and Cox, 1988). On

the other hand, *Chamaedora elegans* and *Peperomia obtusifolia* were not affected by the N source (Conover and Poole, 1986)

Hydrogen Ion concentration in growing media (pH of medium) of indoor plants has an effect on their growth. Generally a slightly acid medium (5 to 6.5 pH) is favourable for most foliage plants species. In certain species a decrease in pH value to 4.5 showed to be more favourable such in case of some foliage plants (Beel and Schelstrate, 1987). However a high pH value (8) or low pH value (4) were reported to produce an inhibitory effect on root growth of some plants (Zieslin and Snir, 1989).

The aim of this study was to investigate the effect of nitrogen source, ratio of ammonium to nitrate and pH level on growth characters of *Syngonium podophyllum*.

MATERIALS AND METHODS

This study was carried out at the Dept. of Ornamental Horticulture, Fac. of Agric., Cairo Univ. during the two seasons, 2004 and 2005; a part of the experimental work has been carried out at the Hort. Rese. Inst., Minsitry of Agriculture, Giza.

The objective of the study was to investigate the effect of nitrogen source, ratio of ammonium to nitrate and pH value on growth characters of *Syngonium podophyllum* Schott (Syn. *Nephthytis triphylla*).

Procedure:-

Uniform tip cuttings of syngonium (appro. 6 cm long) were prepared, a pair of leaves was kept on each cutting, and the cuttings were planted in a rooting medium composed of peatmoss and sand (1:1 v/v) and were kept in the greenhouse for two weeks.

Uniform rooted cuttings of 8 cm long, having 2 to 3 leaves and an average root length of 3-4 cm were transplanted in 14-cm pots filled with clean fine sand (1850 g sand / pot). The plants were supplied regularly with Hoagland solution (Table A). pH of solution was adjusted at 5 and 6.

Table (A): The composition of the stock solution used in this investigation.

Composition	Stock solution	Concentration
$Mg\ SO_4.7H_2O$	24.6 gm /100 ml	2 ml/L.
$Ca(NO_3)_2.\ 4\ H_2O$	23.6 gm /100 ml	5 ml/L.
$K\ H_2\ PO_4$	13.6 gm /100 ml	1 ml/L.
$K\ (NO_3)$	10.1 gm /100 ml	5 ml/L.
H_3BO_3	2.86 gm / L	1 ml/L.
$MnCl.\ 4\ H_2O$	0.22 gm / L	1 ml/L.
$Cu\ SO_4.\ 5\ H_2O$	0.09 gm / L	1 ml/L.
$(NH_4)_2Mo\ O_3$	0.01 gm / L	1 ml/L.
Fe-EDTA	---------	5 mg /L.

Nitrogen fertilization treatments started after two weeks from planting; and nitrogen was applied every 10 days in two forms: ammonium sulphate ($(NH_4)_2\ SO_4$) and calcium nitrate ($Ca(NO_3)_2.\ H_2O$) at various ratios as follows:-

In view of the present results it seems that N fertilization using relatively high levels of NO_3 at pH6 is favourable for increasing plant height of *Syngonium podophyllum* Schott. The results are in agreement with previous ones on *Spathiphyllium* cv. Sensation (Yeh and Lin, 1999).

Number of leaves/plant:

At the first stage of growth, the application of ammonium : nitrate at a ratio of 75:25 increased significantly the number of leaves (5.34 leaf/plant) compared with the control and with other N treatments during the first seasons; while in the second season the reverse ratio i.e. 25:75 produced the greatest effect on increasing leaf number (6.63). Growing the plants at pH 6 significantly increased the number of leaves in both seasons compared with plants grown at pH 5 (Table2).

At the second stage of growth, in both seasons all the fertilizer treatments had a significant effect on increasing the number of leaves compared with the control. However the greatest values of leaf number (9.67 and 10.40 leaf/plant in the first and second seasons, respectively) were obtained by applying ammonium and nitrate at ratio 25 :75; also the ratio of 75:25 had a strong effect in the two seasons compared with the other treatments. On the other hand, unfertilized plants produced the lowest number of leaves in both seasons. The pH value of the medium at 6 showed to be more favourable for increasing the number of leaves than pH 5 during the second season only, but in the first season no difference was observed.

At the third stage of growth, all the nitrogen treatments increased the number of leaves compared with the control. However, the application of NH_4 :NO_3 at either 75:25 or 25:75 was the most effective treatment for increasing the number of leaves compared with the control and the other treatments during the first season; while the ratio of 25:75 NH_4 to NO_3 was the most effective in the second season. The pH 6 produced a significant increase in the number of leaves compared to the pH 5 in the second season only.

In view of the presented results it might be concluded that nitrogen fertilization was beneficial for increasing leaf number of syngonium especially at the second and third stage of growth; moreover, the ratio of 25 ammonium : 75 nitrate showed to be the most favourable treatment.

In regarded to medium pH, adjusting the pH at 6 showed to be more favourable than pH 5 during the early stage of growth in both seasons; whereas at the second and third stages of growth the response to pH variation differed between the two seasons. Similar results were obtained by Saleh *et al.*, (1998) on *Ficus benjaminia*, they found that, the highest rate of ammonium nitrate had the greatest effect on the number of leaves/plant.

Number of roots/plant:-

At the first stage of growth, all nitrogen treatments increased significantly the number of roots compared with the control in both the first and second seasons as shown in Table (3). The most effective N treatment which produced the greatest increase in root number (10.17 and 10.76 in the first and second seasons, respectively) was nitrogen applied as nitrate without ammonium. Also, the application of NO_3 at high ratio (75:25 NO_3^- :NH_4^+) was highly effective in the second season.

Table 2: Number of leaves/plant of *Syngonum podophyllum* in response to nitrogen fertilization and pH value

First season 2005

Nitrogen treatment (A)	Stage I* pH value (B) 5	6	Mean	Stage II** pH value (B) 5	6	Mean	Stage III*** pH value (B) 5	6	Mean
Control	4.00e	5.33ab	4.67c	7.33h	7.67g	7.50d	10.33h	11.62g	10.98e
$NH_4:NO_3$ 100:0	4.33de	5.00bc	4.67c	8.00f	8.33e	8.17c	13.00d	12.00f	12.50c
$NH_4:NO_3$ 75:25	5.00bc	5.67a	5.34a	9.67b	8.67d	9.17b	14.48a	12.67e	13.57a
$NH_4:NO_3$ 50:50	4.33de	4.00e	4.17d	8.67d	8.00f	8.34c	12.67e	13.00d	12.84b
$NH_4:NO_3$ 25:75	4.67cd	5.33ab	5.00b	10.00a	9.33c	9.67a	14.00b	13.33c	13.66a
$NH_4:NO_3$ 0:100	4.33de	4.33de	4.33d	7.67g	8.67d	8.17c	11.67g	12.00f	11.84d
Mean	4.44b	4.94a	----	8.56a	8.45a	-----	12.69a	12.44b	-----
LSD at 5% A	0.29			0.23			0.21		
LSD at 5% B	0.17			0.13			0.12		
LSD at 5% AB	0.41			0.33			0.29		

Second season 2006

Control	5.00f	5.75de	5.38c	8.33f	8.75e	8.54d	12.25i	12.75h	12.50e
$NH_4:NO_3$ 100:0	5.50e	6.33b	5.92b	9.10d	10.50b	9.80b	13.00g	14.00d	13.50d
$NH_4:NO_3$ 75:25	6.00cd	5.50e	5.75b	9.75c	10.67b	10.21a	13.75e	15.75b	14.75b
$NH_4:NO_3$ 50:50	4.75f	6.25bc	5.50c	7.25g	11.23a	9.24c	14.00d	15.25c	14.63b
$NH_4:NO_3$ 25:75	6.25bc	7.00a	6.63a	10.00c	10.80b	10.40a	15.25c	16.00a	15.63a
$NH_4:NO_3$ 0:100	5.00f	6.75a	5.88b	9.67c	9.25d	9.46c	13.50f	15.30c	14.40c
Mean	5.42b	6.26a	-----	9.02b	10.20a	-----	13.63b	14.84a	----
LSD at 5% A	0.23			0.24			0.17		
LSD at 5% B	0.13			0.14			0.10		
LSD at 5% AB	0.32			0.35			0.24		

* 21- days old

** 63-days old

*** 105-days old

In view of the present results it seems that N fertilization using relatively high levels of NO_3 at pH6 is favourable for increasing plant height of *Syngonium podophyllum* Schott. The results are in agreement with previous ones on *Spathiphyllium* cv. Sensation (Yeh and Lin, 1999).

Number of leaves/plant:

At the first stage of growth, the application of ammonium : nitrate at a ratio of 75:25 increased significantly the number of leaves (5.34 leaf/plant) compared with the control and with other N treatments during the first seasons; while in the second season the reverse ratio i.e. 25:75 produced the greatest effect on increasing leaf number (6.63). Growing the plants at pH 6 significantly increased the number of leaves in both seasons compared with plants grown at pH 5 (Table2).

At the second stage of growth, in both seasons all the fertilizer treatments had a significant effect on increasing the number of leaves compared with the control. However the greatest values of leaf number (9.67 and 10.40 leaf/plant in the first and second seasons, respectively) were obtained by applying ammonium and nitrate at ratio 25 :75; also the ratio of 75:25 had a strong effect in the two seasons compared with the other treatments. On the other hand, unfertilized plants produced the lowest number of leaves in both seasons. The pH value of the medium at 6 showed to be more favourable for increasing the number of leaves than pH 5 during the second season only, but in the first season no difference was observed.

At the third stage of growth, all the nitrogen treatments increased the number of leaves compared with the control. However, the application of NH_4 :NO_3 at either 75:25 or 25:75 was the most effective treatment for increasing the number of leaves compared with the control and the other treatments during the first season; while the ratio of 25:75 NH_4 to NO_3 was the most effective in the second season. The pH 6 produced a significant increase in the number of leaves compared to the pH 5 in the second season only.

In view of the presented results it might be concluded that nitrogen fertilization was beneficial for increasing leaf number of syngonium especially at the second and third stage of growth; moreover, the ratio of 25 ammonium : 75 nitrate showed to be the most favourable treatment.

In regarded to medium pH, adjusting the pH at 6 showed to be more favourable than pH 5 during the early stage of growth in both seasons; whereas at the second and third stages of growth the response to pH variation differed between the two seasons. Similar results were obtained by Saleh *et al.*, (1998) on *Ficus benjaminia*, they found that, the highest rate of ammonium nitrate had the greatest effect on the number of leaves/plant.

Number of roots/plant:-

At the first stage of growth, all nitrogen treatments increased significantly the number of roots compared with the control in both the first and second seasons as shown in Table (3). The most effective N treatment which produced the greatest increase in root number (10.17 and 10.76 in the first and second seasons, respectively) was nitrogen applied as nitrate without ammonium. Also, the application of NO_3 at high ratio (75:25 NO_3^- :NH_4^+) was highly effective in the second season.

Table 2: Number of leaves/plant of *Syngonium podophyllum* in response to nitrogen fertilization and pH value

First season 2005

Nitrogen treatment (A)	Stage I* pH value (B) 5	6	Mean	Stage II** pH value (B) 5	6	Mean	Stage III*** pH value (B) 5	6	Mean
Control	4.00e	5.33ab	4.67c	7.33h	7.67g	7.50d	10.33h	11.62g	10.98e
NH_4:$NO_3$100:0	4.33de	5.00bc	4.67c	8.00f	8.33e	8.17c	13.00d	12.00f	12.50c
NH_4:$NO_3$75:25	5.00bc	5.67a	5.34a	9.67b	8.67d	9.17b	14.48a	12.67e	13.57a
NH_4:$NO_3$50:50	4.33de	4.00e	4.17d	8.67d	8.00f	8.34c	12.67e	13.00d	12.84b
NH_4:$NO_3$25:75	4.67cd	5.33ab	5.00b	10.00a	9.33c	9.67a	14.00b	13.33c	13.66a
NH_4:$NO_3$0:100	4.33de	4.33de	4.33d	7.67g	8.67d	8.17c	11.67g	12.00f	11.84d
Mean	4.44b	4.94a	----	8.56a	8.45a	-----	12.69a	12.44b	-----
LSD at 5% A	0.29			0.23			0.21		
LSD at 5% B	0.17			0.13			0.12		
LSD at 5% AB	0.41			0.33			0.29		

Second season 2006

Control	5.00f	5.75de	5.38c	8.33f	8.75e	8.54d	12.25i	12.75h	12.50e
NH_4:$NO_3$100:0	5.50e	6.33b	5.92b	9.10d	10.50b	9.80b	13.00g	14.00d	13.50d
NH_4:$NO_3$75:25	6.00cd	5.50e	5.75b	9.75c	10.67b	10.21a	13.75e	15.75b	14.75b
NH_4:$NO_3$50:50	4.75f	6.25bc	5.50c	7.25g	11.23a	9.24c	14.00d	15.25c	14.63b
NH_4:$NO_3$25:75	6.25bc	7.00a	6.63a	10.00c	10.80b	10.40a	15.25c	16.00a	15.63a
NH_4:$NO_3$0:100	5.00f	6.75a	5.88b	9.67c	9.25d	9.46c	13.50f	15.30c	14.40c
Mean	5.42b	6.26a	-----	9.02b	10.20a	-----	13.63b	14.84a	----
LSD at 5% A	0.23			0.24			0.17		
LSD at 5% B	0.13			0.14			0.10		
LSD at 5% AB	0.32			0.35			0.24		

* 21- days old

** 63-days old

*** 105-days old

Table 3: Number of roots/plant of *Syngonum podophyllum* in response to nitrogen fertilization and pH value

First season 2005

Nitrogen treatment (A)	Stage I* pH value (B) 5	6	Mean	Stage II** pH value (B) 5	6	Mean	Stage III*** pH value (B) 5	6	Mean
Control	4.93e	5.11e	5.02d	10.22g	11.69f	10.96d	16.00i	17.67gh	16.84e
NH_4:$NO_3$100:0	7.00d	8.33bc	7.67c	13.00e	14.33d	13.67c	18.10g	21.00c	19.55c
NH_4:$NO_3$75:25	9.67a	8.25bc	8.96b	14.30d	13.67de	13.99c	20.03d	19.15ef	19.59c
NH_4:$NO_3$50:50	7.67cd	8.67b	8.17c	16.80b	18.33a	17.57a	19.33ef	24.33b	21.83b
NH_4:$NO_3$25:75	8.67b	7.33d	8.00c	13.60de	14.33d	13.97c	17.07h	19.07f	18.07d
NH_4:$NO_3$0:100	10.00a	10.33a	10.17a	15.33c	15.67c	15.50b	19.73de	25.10a	22.42a
Mean	7.99a	8.00a	----	13.88b	14.67a	----	18.38b	21.05a	----
LSD at 5%	A	0.64		A	0.70		A	0.45	
	B	0.37		B	0.40		B	0.26	
	AB	0.90		AB	0.99		AB	0.64	

Second season 2006

Control	5.50g	6.25g	5.88d	11.25f	11.76ef	11.51c	15.25f	16.50f	15.88d
NH_4:$NO_3$100:0	8.25f	9.00def	8.63c	14.50cd	17.20a	15.85a	23.00c	25.00b	24.00a
NH_4:$NO_3$75:25	8.67ef	9.75cd	9.21c	12.25e	16.50a	14.38b	21.76cd	26.50ab	24.13a
NH_4:$NO_3$50:50	9.50cde	10.25bc	9.88b	15.33bc	16.25ab	15.79a	22.10c	23.00c	22.55b
NH_4:$NO_3$25:75	10.00bc	11.50a	10.75a	14.62cd	14.10d	14.36b	20.25d	27.76a	24.01a
NH_4:$NO_3$0:100	10.75ab	10.76ab	10.76a	12.25e	15.25c	13.75b	18.50e	22.25c	20.38c
Mean	8.78b	9.59a	----	13.37b	15.18a	----	20.14b	23.50a	----
LSD at 5%	A	0.60		A	0.70		A	1.07	
	B	0.35		B	0.40		B	0.62	
	AB	0.85		AB	0.99		AB	1.51	

*** 21-days old** **** 63-days old** ***** 105- days old**

No difference was observed with varying the pH of the medium in the first season; while increasing the pH value to 6 was associated with a significant increase in root number during the second season.

At the second stage of growth, all treatments increased the number of roots/plant compared with the control. The treatment in which NH_4 and NO_3 were applied at a ratio of 50:50 showed to be the most favourable for increasing root number than the other nitrogen treatments. The increase in pH value from 5 to 6 was associated with a significant increase in root number in the first and second seasons.

At the last stage of growth, all nitrogen treatments increased the number of roots (range from 18.7 to 22.42 roots/plant) compared with the control (16.84 root/plant) in the first seasons; a similar effect was occurred as well in the second season. Moreover, the effectiveness of treatments applied varied from the first to the second season. The response to the medium pH was similar to that observed in the previous stage of growth.

In view of the presented results it might be concluded that nitrogen fertilization was beneficial for increasing root number of syngonium especially at the second and third stages of growth; moreover the ratio of ammonium without nitrate showed to be the most favourable treatment.

Root length (cm):

At the earliest stage of growth, in the first season treating the plants with ammonium without nitrate (100:0) produced the greatest increas in root length compared with the control; and the other treatments. On the other hand, different response was observed in this season, the treatment with nitrate without ammonium (100:0) produced the greatest increase in root length, as well as the treatment with NH_4 : NO_3 at ratio 50:50, compared with the control and the other treatments. The response to the pH value of the medium differed also in the two seasons(Table 4).

At the second stage of growth, all treatments resulted in a significant increase in root length compared with the control in the two seasons. The pH 5 increased the root length than pH 6, in the first season. Whereas the reverse was occurred in the second season.

At the last stage of growth, in the first season the treatment with NH_4: NO_3 at a ratio of 50:50 produced the longest the root (45.55 cm) as compared with the control and the other treatments (range from 31.31 to 42.40 cm); while in the second season the most effective treatment was ammonium to nitrate of ratio 25:75. the response to pH variation was similar to the observed to the second season.

In view of the present results it seems that N fertilization using ammonium to nitrate at the ratio of 50:50 and pH 6 at the second stage in the second season was the best. Several workers reported that the most of foliage plants grow best at pH between 6-6.5 (Lutt, 1984).

Fresh weight of shoot (g):-

At the first stage of growth, all treatments increased the fresh weight of shoot as compared with the control, in both seasons. Among treatments ammonium applied without nitrate was showed to be the most effective in the first seasons; in contrast the reverse was occurred in the second season.

Table 4: Root length (cm) of *Syngonum podophyllum* in response to nitrogen fertilization and pH value.

First season 2005

Nitrogen treatment (A)	Stage I* pH value (B) 5	Stage I* pH value (B) 6	Stage I* Mean	Stage II** pH value(B) 5	Stage II** pH value(B) 6	Stage II** Mean	Stage III*** pH value(B) 5	Stage III*** pH value(B) 6	Stage III*** Mean
Control	11.41ef	10.82f	11.12c	21.46fg	22.07fg	21.77d	31.87e	32.38de	32.13de
NH_4:$NO_3$100:0	14.17bc	17.59a	15.88a	22.72ef	27.91d	25.32c	33.07de	35.33d	34.20d
NH_4:$NO_3$75:25	15.38b	13.29cd	14.34b	35.87b	20.12g	28.00b	45.62b	34.81de	40.22c
NH_4:$NO_3$50:50	17.42a	11.24ef	14.33b	29.37d	38.53a	33.95a	41.00c	50.10a	45.55a
NH_4:$NO_3$25:75	10.94f	10.16f	10.55cd	24.37e	23.52ef	23.95c	33.71de	28.91f	31.31e
NH_4:$NO_3$0:100	12.42de	7.38g	9.90d	36.43ab	33.17c	34.80a	45.08b	39.72c	42.40b
Mean	13.62a	11.75b	----	28.37a	27.55b	----	38.39a	36.88b	----
LSD at 5% A		1.04			1.51			2.09	
LSD at 5% B		0.60			0.87			1.20	
LSD at 5% AB		1.47			2.13			2.95	

Second season 2006

Control	12.04g	13.50f	12.77d	23.50i	25.36hi	24.43d	34.71f	36.53e	35.62e
NH_4:$NO_3$100:0	14.21f	16.32de	15.27c	27.82fg	29.24ef	28.53c	36.18e	40.00cd	38.09d
NH_4:$NO_3$75:25	16.03e	17.52cd	16.78b	31.18cd	30.15de	30.67b	39.78cd	42.50b	41.14b
NH_4:$NO_3$50:50	19.26b	18.20bc	18.73a	34.27b	32.28c	33.28a	40.60c	39.18d	39.89c
NH_4:$NO_3$25:75	10.84g	14.61f	12.73d	26.32gh	38.26a	32.29a	36.19e	48.20a	42.20a
NH_4:$NO_3$0:100	14.50f	21.34a	17.92a	24.81hi	34.73b	29.77bc	34.26f	42.11b	38.19d
Mean	14.48b	16.92a	----	27.98b	31.67a	----	36.95b	41.42a	----
LSD at 5% A		0.95			1.34			0.78	
LSD at 5% B		0.55			0.77			0.45	
LSD at 5% AB		1.35			1.89			1.11	

* 21-days old

** 63- days old

*** 105- days old

Table 5: Fresh weight of shoot (gm) of *Syngonum podophyllum* in response to nitrogen fertilization and pH value

First season 2005

Nitrogen treatment (A)	Stage I* pH value (B) 5	6	Mean	Stage II** pH value (B) 5	6	Mean	Stage III*** pH value (B) 5	6	Mean
Control	3.03d	3.79c	3.41c	8.45h	9.06g	8.76d	12.27i	13.89h	13.08e
NH_4:$NO_3$100:0	3.90c	5.74a	4.82a	10.74d	9.99f	10.36c	17.79f	18.32e	18.06d
NH_4:$NO_3$75:25	4.99b	3.81c	4.40b	9.84f	11.86c	10.85b	15.72g	23.44b	19.58c
NH_4:$NO_3$50:50	3.97c	5.15b	4.56ab	7.77i	12.98b	10.38c	15.76g	27.19a	21.48b
NH_4:$NO_3$25:75	3.76c	4.93b	4.35b	10.13ef	10.45de	10.29c	20.26d	22.29c	21.27b
NH_4:$NO_3$0:100	3.74c	4.69b	4.22b	10.54de	13.92a	12.23a	22.17c	26.87a	24.52a
Mean	3.90b	4.69a	----	9.58b	11.38a	----	17.33b	22.00a	---
LSD at 5% A		0.37			0.31			0.31	
LSD at 5% B		0.21			0.18			0.18	
LSD at 5% AB		0.53			0.44			0.44	

Second season 2006

Control	3.63f	4.71e	4.17e	9.41g	10.98f	10.19c	18.56i	22.47g	20.51f
NH_4:$NO_3$100:0	4.78e	6.92b	5.85cd	11.81de	13.86ab	12.84b	21.84h	24.64e	23.24e
NH_4:$NO_3$75:25	5.60d	5.58d	5.59d	12.63c	12.41cd	12.52b	21.70h	25.44d	23.57d
NH_4:$NO_3$50:50	5.53d	6.81b	6.17bc	12.12cde	13.65b	12.89b	21.80h	28.34b	25.07b
NH_4:$NO_3$25:75	6.28c	6.74bc	6.51b	11.63ef	14.09ab	12.86b	21.84h	26.75c	24.30c
NH_4:$NO_3$0:100	6.43bc	7.54a	6.99a	12.57c	14.57a	13.57a	23.53f	30.25a	26.89a
Mean	5.38b	6.38a	----	11.69b	13.26a	----	21.55b	26.32a	----
LSD at 5% A		0.35			0.51			0.26	
LSD at 5% B		0.20			0.29			0.15	
LSD at 5% AB		0.49			0.72			0.37	

* 21-days old

** 63-days old

*** 105- days old

The response to change in medium pH was similar in both seasons, as pH 6 increased significantly fresh weight of shoot in comparison with pH 5(Table5).

At the second stage of growth, all nitrogen treatments increased significantly the fresh weight of shoot compared with the control in both seasons. Among treatments, the most effective one was ammonium to nitrate at ratio of 0:100 which increased significantly the fresh weight of shoot (12.23 and 13.57 g, in the first and second seasons, respectively). Increasing the medium pH from 5 to 6 produced significantly an increase in fresh weight of shoot in both seasons.

At third stage of growth, the response to nitrogen treatment and to pH value of the media followed the same trend observed at the second stage.

In view of the present results it seems that N fertilization using relatively high levels of NO_3 at pH 6 is favourable for increasing fresh weight of shoot of *Syngonium podophyllum* at the second and third stage of growth.

Dry weight of shoot (g):

At the first stage of growth, the various N treatment applied produced significantly an increase in the dry weight of shoot as compared with the control in both the first and second seasons. The weight of shoots was increased significantly at pH 6 compared with that resulting at pH 5 in the two seasons(Table6).

At the second stage of growth. all nitrogen treatments increased significantly the dry weight of shoot compared with the control in both seasons and certain treatments were more effective than others, such as ammonium to nitrate at a ratio of 0:100 in the first and second seasons; and ammonium to nitrate at 50:50 in the second season only. The pH 6 produced the more dry weight of shoot compared with pH 5, in the two seasons.

At the third stage of growth, the results obtained showed that the effect nitrogen treatments followed the same trend of observed at the second stage. Moreover, the response to pH change from 5 to 6 was also similar to that recorded at two previous stages.

In view of the presented results in might be concluded that nitrogen fertilization was beneficial for increasing dry weight of shoot of syngonium especially at the second and third stages of growth; moreover, the ratio of high level nitrate showed to be the most favourable treatment. The results are in a agreement with previous ones on poinsettia (Gaffiney *et al.*, 1982).

Fresh and dry weight of roots (g):-

At the first stage of growth, the most effective treatment for increasing fresh weight of roots in both seasons was nitrate to ammonium at a ratio of 100:0. the pH level at 6 produced the heaviest fresh weight of roots compared with pH 5, in two seasons(Table 7and8).

At the first stage of growth, the response to nitrogen treatment and to pH of the media on dry weight of roots followed the same trend observed for the fresh weight of roots at the first stage.

At the second stage of growth, in both seasons nitrogen fertilization treatments produced significantly an increase in the fresh weight of roots compared with the control.

Table 6: Dry weight of shoot (gm) of *Syngonum podophyllum* in response to nitrogen fertilization and pH value

First season 2005

Nitrogen treatment (A)	Stage I* pH value (B) 5	6	Mean	Stage II** pH value (B) 5	6	Mean	Stage III*** pH value (B) 5	6	Mean
Control	0.31g	0.61de	0.46d	1.13i	1.40h	1.27d	2.94h	3.43g	3.18d
$NH_4:NO_3$ 100:0	0.65cd	0.91a	0.78a	1.66efg	1.48gh	1.57c	5.01bc	4.56de	4.79c
$NH_4:NO_3$ 75:25	0.71bc	0.89a	0.80a	1.73def	2.54c	2.14b	4.36ef	5.27b	4.82c
$NH_4:NO_3$ 50:50	0.65cd	0.78b	0.71b	1.54fgh	2.87b	2.21b	4.10f	6.68a	5.39b
$NH_4:NO_3$ 25:75	0.51f	0.69bcd	0.60c	1.66efg	1.90d	1.78c	4.73cd	5.13b	4.93c
$NH_4:NO_3$ 0:100	0.55ef	0.61de	0.58c	1.74de	3.55a	2.65a	4.97bc	6.78a	5.88a
Mean	0.56b	0.75a	----	1.58b	2.29a	---	4.35b	5.31a	----
LSD at 5% A		0.06			0.14			0.27	
LSD at 5% B		0.04			0.08			0.15	
LSD at 5% AB		0.09			0.20			0.36	

Second season

Control	0.50e	1.14d	0.82d	4.80e	5.10e	4.95c	10.10h	11.82g	10.96e
$NH_4:NO_3$ 100:0	1.13d	2.19b	1.66c	5.78d	7.81b	6.97b	12.33fg	14.34d	13.34d
$NH_4:NO_3$ 75:25	1.35cd	1.53c	1.44c	6.71c	6.99c	6.85b	12.27fg	14.82d	13.55d
$NH_4:NO_3$ 50:50	1.48c	2.77a	2.13b	6.59c	7.87ab	7.23a	12.59f	17.19b	14.89b
$NH_4:NO_3$ 25:75	2.00b	2.19b	2.10b	5.71d	8.14ab	6.93ab	12.67f	15.92c	14.30c
$NH_4:NO_3$ 0:100	2.09b	2.93a	2.57a	6.12d	8.29a	7.21a	13.43e	19.32a	16.38a
Mean	1.43b	2.12a	----	5.95b	7.37a	----	12.23b	15.57a	----
LSD at 5% A		0.24			0.31			0.38	
LSD at 5% B		0.14			0,18			0.22	
LSD at 5% AB		0.34			0.44			0.53	

*** 21-days old** **** 63-days old** ***** 105-days old**

The response to change in medium pH was similar in both seasons, as pH 6 increased significantly fresh weight of shoot in comparison with pH 5(Table5).

At the second stage of growth, all nitrogen treatments increased significantly the fresh weight of shoot compared with the control in both seasons. Among treatments, the most effective one was ammonium to nitrate at ratio of 0:100 which increased significantly the fresh weight of shoot (12.23 and 13.57 g, in the first and second seasons, respectively). Increasing the medium pH from 5 to 6 produced significantly an increase in fresh weight of shoot in both seasons.

At third stage of growth, the response to nitrogen treatment and to pH value of the media followed the same trend observed at the second stage.

In view of the present results it seems that N fertilization using relatively high levels of NO_3 at pH 6 is favourable for increasing fresh weight of shoot of *Syngonium podophyllum* at the second and third stage of growth.

Dry weight of shoot (g):

At the first stage of growth, the various N treatment applied produced significantly an increase in the dry weight of shoot as compared with the control in both the first and second seasons. The weight of shoots was increased significantly at pH 6 compared with that resulting at pH 5 in the two seasons(Table6).

At the second stage of growth. all nitrogen treatments increased significantly the dry weight of shoot compared with the control in both seasons and certain treatments were more effective than others, such as ammonium to nitrate at a ratio of 0:100 in the first and second seasons; and ammonium to nitrate at 50:50 in the second season only. The pH 6 produced the more dry weight of shoot compared with pH 5, in the two seasons.

At the third stage of growth, the results obtained showed that the effect nitrogen treatments followed the same trend of observed at the second stage. Moreover, the response to pH change from 5 to 6 was also similar to that recorded at two previous stages.

In view of the presented results in might be concluded that nitrogen fertilization was beneficial for increasing dry weight of shoot of syngonium especially at the second and third stages of growth; moreover, the ratio of high level nitrate showed to be the most favourable treatment. The results are in a agreement with previous ones on poinsettia (Gaffiney *et al.*, 1982).

Fresh and dry weight of roots (g):-

At the first stage of growth, the most effective treatment for increasing fresh weight of roots in both seasons was nitrate to ammonium at a ratio of 100:0. the pH level at 6 produced the heaviest fresh weight of roots compared with pH 5, in two seasons(Table 7and8).

At the first stage of growth, the response to nitrogen treatment and to pH of the media on dry weight of roots followed the same trend observed for the fresh weight of roots at the first stage.

At the second stage of growth, in both seasons nitrogen fertilization treatments produced significantly an increase in the fresh weight of roots compared with the control.

Table 6: Dry weight of shoot (gm) of *Syngonum podophyllum* in response to nitrogen fertilization and pH value

First season 2005

Nitrogen treatment (A)	Stage I* pH value (B) 5	6	Mean	Stage II** pH value (B) 5	6	Mean	Stage III*** pH value (B) 5	6	Mean
Control	0.31g	0.61de	0.46d	1.13i	1.40h	1.27d	2.94h	3.43g	3.18d
NH_4:$NO_3$100:0	0.65cd	0.91a	0.78a	1.66efg	1.48gh	1.57c	5.01bc	4.56de	4.79c
NH_4:$NO_3$75:25	0.71bc	0.89a	0.80a	1.73def	2.54c	2.14b	4.36ef	5.27b	4.82c
NH_4:$NO_3$50:50	0.65cd	0.78b	0.71b	1.54fgh	2.87b	2.21b	4.10f	6.68a	5.39b
NH_4:$NO_3$25:75	0.51f	0.69bcd	0.60c	1.66efg	1.90d	1.78c	4.73cd	5.13b	4.93c
NH_4:$NO_3$0:100	0.55ef	0.61de	0.58c	1.74de	3.55a	2.65a	4.97bc	6.78a	5.88a
Mean	0.56b	0.75a	----	1.58b	2.29a	---	4.35b	5.31a	----
LSD at 5% A		0.06			0.14			0.27	
LSD at 5% B		0.04			0.08			0.15	
LSD at 5% AB		0.09			0.20			0.36	
Second season				**Second season**			**Second season**		
Control	0.50e	1.14d	0.82d	4.80e	5.10e	4.95c	10.10h	11.82g	10.96e
NH_4:$NO_3$100:0	1.13d	2.19b	1.66c	5.78d	7.81b	6.97b	12.33fg	14.34d	13.34d
NH_4:$NO_3$75:25	1.35cd	1.53c	1.44c	6.71c	6.99c	6.85b	12.27fg	14.82d	13.55d
NH_4:$NO_3$50:50	1.48c	2.77a	2.13b	6.59c	7.87ab	7.23a	12.59f	17.19b	14.89b
NH_4:$NO_3$25:75	2.00b	2.19b	2.10b	5.71d	8.14ab	6.93ab	12.67f	15.92c	14.30c
NH_4:$NO_3$0:100	2.09b	2.93a	2.57a	6.12d	8.29a	7.21a	13.43e	19.32a	16.38a
Mean	1.43b	2.12a	----	5.95b	7.37a	----	12.23b	15.57a	----
LSD at 5% A		0.24			0.31			0.38	
LSD at 5% B		0.14			0.18			0.22	
LSD at 5% AB		0.34			0.44			0.53	

* 21-days old

** 63-days old

*** 105-days old

Using ammonium without nitrate was the most effective treatment compared with the other treatments, in the first season, different response was of observed in the second season, as the treatment ammonium to nitrate ratio of 0:100 was the most the favourble than the other treatments. Decreasing the pH value of the medium from 6 to 5 was associated with a significant increase in root fresh weight in the first season; whereas a reverse response was occurred in the second season.

At the second stage of growth, the response to N treatments and to pH of the media on dry weight of roots followed the same trend observed the fresh weight of roots at the first stage.

At the last stage of growth, the results obtained show the effect of nitrogen treatments whcih followed the same trend observed the second stage on fresh and dry weight of roots. Moreover, the response to pH change from 5 to 6 was also similar to that recorded at the two previous stages. This result was in the agreement with that obtained by Cho *et al.*, (2000) on *Aster tataricus* and *Chrysanthemum boreale*, they found that, using NO_3 increased the fresh weight of shoot and roots.

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تأثير مصادر النتروجين ومعدلات الامونيوم والنترات ومستوى درجة الحموضة على صفات النمو لنبات السنجونيوم

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****قسم بحوث الزينة وتنسيق الحدائق – معهد بحوث البساتين – الجيزة**

اجرى هذا البحث خلال الاعوام ٢٠٠٤ ، ٢٠٠٥ بمشتل قسم بحوث الزينة وتنسيق الحدائق بمعهد بحوث البساتين – الجيزة وقسم بساتين الزينة– كلية الزراعة –جامعة القاهرة.

ويهدف هذا البحث الى دراسة تاثير مصادر النتروجين ومعدلات الامونيوم والنترات ومستوى درجة الحموضة على صفات النمو لنبات السنجونيوم.

وقد تم تسميد النباتات كل اسبوعين بكبريتات الامونيوم ونترات الكالسيوم بالمعدلات والنسب الاتية: (صفر ، ١٠٠: صفر، ٢٥:٧٥ ، ٥٠:٥٠ ، ٧٥:٢٥ ، صفر :١٠٠).

اوضحت النتائج ان معاملة نباتات السنجونيوم بكبريتات الامونيوم: نترات الكالسيوم بنسبة ٧٥:٢٥ اعطت احسن نمو خضرى مثل طول النباتات وعدد الاوراق. كما ادت المعاملة بنترات الكالسيوم بدون اضافة كبريتات الامونيوم الى زيادة فى الوزن الطازج والجاف للمجموع الخضرى تحققت نتائج افضل مع درجة الحموضة (pH) ٦ مقارنة بدرجة حموضة (pH) ٥.