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EVALUATION OF DIFFERENT PLANTING MEDIA AND NITRATE TO AMMONIUM RATIOS FOR POINSETTIA NUTRITIONAL STUDIES

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Abstract: This study was done on potted poinsettia (*Euphorbia pulcherrima*, Willd.) seedlings during 2000 and 2001 seasons to evaluate the suitability of different planting media combined with NO^-_3/NH^+_4 nutrition for growth, flowering and chemical composition. Some substrates in different combinations and proportions "ratio by volume" were used as potting media. Clay was used as a base alone "control" or mixed with sand (2:1) as well as the mixtures of (clay + sand) with any of foam, peat moss, perlite and vermiculite in equal proportions. A nutrient solution (containing macro and microelements) was supplied at 1.5 litre/pot/week and was divided into 3 doses which were alternated with irrigation water and providing with a total N concentration of 12 meq/l varying in proportion of nitrate (NO^-_3): ammonium (NH^+_4) ratios (% NO^-_3/ %NH^+_4) of (100/0), (75/25), (50/50), (25/75) and (0/100), besides tap water "control" was supplied daily.

Data obtained proved the superiority of planting medium contained 2 clay + 1 sand over the investigated other ones in stimulating the vegetative and root growth. It produced the tallest plants with the greatest number of lateral branches and leaves, the thickest stem diameter, the largest leaf area, the heaviest weights (fresh & dry) of branches, leaves and roots, and the highest shoot-root ratio. Moreover, it induced early flowering (28-30 days), produced the maximum inflorescence yield (76% higher than control) and improved flowering quality resulting in the highest values of inflorescence diameter, fresh and dry weights, bract number and size, and total bract area per plant. On the contrary, clay medium alone was the inferior one in relation to growth and flowering, however, the other media achieved intermediate results.

Concerning NO^-_3/NH^+_4 nutrition, the ratio of (75/25) was the most effective in increasing the vegetative and root measurements as well as favouring the flowering characteristics, inducing early flowering by 24 days and increasing inflorescence production by 92% over the control. However, NO^-_3 and NH^+_4 in equal proportions (50/50) resulted in the next higher values of growth and flowering parameters. In contrast, feeding with NH^+_4 alone (0/100) induced inhibitory effect resulting in the greatest reductions in vegetative growth and flowering as well as showing characteristic symptoms of NH^+_4 injury to plant and large increase

in tissue NH^{+}_{4}-N, leaf interveinal chlorosis and marginal necrosis which did not occur in any other treatment.

Leaf contents of total-N, NO^{-}_{3}-N, P, K, Ca, Mg and chlorophylls (a&b), anthocyanin content in bracts, total carbohydrates in plant organs and leaf C/N ratio showed a positive relation with the best growth and flowering.

Nitrate reductase (NR) activity followed similar trend in leaves and roots, while it was higher in roots than in leaves. The NR activity in poinsettia plants tended to be greater due to using the medium contained 2 clay + 1 sand. Feeding with NO^{-}_{3} stimulated NR activity in leaves and roots, however, these activities were increased with increasing NO^{-}_{3} concentration in the nutrient solution.

The combined treatment (medium contained 2 clay + 1 sand plus NO^{-}_{3}/ NH^{+}_{4} at 75/25) proved to be the most effective for producing high quality poinsettias that could be recommended for commercial production.

Introduction

Poinsettia(*Euphorbia pulcherrima*, Willd.) is widely used all over the world as garden subject in the landscape, also it is among the most economical ornamental crops using as a flowering pot plant and as cut flowers.

The marketability of poinsettias is greatly influenced by the quality of plants produced. Quality poinsettias should be healthy and showy having large attractive bright ruby red bracts contrasting with dark green foliage that make an interesting presentation. Since, it is desirable to produce vigorous bushy plants with large number of flowering branches of high quality flowers (Hartley, 1992).

Poinsettia has a slow growth rate at seedling stage, so accelerating its growth, producing excellent branching and providing the growers with a predictable multiflowered plants of high quality could be accomplished by different means of agriculture treatments such as planting media and N-nutrition which are often very useful in improving growth and flowering of poinsettia (Hartley, 1992).

The characteristics of planting media play an important role in determining the behaviour of growth and development of root system which influencing, positively or negatively, the other plant organs and consequently reflect on the whole life cycle. In this connection, moisture capacity, osmotic tension, oxygen supply, drainage properties, nutrient balance, pH and buffer capacity, heat balance, physical stability and others, are the considerable characteristics (Bunt, 1974). The growers should obtain the most suitable of these properties with lesser cost, time and labour as possible. So it is necessary to find a superior medium to serve all these requirements.

Nursery growers in Egypt usually use clay soil as a commonly and cheap growing medium. Numerous investigators used number of materials in various mixtures with clay, varied from organic substrates such as peat moss to artificial substrates like perlite, vermiculite and polyphenol foam granules to increase the porosity and drainage of the medium in order to improve aeration. Moreover, these substrates have a high cation exchange capacity and water holding capacity, consequently favoured poinsettia growth and flowering; Fonteno *et al.* (1981), Pertuit and Mazur (1981), Scharpf *et al.* (1981), Lee *et al.* (1987), Tesi and Tosi (1987) and Danwitz and Escher (1988). They reported that poinsettias responded effectively to different mixtures of container media, however, such response was greatly varied not only from medium to another, but also plant cultivar has specific response and must be put into consideration.

On the other hand, nitrate or ammonium ions constitute the most important sources of the nitrogen utilized by plants. Experiments with a number of poinsettia cultivars comparing NO^-_3 and NH^+_4 nutrition have shown that the form of N supply exerts a pronounced effect on both growth and chemical composition of the plant (Mehne-Jakobs and Gulpen, 1997). Furthermore, hydroponic solutions containing NO^-_3 and/or NH^+_4 have been used for nutritional studies of poinsettias by Gaffney *et al.* (1982), Cox and Seeley (1984), Nell and Barrett (1985), Scoggins and Mills (1998) and Whipker and Hammer (1998a&b). They concluded that growth, development and uptake of essential nutrients were influenced by N-form nutrition.

Therefore, the objective of this study was to investigate the combined effect of different potting media and NO^-_3/NH^+_4 nutrition on growth, flowering and chemical composition of poinsettia.

Materials and Methods

A pot experiment was carried out in 2000 and 2001 seasons at the Floriculture Nursery, Faculty of Agriculture, Assiut University, to study the effect of different planting media and the form of N-nutrition on growth, flowering and chemical composition of poinsettia (*Euphorbia pulcherrima*, Willd.).

On March 10th of both seasons, healthy and vigorous seedlings (one-year old) were carefully selected as being uniform in their size, then their main stems were pruned at 25 cm height without lateral branches.

Seedlings were transplanted singly into 25-cm clay pots filled with different growing media whose constituents and properties are shown in Table (A). Two weeks later the plants were supplied at alternate irrigations with a nutrient solution composed to achieve optimum poinsettia growth according to Cox and Seeley (1994), Scoggins and Mills (1998) and Whipker and Hammer (1998a). One half-strength solution was applied for a week-pretreatment, then plants were subjected to a full-strength nutrient solution with a total N concentration of 12 meq/l varying in proportion of nitrate (NO^-_3): ammonium (NH^+_4) ratios (%NO^-_3: %NH^+_4); (100/0), (75/25), (50/50), (25/75) and (0/100). Besides, tap water as a control was supplied daily.

Compounds used to create the different N-form ratios are presented in Table (B). The nutrient solutions were prepared from laboratory grade chemicals and distilled water was used for preparing all solutions. Solution pH was adjusted to 5.5 with NaOH (2N) or H_2SO_4 (1N).

The nutrient solution was supplied at 1.5 litre/pot/week and was divided into 3 doses in alternation with irrigation water.

The experiment consisted of 36 treatments and replicated 3 times, each treatment contained 4 plants (pots), in complete randomized blocks in a factorial design. Plants were grown under shade conditions with averaged light intensity 8500 lux, ambient temperatures 30°/25°C day/night and 80% relative humidity until full flowering stage for both seasons. Plants were pinched once on July 10th and all horticultural practices were similarly done whenever needed.

At the end of the experiment (December 25th) data were recorded on vegetative measurements, fresh and dry weights of roots, number of days to flowering from planting and inflorescence characteristics. Shoot-root ratio was calculated by dividing the dry mass of shoot by the root one. Determinations of leaf nutrient contents (total-N, NO^-_3-N, NH^+_4-N, P, K, Ca and Mg) and analysis of planting media were done according to Piper (1967). Nitrate reductase activity in leaves and roots was measured by modifying the in vivo assay described by Yandow and Klein (1986). Besides, photosynthetic pigments in leaves (Vernon, 1960), total anthocyanin content in red bracts (Fuleki and Francis, 1968) and total carbohydrates content in plant organs (Hansen and Moller, 1975) were estimated. Leaf C/N ratio was also calculated. Data obtained were statistically analysed according to Snedecor and Cochran (1989).

Table (A): Constituents and properties of the used media at the beginning of the experiment (average six samples of both seasons; 2000 and 2001).

Media (v/v ratio)			Soluble ions meq/100g soil*						Available nutrients mg/100g soil			pH**	F.C.	EC* mS/cm
			Cations			Anions								
			Ca^{2+}	Mg^{2+}	Na^{+}	HCO^{-}_{3}	Cl^{-}	SO^{2-}_{4}	N	P	K			
Clay (control)		"M_1"	1.0	2.6	2.9	0.72	2.5	3.28	1.85	0.11	7.32	8.2	35	1.31
Clay + sand	(2:1)	"M_2"	0.6	1.1	3.6	1.10	2.2	2.00	1.94	0.19	8.20	7.9	41	1.15
Clay + sand + foam	(1:1:1)	"M_3"	0.7	1.3	4.0	1.30	2.3	2.40	1.61	0.08	6.10	8.1	26	1.20
Clay + sand + peat moss	(1:1:1)	"M_4"	5.0	7.0	9.7	2.60	10.0	9.10	1.96	0.14	8.91	5.2	44	4.36
Clay + sand + perlite	(1:1:1)	"M_5"	0.8	1.3	5.5	1.60	3.1	2.90	1.47	0.08	6.35	6.2	28	1.53
Clay + sand + vermiculite	(1:1:1)	"M_6"	0.9	0.6	6.4	2.80	3.3	1.80	1.42	0.07	6.44	8.1	30	1.58

* Soil-water extract (1:5) ** Soil-water suspention (1:2.5)

Table (B): Compositions of nutrient solutions for different N-form ratios.

NO^{-}_{3}:NH^{+}_{4} (% ratio)	Compound (meq/l)							
	$(NH_4)_2SO_4$	$Ca(NO_3)_2$	KNO_3	$CaCl_2$	$MgSO_4$	KH_2PO_4	K_2SO_4	total-N (NO^{-}_{3}+NH^{+}_{4})
100:0	0	7	5	3	4	1	0	12
75:25	3	4	5	6	4	1	0	12
50:50	6	6	0	4	4	1	5	12
25:75	9	0	3	10	4	1	2	12
0:100	12	0	0	10	4	1	5	12

The micronutrients were the same for all solutions (mg/l):

Fe 5.00 as Fe-EDTA — Mn 0.50 as $MnCl_2.4H_2O$ — B 0.50 as H_3BO_3

Zn 0.05 as $ZnSO_4.7H_2O$ — Cu 0.02 as $CuSO_4.5H_2O$ — Mo 0.01 as MoO_3

Results and Discussion

Vegetative characteristics:

It is clear from data presented in Tables (1, 2 and 3) that growth characteristics of poinsettia were markedly responded to the planting media. The media "M_2" (2 clay + 1 sand) and "M_3" (1 clay + 1 sand + 1 foam) pronouncedly improved the vegetative growth. However, medium "M_2" was the most effective as it resulted in the maximum values in all vegetative measurements. It produced the tallest plants, the thickest stem diameter, the highest number and heaviest weights (fresh and dry) of both lateral branches and leaves per plant and the largest leaf area. On the contrary, control medium "M_1" as component clay alone gave the minimum values for all growth parameters. The increments of medium "M_2" in plant height, number and fresh weight of branches and leaves, and leaf area were averaged 54, 72, 118, 25, 100 and 47% over medium "M_1", respectively. Meanwhile, the potting media of "M_4" (1 clay + 1 sand + 1 peat moss), M_5 (1 clay + 1 sand + 1 perlite) and M_6 (1 clay + 1 sand + 1 vermiculite) gave intermediate results and showed a relative tendency to be more effective than medium "M_1". Similar results were obtained on poinsettia by Fonteno *et al.* (1981), Pertuit and Mazur (1981), Scharpf *et al.* (1981), Lee *et al.* (1987), Tesi and Tosi (1987), Danwitz and Escher (1988) and Mohamed (1988).

The superiority of media "M_2" and "M_3" and their favourable effects on growth may be attributed to the use of sand and foam which lead to better aeration and drainage as well as increased oxygen in media that enable roots to absorb more water and nutrient elements from the planting media. The presence of clay as component of media "M_2" and "M_3" (66 and 33% by volume, respectively) furnished them with enough nutrients needed for plant growth, besides its relative higher cation capacity. The low EC and high field capacity of medium "M_2" supply available water in adequate quantities for cell turgidity and enlargement as well as plant growth and development. Moreover, the presence of organic matter in potting media is one of the most essential contributions of media that lead to increase granulation, pore space and water holding capacity (Yashie and Watanbe, 1966). In addition, the recorded pH value of M_2 (7.9) was almost ideal for treated plants, generally it suit most greenhouse crops (Lucas and Davis, 1961) and soil microorganisms that convert organic nitrogen to ammonia and to nitrate (Mastalerz, 1977). In this connection, Fonteno *et al.* (1981) on poinsettia, and Conover and Poole (1988) on some foliage plants declared the beneficial effect of soil conditioners and organic matter, and their reflections on soil moisture, structure stability and soil cation exchange capacity.

Regarding the ratios of N-form (NO^-_3/NH^+_4) on poinsettia growth (Tables 1, 2 and 3), it was observed that the vegetative growth and morphological characteristics were greatly influenced by supplying any proportion of either NO^-_3 or NH^+_4 of the N-ratio. Increasing NO^-_3 from 25 to 100% of the total N supply caused a corresponding increase in the growth indices compared to control (tap water). On the contrary, growth reduction and injury were occurred when NH^+_4 constitutes as 100% of the total N supply whereas plants were uniformly yellow-green; symptomatic of N-deficiency (Fig. 1). Similar results were obtained on poinsettia by Gaffney *et al.* (1982) and Cox and Seeley (1984). They concluded that the ratio of N-form has a direct relationship with poinsettia growth.

Poinsettias receiving NH^+_4 as the only N form exhibited NH^+_4 toxicity symptoms as summarized by Bierman *et al.* (1990) and Scoggins and Mills (1998): stunted growth, foliar chlorosis and necrosis, premature leaf abscission, stunted and clubby roots, and delayed or nonexistent bract coloring and flower development. These toxicity symptoms were not observed on plants supplied with NO^-_3 at any portion of the N-ratio, and were all of high visual quality.

The poor growth and appearance of plants sensitive to NH^+_4 is believed to result from the accumulation of free, unassimilated NH^+_4 and soluble organic N (amines and amides) in the shoots which accompanies the absorption of NH^+_4, and the development of severe acidic conditions in the root medium (Barker, 1966, and Maynard and Barker, 1969). The accumulations of NH^+_4 has been correlated with reduced photosynthesis (Purtich and Barker, 1967), protein synthesis (Patnaik *et al.*, 1972), cation uptake and transport (Wilcox *et al.*, 1977), and protein degradation (Barker, 1966). Maintenance of root medium pH near neutrality has been effective in alleviating many of the undesirable effects of NH^+_4 by enhancing NH^+_4 assimilation (Barker, 1966; Maynard and Barker, 1969 and Pierpont and Minotti, 1977).

It was interesting to note that feeding N in mixed form (75/25) resulted in the maximum values of all vegetative measurements (Tables 1, 2 and 3). The increments of plants received (75/25) ratio in height and number of branches and leaves were 35, 50 and 30% higher than NO^-_3-fed plants (100/0) as well as 133, 166 and 99% higher than NH^+_4-fed plants (0/100), conditioners and organic matter, and their reflections on soil moisture, structure stability and soil cation exchange capacity.

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Concerning the interaction effects between N-form ratios and potting media (Tables 1, 2 and 3), it was noticed that the most favourable combination for best growth and quality of poinsettia was medium "M_2" combined with NO^-_3 /NH^+_4 ratio of 75/25 (Fig. 2). These results are in agreement with those obtained by El-Sallami (1996) on *Ficus benjamina*. Such results pointed out that stimulating the growth with 75% NO^-_3 of the total N supply in the nutrient solution might be due to increase the available N level supplied by NO^-_3, in addition to release NPK and possible more minor elements needed for growth from medium "M_2" which has the ability of furnishing plants with them at adequate levels, consequently enhanced the growth.

Root Growth:

Data in Table (3) indicated that the greatest fresh and dry weights of roots were observed in plants grown in medium "M_2". This observation proved the favourable effect of medium "M_2" on root growth due to the desirable chemical and physical properties (Table A). However, medium "M_3" resulted in the next higher values in root fresh and dry weights. On the contrary, the lowest weights of roots were obtained by plants grown in medium "M_1". Meanwhile, the media M_4, M_5 and M_6 achieved intermediate root growth. These results are in agreement with those reported on poinsettia by Fonteno *et al.* (1981), Pertuit and Mazur (1981), Scharpf *et al.* (1981), Lee *et al.* (1987), Danwitz and Escher (1988) and Mohamed (1988).

With regard to the effect of N-form ratios on fresh and dry weights of roots (Table 3), it was noticed that both weights were increased with increasing the proportion of NO^-_3-N in solution. However, the root system characters were improved with 75% NO^-_3-N of the total N supply where roots were white with long, well-developed laterals and heavy weights (fresh and dry). On the contrary, both root weights were decreased with increasing the proportion of NH^+_4-N in solution. The root system of 75 and 100% NH^+_4-N treatments were brown and brittle with short, thick, poorly developed laterals and lightly weight. Yet, root symptoms of NH^+_4 injury

Table (1): Effect of planting media and varied NO_3^-/NH_4^+ ratio in the nutrient solution on plant height and lateral branch number and weights (fresh & dry) of poinsettia during 2000 and 2001 seasons.

Media	NO_3^-/NH_4^+ ratios (% in solution)													
	2000 season							2001 season						
	Control	100/0	75/25	50/50	25/75	0/100	Mean	Control	100/0	75/25	50/50	25/75	0/100	Mean
Plant height (cm)														
M_1	65.2	82.8	105.2	86.3	64.5	50.8	75.8	60.7	86.5	115.4	94.3	60.7	41.9	76.6
M_2	80.4	125.2	166.4	144.6	96.3	75.4	114.7	84.5	131.1	172.0	157.3	104.3	71.4	120.1
M_3	76.3	113.0	148.2	118.6	87.2	69.2	102.1	74.5	118.3	162.7	130.1	90.2	64.5	106.7
M_4	73.5	91.9	138.3	116.3	81.4	67.7	94.9	71.4	103.5	150.5	120.8	83.5	61.3	98.5
M_5	67.6	92.7	124.0	96.8	74.4	60.3	86.0	62.8	101.2	137.2	99.6	70.3	52.7	87.3
M_6	63.8	90.1	112.0	95.0	71.7	55.9	81.4	63.2	97.1	133.6	98.5	74.1	49.2	85.5
Mean	71.1	99.3	132.4	109.6	79.3	63.2		69.5	106.3	145.2	116.8	80.5	56.8	
LSD 5%	Media: 14.8		NO_3^-/NH_4^+: 14.8		Media x NO_3^-/NH_4^+: 36.3			Media: 15.5		NO_3^-/NH_4^+: 15.5		Media x NO_3^-/NH_4^+: 38.0		
Number of lateral branches/plant														
M_1	1.83	2.25	3.33	3.00	1.92	1.50	2.31	1.67	1.83	3.08	2.33	1.67	1.42	2.00
M_2	3.00	3.75	5.17	4.33	3.33	2.42	3.67	3.25	3.67	5.75	3.83	3.33	2.50	3.72
M_3	2.50	2.83	4.67	4.17	2.50	2.00	3.11	2.33	3.25	3.83	3.33	2.92	2.08	2.96
M_4	2.42	2.67	4.17	3.50	2.25	1.92	2.82	2.25	2.67	3.33	2.92	2.33	1.83	2.56
M_5	2.00	2.42	3.92	3.58	2.08	1.83	2.64	2.08	2.33	3.92	2.75	2.25	1.58	2.49
M_6	2.25	2.58	3.83	3.42	2.42	1.83	2.72	1.92	2.25	3.58	2.83	2.17	1.58	2.39
Mean	2.33	2.75	4.18	3.67	2.42	1.92		2.25	2.67	3.92	3.00	2.44	1.83	
LSD 5%	Media: 1.42		NO_3^-/NH_4^+: 1.42		Media x NO_3^-/NH_4^+: 3.48			Media: 1.33		NO_3^-/NH_4^+: 1.33		Media x NO_3^-/NH_4^+: 3.26		
Fresh weight of branches (g)/plant														
M_1	34.8	46.0	68.5	60.4	37.5	25.6	45.5	38.5	52.2	73.1	57.6	41.5	29.4	48.7
M_2	66.9	124.2	153.2	137.7	99.3	48.2	104.9	70.3	118.7	147.5	125.8	88.4	51.5	100.4
M_3	52.5	85.7	117.3	95.2	74.8	36.4	77.0	54.3	80.9	124.3	90.6	69.4	39.1	76.4
M_4	53.0	75.4	111.3	89.0	64.1	34.9	71.3	56.1	69.2	107.8	83.4	59.1	38.4	69.0
M_5	47.6	70.9	99.5	77.0	60.2	37.1	65.4	51.8	66.4	105.4	80.5	57.5	41.7	67.2
M_6	52.5	81.1	89.6	90.6	66.3	39.5	69.9	57.4	77.5	96.6	86.1	62.7	44.3	70.8
Mean	51.2	80.6	106.6	91.7	67.0	37.0		54.7	77.5	109.1	87.3	63.1	40.7	
LSD 5%	Media: 12.8		NO_3^-/NH_4^+: 12.8		Media x NO_3^-/NH_4^+: 31.4			Media: 14.2		NO_3^-/NH_4^+: 14.2		Media x NO_3^-/NH_4^+: 34.8		
Dry weight of branches (g)/plant														
M_1	15.87	22.60	35.70	31.17	17.66	11.39	22.40	17.41	25.42	37.87	29.38	19.34	12.94	23.73
M_2	30.52	61.01	79.82	71.10	46.78	21.45	51.78	31.78	57.81	76.41	64.16	41.19	22.66	49.00
M_3	23.95	42.11	61.12	49.13	35.23	16.20	37.96	24.54	39.40	64.39	46.21	32.34	17.20	37.35
M_4	24.19	37.02	58.00	45.92	30.19	15.53	35.14	25.36	33.71	55.84	42.53	27.55	16.90	33.65
M_5	21.71	34.81	51.85	39.73	28.35	16.51	32.08	23.42	32.34	54.60	41.06	26.80	18.35	32.76
M_6	23.94	39.83	46.68	46.75	31.23	17.58	34.33	26.08	37.75	50.04	43.92	29.22	19.49	34.42
Mean	23.36	39.48	55.53	47.30	31.57	16.44		24.77	37.74	56.53	44.54	29.41	17.92	
LSD 5%	Media: 4.52		NO_3^-/NH_4^+: 4.52		Media x NO_3^-/NH_4^+: 11.07			Media: 3.97		NO_3^-/NH_4^+: 3.97		Media x NO_3^-/NH_4^+: 9.73		

Table (2): Effect of planting media and varied NO_3^-/NH_4^+ ratio in the nutrient solution on leaf characteristics of poinsettia plants during 2000 and 2001 seasons.

Media	NO_3^-/NH_4^+ ratios (% in solution)													
	2000 season							2001 season						
	Control	100/0	75/25	50/50	25/75	0/100	Mean	Control	100/0	75/25	50/50	25/75	0/100	Mean
Number of leaves/plant														
M_1	51.2	63.3	78.1	65.2	50.5	36.1	57.4	47.2	60.5	78.4	70.2	56.0	38.4	58.5
M_2	64.5	74.7	95.6	83.8	60.2	46.0	70.8	67.5	71.2	97.8	85.6	66.9	52.5	73.6
M_3	62.0	71.2	87.3	76.1	65.0	41.4	67.2	62.1	68.3	86.5	78.3	64.5	49.1	68.1
M_4	60.4	66.1	83.5	70.3	58.2	38.5	61.5	59.3	65.4	82.3	74.1	62.0	46.3	64.9
M_5	59.7	64.2	80.6	68.4	52.0	38.2	60.5	56.5	64.0	83.0	75.4	60.1	47.0	64.3
M_6	57.5	63.0	85.0	75.1	53.3	40.6	62.4	57.6	60.1	84.5	61.0	61.3	43.2	61.3
Mean	59.2	67.1	85.0	73.2	56.5	40.1		58.4	64.9	85.4	74.1	61.8	46.1	
LSD 5%	Media: 8.9		NO_3^-/NH_4^+: 8.9		Media x NO_3^-/NH_4^+: 21.8			Media: 9.4		NO_3^-/NH_4^+: 9.4		Media x NO_3^-/NH_4^+: 23.0		
Fresh weight of leaves (g)/plant														
M_1	25.6	34.8	54.7	45.6	27.8	18.1	34.4	23.6	33.4	54.9	49.1	30.7	19.3	35.2
M_2	38.1	61.3	129.1	113.1	42.1	27.1	68.5	39.9	58.6	132.5	115.7	46.5	30.5	70.6
M_3	36.0	53.4	93.4	92.8	38.4	22.8	56.1	36.2	51.5	93.1	94.8	38.2	27.0	56.8
M_4	33.8	46.3	68.5	70.3	40.7	21.6	46.9	33.3	46.2	67.9	73.4	43.3	25.5	48.3
M_5	33.4	48.2	60.5	62.9	36.4	21.4	43.8	31.5	48.1	62.8	69.5	42.0	26.4	46.7
M_6	31.6	47.3	59.5	60.1	39.9	22.3	43.5	31.7	45.0	59.7	49.0	45.6	23.5	42.4
Mean	33.1	48.6	77.6	74.1	37.6	22.2		32.7	47.1	78.5	75.3	41.1	25.4	
LSD 5%	Media: 7.5		NO_3^-/NH_4^+: 7.5		Media x NO_3^-/NH_4^+: 18.4			Media: 8.1		NO_3^-/NH_4^+: 8.1		Media x NO_3^-/NH_4^+: 19.8		
Dry weight of leaves (g)/plant														
M_1	5.02	6.46	10.00	8.15	5.15	3.54	6.39	4.63	6.22	10.09	8.80	5.65	3.74	6.52
M_2	7.29	10.98	25.31	22.04	7.71	5.20	13.09	7.61	10.51	26.10	22.70	8.48	5.85	13.54
M_3	6.63	9.97	17.52	16.89	6.37	4.39	10.30	6.69	9.63	17.48	17.21	6.35	5.22	10.43
M_4	6.34	8.46	12.30	12.51	7.57	4.04	8.54	6.21	8.46	12.39	13.09	8.01	4.67	8.81
M_5	6.33	9.44	11.28	10.94	6.50	4.01	8.08	5.95	9.40	11.75	12.11	7.47	4.90	8.60
M_6	6.10	8.69	10.88	10.51	7.46	4.47	8.02	6.10	8.28	10.95	8.59	8.50	4.73	7.86
Mean	6.29	9.00	14.55	13.51	6.79	4.28		6.20	8.75	14.79	13.75	7.41	4.85	
LSD 5%	Media: 3.13		NO_3^-/NH_4^+: 3.13		Media x NO_3^-/NH_4^+: 7.67			Media: 3.35		NO_3^-/NH_4^+: 3.35		Media x NO_3^-/NH_4^+: 8.21		
Leaf area (cm^2)														
M_1	38.6	48.0	60.6	53.1	34.5	30.4	44.2	41.5	50.5	65.3	56.0	40.8	32.7	47.8
M_2	58.0	69.3	87.8	71.3	52.6	48.5	64.6	64.2	73.6	94.1	78.3	59.3	53.1	70.4
M_3	47.5	60.1	76.6	63.7	44.7	42.1	55.8	54.3	64.8	86.5	69.4	43.2	44.6	60.5
M_4	42.6	43.8	70.5	56.8	36.2	34.7	47.4	47.6	53.6	76.7	64.9	42.3	37.9	53.8
M_5	41.3	47.5	69.3	56.9	36.1	31.8	47.2	49.2	53.3	81.3	65.0	44.1	36.2	54.9
M_6	39.1	50.9	72.7	60.5	37.2	37.6	49.7	45.0	52.8	80.8	60.1	41.5	39.1	53.2
Mean	44.5	54.1	72.9	60.4	40.2	37.5		50.3	58.1	80.8	65.6	45.2	40.6	
LSD 5%	Media: 10.5		NO_3^-/NH_4^+: 10.5		Media x NO_3^-/NH_4^+: 25.7			Media: 9.7		NO_3^-/NH_4^+: 9.7		Media x NO_3^-/NH_4^+: 23.8		

Table (3): Effect of planting media and varied NO_3^-/NH_4^+ ratio in the nutrient solution on stem diameter, fresh and dry weights of roots and shoot-root ratio of poinsettia during 2000 and 2001 seasons.

Media	NO_3^-/NH_4^+ ratios (% in solution)													
	2000 season							2001 season						
	Control	100/0	75/25	50/50	25/75	0/100	Mean	Control	100/0	75/25	50/50	25/75	0/100	Mean
	Stem diameter (cm)													
M_1	0.77	0.94	1.09	0.99	0.74	0.62	0.86	0.74	0.92	1.06	0.97	0.78	0.65	0.85
M_2	1.09	1.14	1.20	1.16	0.96	0.80	1.06	1.05	1.12	1.27	1.16	1.01	0.77	1.06
M_3	0.96	1.08	1.16	1.14	0.82	0.66	0.97	0.92	1.05	1.22	1.12	0.84	0.60	0.96
M_4	0.92	0.96	1.14	1.06	0.88	0.61	0.93	0.85	0.96	1.17	1.10	0.92	0.64	0.94
M_5	0.82	1.10	1.18	1.07	0.84	0.75	0.96	0.86	1.02	1.19	1.09	0.90	0.72	0.96
M_6	0.90	1.04	1.15	1.09	0.80	0.72	0.95	0.80	1.10	1.27	1.06	0.85	0.66	0.96
Mean	0.91	1.04	1.15	1.09	0.84	0.69		0.87	1.03	1.20	1.08	0.88	0.67	
LSD 5%	Media: 0.07		NO_3^-/NH_4^+: 0.07		Media x NO_3^-/NH_4^+: 0.17			Media: 0.08		NO_3^-/NH_4^+: 0.08		Media x NO_3^-/NH_4^+: 0.20		
	Fresh weight of roots (g)/plant													
M_1	17.2	25.9	30.1	27.7	21.8	14.3	22.8	18.5	23.6	33.7	25.0	20.4	13.7	22.5
M_2	34.3	50.7	59.1	53.4	42.3	25.5	44.2	33.7	47.2	63.5	49.6	38.3	22.3	42.4
M_3	27.2	50.0	53.2	49.3	41.8	19.1	40.1	29.6	45.8	56.9	45.1	37.2	18.1	38.8
M_4	24.3	42.1	45.6	48.8	33.5	18.2	35.4	26.4	40.3	47.4	45.5	32.0	19.0	35.1
M_5	20.9	36.0	51.9	42.9	28.3	16.4	32.7	22.0	34.1	50.5	39.9	26.5	15.6	31.4
M_6	23.1	38.3	45.2	32.1	29.7	17.5	31.0	24.5	36.5	44.8	35.0	31.1	16.9	31.5
Mean	24.5	40.5	47.5	42.4	32.9	18.5		25.8	37.9	49.5	40.0	30.9	17.6	
LSD 5%	Media: 7.9		NO_3^-/NH_4^+: 7.9		Media x NO_3^-/NH_4^+: 19.4			Media: 8.4		NO_3^-/NH_4^+: 8.4		Media x NO_3^-/NH_4^+: 20.6		
	Dry weight of roots (g)/plant													
M_1	3.58	7.02	8.85	8.03	6.25	2.78	6.09	3.82	6.45	9.62	7.13	5.63	2.75	5.90
M_2	8.45	13.78	17.66	15.49	12.10	4.97	12.08	8.33	12.78	18.14	14.40	11.27	4.52	11.57
M_3	6.51	13.50	15.43	14.23	11.18	3.72	10.76	7.08	12.40	15.59	13.10	10.25	3.61	10.34
M_4	5.46	11.42	15.11	14.11	11.09	3.50	10.12	5.90	10.91	14.61	13.22	10.34	3.85	9.81
M_5	4.72	9.81	13.34	12.44	9.76	3.22	8.88	4.96	9.24	14.42	11.63	9.09	3.16	8.75
M_6	5.17	10.38	13.85	9.30	7.31	3.41	8.24	5.49	9.85	12.80	10.19	7.96	3.40	8.28
Mean	5.65	10.99	14.04	12.27	9.62	3.60		5.93	10.27	14.20	11.61	9.09	3.55	
LSD 5%	Media: 2.38		NO_3^-/NH_4^+: 2.38		Media x NO_3^-/NH_4^+: 5.83			Media: 2.74		NO_3^-/NH_4^+: 2.74		Media x NO_3^-/NH_4^+: 6.71		
	Shoot/root ratio													
M_1	6.12	4.41	5.50	5.25	3.86	5.50	5.11	6.08	5.23	5.27	5.71	4.70	6.23	5.54
M_2	4.76	5.49	6.44	6.35	4.72	5.57	5.56	5.02	5.57	6.10	6.38	4.63	6.58	5.71
M_3	4.97	4.08	5.46	4.94	3.87	5.74	4.84	4.68	4.21	5.58	5.16	3.97	6.43	5.01
M_4	5.86	4.15	4.98	4.40	3.57	5.82	4.80	5.63	4.08	5.00	4.52	3.62	5.85	4.78
M_5	6.21	4.71	5.05	4.38	3.70	6.53	5.10	6.23	4.76	4.90	4.91	3.95	7.57	5.39
M_6	6.10	4.90	4.44	6.52	5.48	6.60	5.67	5.63	4.93	5.09	5.50	4.94	7.29	5.56
Mean	5.67	4.62	5.31	5.31	4.20	5.96		5.55	4.80	5.32	5.36	4.30	6.66	

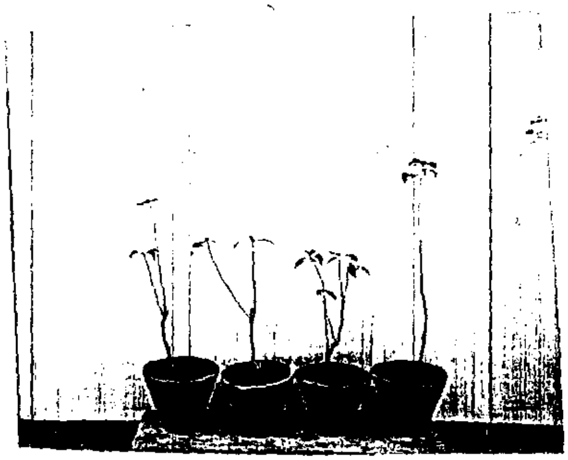

Fig. (1): Effect of ammonium injury on poinsettia growth and flowering.

Fig. (2): Interaction effect between planting media and N-form ratios. A- The combination of medium "M_2" (2 clay + 1 sand) and NO_3^-/NH_4^+ ratio of 75/25 in the nutrient solution. B- The combination of clay medium "M_1" and irrigation water.

were observed despite the deleterious effects of NH^{+}_{4} on growth with NH^{+}_{4}-N as N source. Similar results have been reported on poinsettia by Gaffney *et al.* (1982), Cox and Seeley (1984), Nell and Barrett (1985), Lawton *et al.* (1989), Rose (1992), Whipker and Hammer (1998a&b), and Scoggins and Mills (1998).

Clearly, the interaction between potting media and N-form ratios (Table 3) showed that the combination of medium "M_2" and the ratio of (75/25) was the most effective treatment in increasing the fresh and dry weights of roots.

The relationship between the vegetative and root growth is very important in ornamental shrubs to produce vigour and healthy ones. So, this work studied shoot-root ratios of poinsettia plants as affected by different treatments (Table 3). Generally, medium "M_2" increased shoot-root ratio compared with the other media. The increase in shoot-root ratio could be attributed to the gained increase in shoot weight. It might be due to the enhancement of root absorption of high rates of nutrients and water reflecting on more vegetative growth inducing increase in photosynthetic efficiency of foliage. Similar trend of shoot-root relationship was reported by Mertens and Wright (1978). They concluded that the rhythmic growth of Japanese holly was occurred by absorbing nitrogen in roots which reacts with carbohydrates to promote their development.

In the meantime, shoot-root ratio tended to decrease as the proportion of nitrate increased from 25 to 100% in the nutrient solution (Table 3). Meanwhile, feeding with NH^{+}_{4} alone resulted in the highest shoot-root ratio. This result could be attributed to root reduction which associated with shoot stunting as a result of ammonium injury. These results are paralleled to the results of Van Den Driessche (1971) on some conifer seedlings.

Flowering characteristics:

It was important to notice that time to flowering as well as inflorescence yield and all measurements were markedly responded to various treatments of potting media and N-form ratios in nutrient solution (Tables 4 & 5). Apparently, all media enhanced inflorescence development and induced early flowering as well as improved inflorescence characteristics compared to clay medium "M_1". However, medium "M_2" was the most effective for accelerating and advancing the flowering time by 28-30 days as well as producing the maximum inflorescence yield (76% in average higher than "M_1"). Moreover, it gave the maximum responses of inflorescence quality with attractive bracts. It resulted in the heaviest inflorescence fresh and dry weights, the widest inflorescence diameter, the highest number of bracts per inflorescence, the largest bract area and the maximum total bract area per plant. The increments of these parameters were 122, 124, 30, 76, 67 and 190% over clay medium "M_1", respectively.

In the meantime, the other potting mixtures of "M_3", "M_4", "M_5" and "M_6" induced also earlier flowering (9-15 days), higher inflorescence production (20-60%) and better inflorescence characters than "M_1" (Tables 4 & 5).

The favourable effect of potting medium "M_2" on flowering characteristics may be due to the initial presence of high content of NPK and pH accepted value as well as to low salinity and high field capacity which enhanced vegetative growth that reflected on best flowering. These results are in accordance with the findings of Fonteno *et al.* (1981), Pertuit and Mazur (1981), Scharpf *et al.* (1981), Lee *et al.* (1987) and Danwitz and Escher (1988) on poinsettia, and Mohamed and Khalil (1992) on *Pelargonium zonal.*

Concerning the effect of NO^-_3/ NH^+_4 nutrition on flowering (Tables 4 & 5), it was noticed that the ratios of (100/0), (75/25) and (50/50) induced earlier flowering averaged by 16, 24 and 8 days compared to the control, respectively. On the contrary, the proportion of 75 and 100% NH^+_4 in the nutrient solution delayed poinsettia flowering by 9 and 14 days, respectively. Although feeding with NO^-_3 alone (100/0) increased inflorescence yield by 22% (in average) and with NH^+_4 alone (0/100) decreased it by 30% compared to the control, supplying NO^-_3 and NH^+_4 in combination (75/25) showed considerable increase in inflorescence production per plant as recorded 92% higher than the control. However, feeding with NO^-_3 and NH^+_4 in equal proportions (50/50) increased inflorescence yield by 55% compared to the control. These results are in conformity with those reported on poinsettia by Gaffney *et al.* (1982), Cox and Seeley (1984), Nell and Barrett (1985) and Scoggins and Mills (1998).

In respect of inflorescence measurements (Tables 4 & 5), it was observed that the ratio of (75/25) stimulated the inflorescence characteristics and improved bract quality. It produced the heaviest inflorescence fresh and dry weights, the widest inflorescence diameter, the highest number of bracts per inflorescence, the largest bract area and the maximum total bract area per plant. The increments of these measurements were 217, 204, 46, Table (4): Effect of planting media and varied NO_3^-/NH_4^+ ratio in the nutrient solution on flowering time and inflorescence number and weights (fresh & dry) of poinsettia during 2000 and 2001 seasons.

Media	NO_3^-/NH_4^+ ratios (% in solution) 2000 season							2001 season						
	Control	100/0	75/25	50/50	25/75	0/100	Mean	Control	100/0	75/25	50/50	25/75	0/100	Mean
Number of days to flowering														
M_1	269	261	245	254	270	283	264	274	265	249	258	278	286	268
M_2	237	230	218	224	246	251	234	242	234	221	230	247	265	240
M_3	245	240	236	245	268	259	249	249	247	240	239	274	273	254
M_4	256	252	228	237	262	274	252	263	252	233	244	273	275	257
M_5	260	251	231	240	266	280	255	268	255	236	246	275	271	259
M_6	263	255	233	241	264	275	255	270	259	238	248	274	273	260
Mean	255	248	232	240	263	270		261	252	236	244	270	274	
LSD 5%	Media: 12		NO_3^-/NH_4^+: 12		Media x NO_3^-/NH_4^+: 29			Media: 14		NO_3^-/NH_4^+: 14		Media x NO_3^-/NH_4^+: 34		
Number of inflorescences/plant														
M_1	1.58	2.17	3.17	2.83	1.83	1.33	2.15	1.42	1.67	3.00	2.17	1.58	1.17	1.84
M_2	2.75	3.42	5.17	4.25	3.08	2.00	3.45	3.00	3.42	5.67	3.75	3.17	2.17	3.53
M_3	2.17	2.67	4.50	4.00	2.25	1.67	2.88	2.17	3.08	3.67	3.17	2.67	1.75	2.75
M_4	2.00	2.42	4.00	3.33	2.17	1.58	2.58	2.08	2.50	3.25	2.83	2.25	1.58	2.42
M_5	1.92	2.25	3.83	3.33	1.92	1.50	2.46	1.83	2.17	3.83	2.67	2.17	1.42	2.35
M_6	2.08	2.33	3.75	3.17	2.17	1.50	2.50	1.75	2.08	3.58	2.67	2.00	1.33	2.24
Mean	2.08	2.54	4.07	3.49	2.24	1.60		2.04	2.49	3.83	2.88	2.31	1.57	
LSD 5%	Media: 0.91		NO_3^-/NH_4^+: 0.91		Media x NO_3^-/NH_4^+: 2.23			Media: 0.85		NO_3^-/NH_4^+: 0.85		Media x NO_3^-/NH_4^+: 2.08		
Fresh weight of inflorescences (g)/plant														
M_1	7.3	13.2	23.8	18.8	9.9	2.4	12.6	8.6	14.8	21.7	16.9	10.5	2.9	12.6
M_2	16.7	26.7	61.0	38.3	18.7	7.0	28.1	17.2	28.6	58.6	35.8	17.8	8.3	27.7
M_3	12.6	19.6	41.4	31.2	11.8	5.8	20.4	13.1	21.2	38.7	30.6	14.3	6.1	20.7
M_4	10.5	15.2	36.0	24.4	12.6	5.3	17.3	11.8	18.6	34.8	27.2	12.8	6.5	18.6
M_5	8.8	13.6	31.8	25.0	8.8	3.8	15.3	10.5	15.9	32.0	25.9	11.1	4.8	16.7
M_6	10.9	15.4	29.3	24.7	10.1	3.1	15.6	11.3	16.7	30.5	25.1	11.7	4.0	16.6
Mean	11.1	17.3	37.2	27.1	12.0	4.6		12.1	19.3	36.1	26.9	13.0	5.4	
LSD 5%	Media: 2.3		NO_3^-/NH_4^+: 2.3		Media x NO_3^-/NH_4^+: 5.6			Media: 2.6		NO_3^-/NH_4^+: 2.6		Media x NO_3^-/NH_4^+: 6.4		
Dry weight of inflorescences (g)/plant														
M_1	1.01	1.87	3.00	2.80	1.34	0.36	1.73	1.19	2.10	2.74	2.53	1.48	0.44	1.75
M_2	2.37	3.63	8.53	5.27	2.62	1.02	3.91	2.44	3.89	8.23	4.95	2.50	1.22	3.87
M_3	1.80	2.96	5.54	4.24	1.64	0.77	2.83	1.89	3.20	5.20	4.16	1.99	0.81	2.88
M_4	1.46	1.91	4.96	3.70	1.80	0.79	2.44	1.65	2.34	4.82	4.12	1.83	0.97	2.62
M_5	1.28	1.94	4.29	3.79	1.27	0.51	2.18	1.53	2.25	4.35	3.95	1.60	0.66	2.39
M_6	1.52	2.31	3.98	3.36	1.37	0.45	2.17	1.58	2.51	4.14	3.54	1.59	0.58	2.32
Mean	1.57	2.44	5.05	3.86	1.67	0.65		1.71	2.72	4.91	3.88	1.83	0.78	
LSD 5%	Media: 0.41		NO_3^-/NH_4^+: 0.41		Media x NO_3^-/NH_4^+: 1.00			Media: 0.36		NO_3^-/NH_4^+: 0.36		Media x NO_3^-/NH_4^+: 0.88		

Table (5): Effect of planting media and varied NO^-_3/NH^+_4 ratio in the nutrient solution on inflorescence diameter and bract characteristics of poinsettia during 2000 and 2001 seasons.

Media	NO^-_3/NH^+_4 ratios (% in solution)													
	2000 season							2001 season						
	Control	100/0	75/25	50/50	25/75	0/100	Mean	Control	100/0	75/25	50/50	25/75	0/100	Mean
Inflorescence diameter (cm)														
M_1	14.7	16.4	21.5	18.5	13.3	9.8	15.7	14.1	15.3	23.0	19.3	12.8	10.2	15.8
M_2	18.0	21.5	28.2	25.3	15.6	14.3	20.5	17.6	21.2	27.8	24.7	16.4	14.9	20.4
M_3	15.1	18.7	24.7	21.4	14.6	11.6	17.7	16.1	20.3	24.2	23.7	14.1	12.8	18.5
M_4	16.7	17.9	23.5	20.1	14.2	13.2	17.6	16.3	16.8	21.6	19.0	14.3	12.6	16.8
M_5	17.8	18.2	24.2	21.2	15.6	12.7	18.3	15.8	16.9	22.2	19.6	13.7	11.8	16.7
M_6	17.6	16.5	22.6	19.5	15.9	11.5	17.3	16.7	17.0	23.7	18.5	14.5	12.7	17.2
Mean	16.7	18.2	24.1	21.0	14.9	12.2		16.1	17.9	23.8	20.8	14.3	12.5	
LSD 5%	Media: 3.3		NO^-_3/NH^+_4: 3.3		Media x NO^-_3/NH^+_4: 8.1			Media: 3.6		NO^-_3/NH^+_4: 3.6		Media x NO^-_3/NH^+_4: 8.8		
Number of bracts/inflorescence														
M_1	13.3	14.3	20.7	16.3	12.3	10.5	14.6	11.7	13.7	19.5	15.7	11.6	9.8	13.7
M_2	24.7	26.6	32.7	29.7	20.5	17.5	25.3	22.5	25.2	35.3	28.5	18.2	16.7	24.4
M_3	20.0	24.3	29.8	25.5	18.0	13.8	21.9	15.6	20.0	27.5	23.9	16.5	12.6	19.3
M_4	17.1	20.0	28.0	22.2	15.6	13.7	19.4	16.2	18.5	27.7	20.5	15.3	14.1	18.7
M_5	15.4	17.5	27.7	20.3	15.3	12.5	18.1	15.3	18.1	28.4	21.6	14.8	11.3	18.3
M_6	16.6	17.3	25.0	21.7	16.1	11.6	18.1	15.5	18.3	27.7	21.1	14.4	10.5	17.9
Mean	17.9	20.0	27.3	22.6	16.3	13.3		16.1	19.0	27.7	21.9	15.1	12.5	
LSD 5%	Media: 2.1		NO^-_3/NH^+_4: 2.1		Media x NO^-_3/NH^+_4: 5.1			Media: 1.9		NO^-_3/NH^+_4: 1.9		Media x NO^-_3/NH^+_4: 4.7		
Bract area (cm^2)														
M_1	6.1	10.5	15.6	13.8	6.8	4.4	9.5	5.8	8.7	15.2	12.9	6.2	4.2	8.8
M_2	10.3	17.0	24.9	19.3	11.8	7.6	15.2	9.9	17.8	25.3	20.1	11.3	7.2	15.3
M_3	8.4	12.7	21.6	16.6	9.5	6.2	12.5	7.7	12.1	20.4	16.2	8.9	6.0	11.9
M_4	7.5	11.9	19.7	16.8	7.7	4.8	11.4	6.9	10.5	18.0	14.7	6.5	4.7	10.2
M_5	7.0	11.6	19.2	15.2	7.6	5.1	11.0	7.1	10.4	19.3	14.2	6.8	4.8	10.4
M_6	8.1	11.4	20.3	14.3	8.3	5.0	11.2	6.5	11.9	18.3	13.8	7.2	4.4	10.4
Mean	7.9	12.5	20.2	16.0	8.6	5.5		7.3	11.9	19.4	15.3	7.8	5.2	
LSD 5%	Media: 3.4		NO^-_3/NH^+_4: 3.4		Media x NO^-_3/NH^+_4: 8.3			Media: 3.2		NO^-_3/NH^+_4: 3.2		Media x NO^-_3/NH^+_4: 7.8		
Total bract area (cm^2)/plant														
M_1	81	150	323	225	84	46	152	68	119	296	203	72	41	133
M_2	254	452	814	573	242	133	411	223	449	893	573	206	120	411
M_3	168	309	644	423	171	86	300	120	242	561	387	147	76	256
M_4	128	238	552	373	120	66	246	112	194	499	301	99	66	212
M_5	108	203	532	309	116	64	222	109	188	548	307	101	54	218
M_6	134	197	508	310	134	58	224	101	218	507	291	104	46	211
Mean	146	258	562	369	145	76		122	235	551	344	122	67	
LSD 5%	Media: 75		NO^-_3/NH^+_4: 75		Media x NO^-_3/NH^+_4: 184			Media: 69		NO^-_3/NH^+_4: 69		Media x NO^-_3/NH^+_4: 169		

62, 161 and 319% over the control, respectively. However, the ratio of (50/50) resulted in the next higher values of inflorescences parameters reflecting in better quality than 100/0 and 25/75 ratios. On the contrary, NH^+_4-fed plants showed great reductions in all inflorescence measurements (Fig. 1). These reductions were probably caused by the effect of ammonium injury on poinsettia growth and development of both roots and vegetation causing poorly flowering and low quality. These results are in harmony with those reported on poinsettia by Lawton *et al.* (1989), Rose (1992), Scoggins and Mills (1998) and Whipker and Hammer (1998a&b).

The favourable effect of (75/25) ratio on flowering characters may be due to the suitable level of N supply on growth and its positive reflection on flowering. High nitrogen supply tended to increase leaf cell number and cell size with an overall increase in leaf production (Rose, 1992; and Whipker and Hammer, 1998a&b). In addition, Cox and Seeley (1984) found that the detrimental effects of NH^+_4 on poinsettia were attributed to reduction in N absorption with 75 and 100% NH^+_4. The reduction in N absorption by supplying 100% NH^+_4 resulted in the appearance of N-deficiency symptoms.

The interaction effect between potting media and N-form ratios (Tables 4 & 5) indicated that the earliest flowering with high quality and best inflorescence characteristics were obtained by plants grown in medium "M_2" and supplying with NO^-_3/NH^+_4 ratio of 75/25 (Fig. 2). This combination enhanced inflorescence development, stimulated flowering process and accelerated the flowering time by 52 days as well as magnified inflorescence yield by 263% comparing with plants grown in clay soil alone and irrigated with water whereas they produced fewer inflorescence with poor quality.

Nutrient contents:

Data in Tables (6 & 7) indicated that plants grown in medium "M_2" (2 clay + 1 sand) enhanced nutrient absorptions by roots resulting in the highest contents of total-N, NO^-_3-N, P, K, Ca and Mg in leaves, while NH^+_4-N concentration was the lowest. The higher absorption of NO^-_3-N more than NH^+_4-N was reflected in higher NO^-_3-N/NH^+_4-N ratio in leaves than the other planting media. In this connection, Whipker and Hammer (1998b) reported that nutrient uptake ratios are a method of comparing nutrient uptake levels. Such result pointed out that medium "M_2" was the most suitable one which has the ability of furnishing plants with elements of the nutrient solution at adequate levels and consequently produced the best growth and flowering. However, medium "M_3" resulted in the next higher values of leaf nutrient contents, hence clay medium "M_1" was the inferior one in this respect. Meanwhile, the media M_4, M_5 and M_6 showed positive effects on nutrients uptake and gave intermediate results compared to the other media. These results are in agreement with those reported by Mohamed (1988) on *Euphorbia pulcherrima, Aglaonema modestum* and *Syngonium podophyllum,* Yelanich and Biernbaum (1993) on poinsettia, Hassan *et al.* (1994) on *Cupressus sempervirens,* Mansour *et al.* (1994) on *Syngonium podophyllum*, El-Sallami (1996) on *Ficus benjamina* and El-Sallami and Mahros (1997) on *Thuja orientalis*.

Regarding the effect of N-form nutrition on nutrients uptake, Tables (6 & 7) showed that although the leaf contents of total-N, NO^-_3- N, NH^+_4-N, P, K, Ca and Mg were increased with the presence of 100% NO^-_3 in the nutrient solution and decreased them with 100% NH^+_4, except P and NH^+_4, the nutrient contents were the greatest with supplying a mixed N source of (75/25) followed by (50/50). This effect was mainly promoted by NH^+_4 uptake. Similar results were obtained on poinsettia (Cox and Seeley, 1984; Scoggins and Mills, 1998 and Whipker and Hammer, 1998a) and some conifer seedlings (Van Den Driessche, 1971; Ingestad, 1979 and Mehne-Jakobs and Gulpen, 1997). They concluded that when both N-forms were present in the growth medium the plants contained higher nutrients than either nitrate or ammonium alone. Meanwhile, higher ammonium feeding reduced the accumulations of total-N, NO^-_3-N, K, Ca and Mg in leaves, but for NH^+_4-dominated nutrition adverse effects, including toxicity at high concentrations, soil acidification and disturbance of ion balance causing plant damage by inducing nutrient imbalances especially on soils with limiting availabilities of cations such as K, Ca and Mg.

The interaction between planting media and N-form nutrition (Tables 6 & 7) showed that the maximum concentrations of total-N, NO^-_3-N, P, K, Ca and Mg in leaves occurred with medium "M_2" plus both N-forms (75/25).

Nitrate reductase (NR) activity:

Nitrate reductase is generally believed to be the enzyme reducing NO^-_3 to NO^-_2. The enzyme is substrate induced, and the amount is determined by the NO^-_3 supply (Beevers and Hageman, 1969). Data illustrated in Figure (3) showed that NR activity followed similar trend in leaves and roots, while it was higher in roots than in leaves. The low activity lead to higher accumulation

Table (6): Effect of planting media and varied NO^-_3/NH^+_4 ratio in the nutrient solution on the concentrations of total nitrogen, nitrate-N (NO^-_3), ammonium-N (NH^+_4) and NO^-_3N/NH^+_4-N ratio in poinsettia leaves during 2000 and 2001 seasons.

Media	NO^-_3/NH^+_4 ratios (% in solution)													
	2000 season							2001 season						
	Control	100/0	75/25	50/50	25/75	0/100	Mean	Control	100/0	75/25	50/50	25/75	0/100	Mean
	Total nitrogen (%)													
M_1	2.85	2.92	3.60	3.41	3.12	2.42	3.05	2.76	3.01	3.56	3.48	3.05	2.31	3.03
M_2	3.55	4.02	4.35	3.92	3.65	3.16	3.78	3.61	4.11	4.49	4.07	3.61	3.20	3.85
M_3	3.11	3.77	4.01	3.66	3.48	2.81	3.47	3.02	3.71	4.11	3.74	3.42	2.70	3.45
M_4	2.92	3.61	3.87	3.54	3.30	2.69	3.32	2.86	3.66	3.92	3.65	3.26	2.45	3.30
M_5	2.80	3.45	3.74	3.72	3.25	2.45	3.24	2.70	3.60	3.95	3.80	3.15	2.50	3.28
M_6	2.84	3.59	3.96	3.80	3.24	2.31	3.29	2.79	3.69	4.03	3.88	3.19	2.33	3.32
Mean	3.01	3.56	3.92	3.68	3.34	2.64		2.96	3.63	4.01	3.77	3.28	2.58	
LSD 5%	Media: 0.25		NO^-_3/NH^+_4: 0.25		Media x NO^-_3/NH^+_4: 0.61			Media: 0.32		NO^-_3/NH^+_4: 0.32		Media x NO^-_3/NH^+_4: 0.78		
	NO^-_3-N (ppm)													
M_1	855	2596	2714	1615	1217	392	1565	812	2556	2820	1668	1180	431	1578
M_2	1118	3465	3340	1966	1995	486	2062	1078	3502	3451	2026	2035	530	2104
M_3	968	3278	3147	1908	1778	452	1922	923	3319	3260	1964	1809	476	1959
M_4	905	3155	2939	1862	1580	440	1814	862	3262	3068	1903	1612	485	1865
M_5	876	3205	2985	1817	1519	438	1807	847	3265	3110	1878	1540	473	1852
M_6	894	3190	3086	1770	1487	445	1812	836	3386	3169	1830	1568	480	1878
Mean	936	3148	3035	1823	1596	442		893	3215	3146	1878	1624	479	
LSD 5%	Media: 134		NO^-_3/NH^+_4: 134		Media x NO^-_3/NH^+_4: 328			Media: 146		NO^-_3/NH^+_4: 146		Media x NO^-_3/NH^+_4: 358		
	NH^+_4-N (ppm)													
M_1	582	621	636	764	868	892	727	620	651	694	831	915	953	777
M_2	532	566	614	709	785	713	653	563	572	642	734	734	768	669
M_3	549	603	705	756	817	898	721	502	640	746	820	853	956	753
M_4	591	656	749	860	872	970	783	647	686	825	918	907	1043	838
M_5	635	678	840	887	932	998	828	695	744	923	970	1028	1060	903
M_6	652	716	806	915	934	1026	842	766	751	916	984	975	1041	906
Mean	590	640	725	815	868	916		632	674	791	876	902	970	
LSD 5%	Media: 54		NO^-_3/NH^+_4: 54		Media x NO^-_3/NH^+_4: 132			Media: 66		NO^-_3/NH^+_4: 66		Media x NO^-_3/NH^+_4: 162		
	NO^-_3-N/NH^+_4-N ratio													
M_1	1.47	4.18	4.27	2.11	1.40	0.44	2.31	1.31	3.93	4.06	2.01	1.29	0.45	2.18
M_2	2.10	6.12	5.44	2.77	2.54	0.68	3.28	1.91	6.12	5.38	2.76	2.77	0.69	3.27
M_3	1.76	5.44	4.46	2.52	2.18	0.50	2.81	1.84	5.19	4.37	2.40	2.12	0.50	2.74
M_4	1.53	4.81	3.92	2.17	1.81	0.45	2.45	1.33	4.76	3.72	2.07	1.78	0.47	2.36
M_5	1.38	4.73	3.55	2.05	1.63	0.44	2.30	1.22	4.39	3.37	1.94	1.50	0.45	2.15
M_6	1.37	4.46	3.83	1.93	1.59	0.43	2.27	1.09	4.51	3.46	1.86	1.61	0.46	2.17
Mean	1.60	4.96	4.25	2.26	1.86	0.49		1.45	4.82	4.06	2.17	1.85	0.50	

Table (7): Effect of planting media and varied NO_3^-/NH_4^+ ratio in the nutrient solution on phosphorus, potassium, calcium and magnesium contents in poinsettia leaves during 2000 and 2001 seasons.

Media	NO_3^-/NH_4^+ ratios (% in solution)													
	2000 season							2001 season						
	Control	100/0	75/25	50/50	25/75	0/100	Mean	Control	100/0	75/25	50/50	25/75	0/100	Mean
	Phosphorus (%)													
M_1	0.321	0.354	0.556	0.477	0.511	0.460	0.447	0.332	0.363	0.569	0.489	0.517	0.472	0.457
M_2	0.460	0.506	0.695	0.589	0.642	0.559	0.575	0.480	0.520	0.709	0.606	0.656	0.575	0.591
M_3	0.375	0.454	0.671	0.542	0.593	0.473	0.518	0.386	0.465	0.684	0.555	0.607	0.484	0.530
M_4	0.367	0.409	0.664	0.520	0.570	0.435	0.494	0.383	0.421	0.676	0.534	0.583	0.448	0.508
M_5	0.369	0.388	0.640	0.524	0.561	0.449	0.489	0.375	0.397	0.662	0.536	0.592	0.461	0.504
M_6	0.375	0.369	0.651	0.502	0.526	0.433	0.476	0.391	0.396	0.667	0.418	0.514	0.435	0.470
Mean	0.378	0.413	0.646	0.526	0.567	0.468		0.391	0.427	0.661	0.523	0.578	0.479	
LSD 5%	Media: 0.063		NO_3^-/NH_4^+: 0.063		Media x NO_3^-/NH_4^+: 0.154			Media: 0.067		NO_3^-/NH_4^+: 0.067		Media x NO_3^-/NH_4^+: 0.164		
	Potassium (%)													
M_1	2.38	2.60	3.04	2.92	2.32	2.01	2.55	2.18	2.69	2.65	3.01	2.15	1.91	2.43
M_2	2.93	3.70	3.89	3.48	2.65	2.25	3.15	3.02	3.84	4.34	3.61	2.52	2.36	3.28
M_3	2.69	3.12	3.46	3.17	2.42	2.19	2.84	2.54	3.25	3.77	3.25	2.24	2.06	2.85
M_4	2.55	2.98	3.38	3.16	2.30	2.02	2.73	2.63	3.07	3.63	3.21	2.17	1.89	2.77
M_5	2.59	2.90	3.31	3.11	2.33	2.03	2.71	2.53	3.15	3.69	3.19	2.20	1.91	2.78
M_6	2.57	3.07	3.37	3.19	2.27	2.01	2.75	2.41	3.12	3.71	3.28	2.11	1.98	2.77
Mean	2.62	3.06	3.41	3.17	2.38	2.09		2.55	3.19	3.63	3.26	2.23	2.02	
LSD 5%	Media: 0.24		NO_3^-/NH_4^+: 0.24		Media x NO_3^-/NH_4^+: 0.59			Media: 0.19		NO_3^-/NH_4^+: 0.19		Media x NO_3^-/NH_4^+: 0.46		
	Calcium (%)													
M_1	1.36	1.58	1.93	1.65	1.37	1.02	1.49	1.41	1.66	1.84	1.63	1.26	1.01	1.47
M_2	2.01	2.17	2.71	2.36	1.96	1.36	2.10	2.09	2.28	2.87	2.51	1.91	1.29	2.16
M_3	1.72	1.88	2.36	2.03	1.61	1.11	1.79	1.74	1.94	2.49	2.06	1.54	1.06	1.81
M_4	1.52	1.79	2.21	1.80	1.36	1.09	1.63	1.60	1.85	2.32	1.73	1.30	1.04	1.64
M_5	1.51	1.66	2.13	1.76	1.39	1.11	1.59	1.63	1.72	2.27	1.68	1.24	1.05	1.60
M_6	1.66	1.73	1.98	1.69	1.43	1.15	1.61	1.67	1.90	2.24	1.86	1.34	1.02	1.67
Mean	1.63	1.80	2.22	1.88	1.52	1.14		1.69	1.89	2.34	1.91	1.43	1.08	
LSD 5%	Media: 0.21		NO_3^-/NH_4^+: 0.21		Media x NO_3^-/NH_4^+: 0.51			Media: 0.18		NO_3^-/NH_4^+: 0.18		Media x NO_3^-/NH_4^+: 0.44		
	Magnesium (%)													
M_1	1.09	1.18	1.34	1.21	0.86	0.74	1.07	1.11	1.21	1.41	1.27	0.92	0.85	1.13
M_2	1.35	1.54	1.88	1.63	1.37	1.15	1.49	1.42	1.71	2.05	1.68	1.45	1.24	1.59
M_3	1.13	1.38	1.77	1.47	1.01	0.92	1.28	1.20	1.42	1.86	1.50	1.06	1.01	1.34
M_4	1.06	1.19	1.56	1.33	0.97	0.79	1.15	1.14	1.24	1.67	1.40	1.04	0.85	1.22
M_5	1.02	1.23	1.64	1.37	0.94	0.76	1.16	1.12	1.28	1.70	1.32	1.02	0.74	1.20
M_6	1.08	1.29	1.65	1.28	0.98	0.69	1.16	1.10	1.31	1.72	1.36	1.06	0.78	1.22
Mean	1.12	1.30	1.64	1.38	1.02	0.84		1.18	1.36	1.74	1.42	1.09	0.91	
LSD 5%	Media: 0.18		NO_3^-/NH_4^+: 0.18		Media x NO_3^-/NH_4^+: 0.44			Media: 0.16		NO_3^-/NH_4^+: 0.16		Media x NO_3^-/NH_4^+: 0.39		

of nitrate in leaves than the corresponding one of roots.It has been suggested that the reduction of NO^-_3 in poinsettia plants occurs principally in the roots and that nitrogen is transported to the leaves entirely in organic form. Similar results were reported on some conifer seedlings by Martin *et al.* (1981), Yandow and Klein (1986), Wingsle *et al.* (1987) and Margolis *et al.* (1988).

On the other hand, the NR activity in poinsettia plants tended to be greater when they grown in medium "M_2" than the other media (Fig. 3). The increments in activities of that plants as percentages over those grown in clay medium "M_1" were 37 and 50% for leaves and roots, respectively. The enhancement effects of medium "M_2" were probably due to produce the greater leaf area, carbohydrates concentration and higher percentage in leaf N which cause a large amount of metabolic NO^-_3 production. These results are in conformity with those reported by Smirnoff *et al.* (1984) on some woody plants and Margolis *et al.* (1988) on jack pine seedlings.

With regard to the effect of N-form nutrition (Fig. 3), it was noticed that NO^-_3-nutrition stimulated NR activity in leaves and roots, however, these activities were increased with increasing nitrate concentration in the nutrient solution. As for NR activities of varied NO^-_3/NH^+_4 ratios had the pattern (100/0) > (75/25) > (50/50) > (75/25). Hence, the highest NR activity was resulted from NO^-_3-fed plants with average 137% higher in leaves and 270% higher in roots than control plants. These results are in accordance with the findings of Smirnoff *et al.* (1984) on some woody plants and Wingsle *et al.* (1987) on Scots pine seedlings. They proved that the ability to increase NR activity in plant could be a mechanism for responding to the higher NO^-_3 level. When NO^-_3 was reduced by one half, the mean NR activity in leaves and roots was also reduced by about one half.

In contrast NR activity was less with NH^+_4-nutrition than with NO^-_3 and averaged 31% lower in leaves and 26% lower in roots than control plants (Fig. 3). These results are in agreement with those obtained by Margolis *et al.* (1988) who concluded that ammonium nutrition negatively affected NR activity compared to nitrate alone or in combination with ammonium in jack pine seedlings. In addition, Martin *et al.* (1981) and Wingsle *et al.* (1987) stated that the decline NR activity might be caused by inhibitory effects of ammonium as a result of inhibition on a metabolic level or a result of lowered NO^-_3 absorption.

The interaction (Fig. 3) showed that the NR activity was greatest in

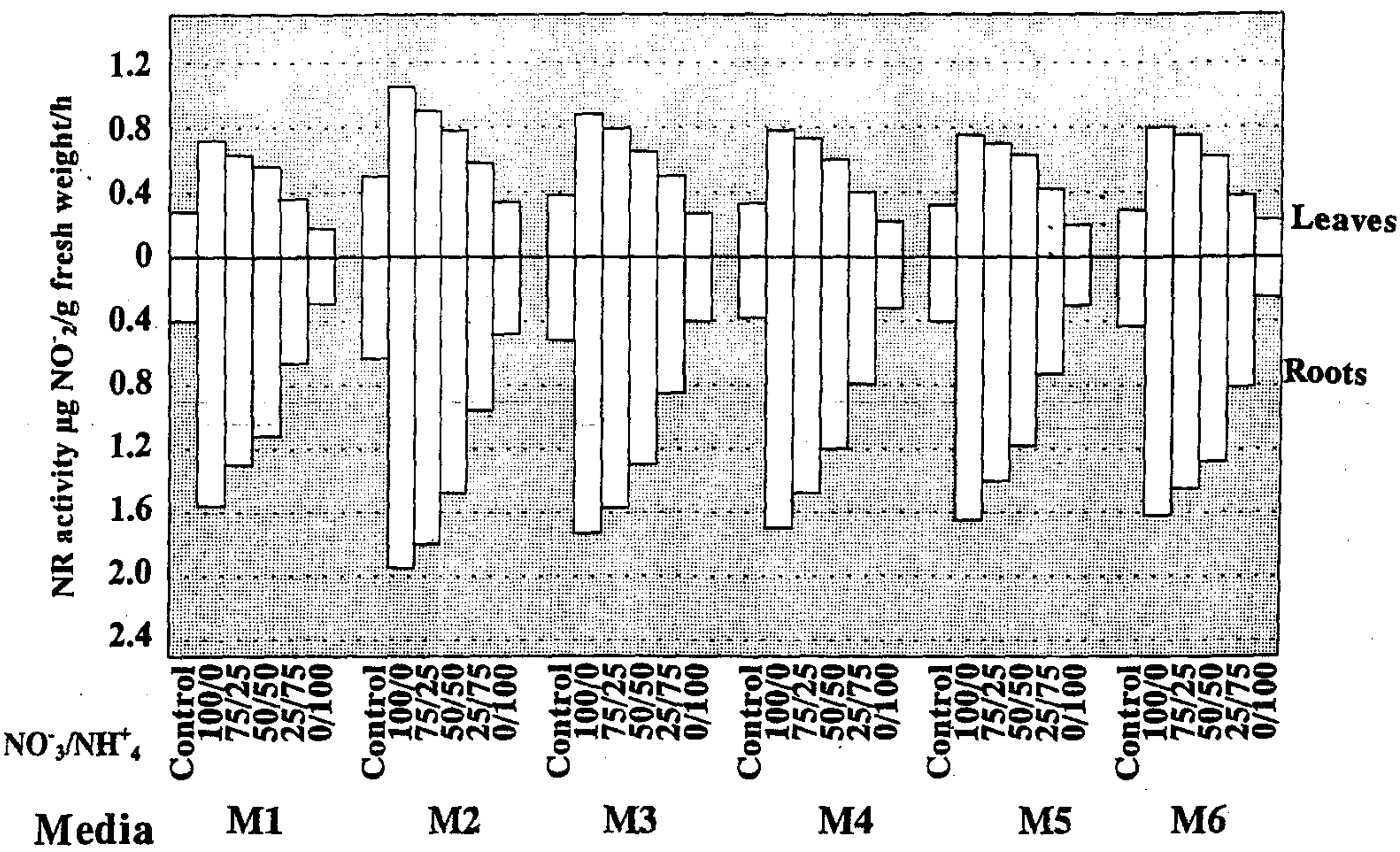

Fig. (3): **Nitrate reductase (NR) activity of poinsettia plants as affected by different planting media and NO^-_3/NH^+_4 ratios in the nutrient solution (average of both seasons).**

plants grown in medium "M_2" and feeding with N-forms of (100/0) and (75/25) and least in seedlings grown in medium "M_1" and supplying with NH^+_4 as a nitrogen source (0/100).

Leaf and bract pigmentation:

Photosynthetic pigments:

Data in Table (8) showed that different treatments of both potting media and NO^-_3/NH^+_4 nutrition had a considerable effect on leaf pigments content in poinsettia leaves. Clearly, all planting media increased chlorophylls (a&b) compared with medium "M_1". However, medium "M_2" was the most effective in increasing their concentrations in leaves resulting in the highest contents. Meanwhile, all potting mixtures had no significant effect on leaf carotenoids content. These results are in harmony with those reported by Mansour *et al.* (1994) on *Syngonium podophyllum*, Abu Dahab (1996) on *Brassaia arboricola*, El-Sallami (1996) on *Ficus benjamina*, El-Sallami and Mahros (1997) on *Thuja orientalis*, and Saleh (2000) on *Ficus benjamina* "Starlight".

Such increase in chlorophylls (a&b) content in leaves which caused by medium "M_2" may confirm the results of nitrogen and magnesium (Tables 6 & 7) which showed also increases in N and Mg contents in leaves. This was based on the fact that N and Mg are considered as essential elements for chlorophyll synthesis. Hence, any increase in leaf N and/or Mg resulted in corresponding increase in chlorophyll building as reported by Bidwell (1974).

With regard to NO^-_3/NH^+_4 ratios effect on leaf pigments (Table 8), it was noticed that the ratio of (75/25) resulted in the maximum chlorophylls (a&b) content. As for carotenoids content, it was progressively increased with increasing the proportion of NH^+_4 in the nutrient solution resulting in the maximum content with the presence of NH^+_4 as sole source nitrogen. In this connection, Mehne-Jakobs and Gulpen (1997) found that chlorophyll concentration was strongly influenced by the applied nitrogen source in current-year needles of Norway spruce. NH^+_4-dominated nutrition resulted in significantly lower chlorophyll content compared to NO^-_3-dominated nutrition. Decrease in chlorophyll concentration was linearly correlated to reduction of Mg bound to chlorophyll as a result of Mg deficiency especially when nutrition was NH^+_4-dominated.

The interaction between growing media and N-form nutrition (Table 8) showed that the highest contents of chlorophylls (a&b) were obtained

Table (8): Effect of planting media and varied NO_3^-/NH_4^+ ratio in the nutrient solution on photosynthetic pigments in poinsettia leaves and anthocyanin content in bracts during 2000 and 2001 seasons.

Media	NO_3^-/NH_4^+ ratios (% in solution)													
	2000 season							2001 season						
	Control	100/0	75/25	50/50	25/75	0/100	Mean	Control	100/0	75/25	50/50	25/75	0/100	Mean
	Chlorophyll "a" (mg/g F.W.)													
M_1	1.16	1.25	1.59	1.27	1.09	0.91	1.21	1.20	1.29	1.63	1.22	1.03	0.96	1.22
M_2	1.52	1.71	1.89	1.76	1.43	1.27	1.60	1.58	1.80	1.96	1.75	1.45	1.26	1.63
M_3	1.36	1.56	1.76	1.65	1.27	1.14	1.46	1.35	1.59	1.80	1.62	1.23	1.08	1.45
M_4	1.27	1.43	1.69	1.60	1.14	1.01	1.36	1.32	1.51	1.74	1.55	1.16	0.96	1.37
M_5	1.30	1.48	1.74	1.61	1.18	1.05	1.39	1.36	1.53	1.77	1.54	1.14	0.98	1.39
M_6	1.26	1.40	1.71	1.58	1.16	0.99	1.35	1.40	1.46	1.79	1.57	1.08	0.95	1.38
Mean	1.31	1.47	1.73	1.58	1.21	1.06		1.37	1.53	1.78	1.54	1.18	1.03	
LSD 5%	Media: 0.23		NO_3^-/NH_4^+: 0.23		Media x NO_3^-/NH_4^+: 0.56			Media: 0.26		NO_3^-/NH_4^+: 0.26		Media x NO_3^-/NH_4^+: 0.64		
	Chlorophyll "b" (mg/g F.W.)													
M_1	0.75	0.81	1.02	0.94	0.69	0.54	0.79	0.78	0.85	1.10	0.96	0.66	0.52	0.81
M_2	1.08	1.19	1.36	1.18	0.92	0.78	1.09	1.14	1.27	1.51	1.25	0.98	0.80	1.16
M_3	0.89	1.11	1.21	1.06	0.78	0.65	0.95	0.92	1.15	1.30	1.15	0.82	0.64	1.00
M_4	0.86	0.95	1.12	1.02	0.74	0.60	0.88	0.94	1.04	1.28	1.07	0.78	0.63	0.96
M_5	0.87	0.98	1.17	0.96	0.69	0.63	0.88	0.91	1.08	1.26	1.03	0.74	0.67	0.95
M_6	0.90	1.03	1.09	1.03	0.75	0.65	0.91	0.89	1.03	1.18	1.09	0.76	0.65	0.93
Mean	0.89	1.01	1.16	1.03	0.76	0.64		0.93	1.07	1.27	1.09	0.79	0.65	
LSD 5%	Media: 0.19		NO_3^-/NH_4^+: 0.19		Media x NO_3^-/NH_4^+: 0.47			Media: 0.17		NO_3^-/NH_4^+: 0.17		Media x NO_3^-/NH_4^+: 0.42		
	Carotenoids (mg/g F.W.)													
M_1	0.36	0.40	0.42	0.47	0.54	0.70	0.48	0.37	0.43	0.45	0.51	0.57	0.70	0.51
M_2	0.39	0.40	0.44	0.50	0.59	0.68	0.50	0.42	0.46	0.49	0.54	0.60	0.74	0.54
M_3	0.40	0.39	0.42	0.48	0.60	0.69	0.50	0.41	0.43	0.48	0.52	0.60	0.72	0.53
M_4	0.36	0.42	0.43	0.49	0.62	0.71	0.51	0.39	0.46	0.47	0.54	0.63	0.70	0.53
M_5	0.37	0.38	0.41	0.46	0.56	0.67	0.48	0.38	0.42	0.45	0.53	0.60	0.69	0.51
M_6	0.36	0.41	0.46	0.49	0.63	0.70	0.51	0.37	0.45	0.49	0.55	0.61	0.73	0.53
Mean	0.37	0.40	0.43	0.48	0.59	0.69		0.39	0.44	0.47	0.53	0.60	0.71	
LSD 5%	Media: N.S		NO_3^-/NH_4^+: 0.15		Media x NO_3^-/NH_4^+: N.S.			Media: N.S.		NO_3^-/NH_4^+: 0.14		Media x NO_3^-/NH_4^+: N.S.		
	Anthocyanin (mg/100 F.W.)													
M_1	12.6	15.2	20.4	16.2	12.8	11.6	14.8	11.9	13.8	18.6	15.7	11.5	10.8	13.7
M_2	18.9	23.4	29.3	22.6	17.7	14.2	21.0	18.3	24.6	28.7	23.2	16.2	14.6	20.9
M_3	16.8	21.2	26.4	18.4	14.8	13.6	18.5	16.1	19.0	25.9	17.6	14.3	12.8	17.6
M_4	16.0	18.8	24.3	17.5	14.3	12.6	17.3	15.7	18.3	23.8	16.1	13.1	10.6	16.3
M_5	17.3	19.1	24.8	16.9	14.5	10.3	17.2	16.3	17.7	23.5	17.3	12.8	11.0	16.4
M_6	16.9	19.4	23.6	17.6	14.2	12.1	17.3	16.6	17.6	22.9	15.8	12.6	10.1	15.9
Mean	16.4	19.5	24.8	18.2	14.7	12.4		15.8	18.5	23.9	17.6	13.4	11.7	
LSD 5%	Media: 1.4		NO_3^-/NH_4^+: 1.4		Media x NO_3^-/NH_4^+: 3.4			Media: 1.6		NO_3^-/NH_4^+: 1.6		Media x NO_3^-/NH_4^+: 3.9		

by the combination of medium "M_2" and the NO^-_3/NH^+_4 ratio of (75/25).

Total anthocyanin:

The anthocyanin content in poinsettia bracts was directly influenced by potting media and variations of the NO^-_3/NH^+_4 ratios (Table 8). Apparently, all growing media significantly increased anthocyanin content, while the medium "M_2" was most effective. Besides, the ratios of (100/0), (75/25) and (50/50) significantly increased anthocyanin concentration compared to control. However, (75/25) ratio resulted in the maximum content. Meanwhile, higher NH^+_4 feeding (25/75) and NH^+_4-dominated nutrition (0/100) showed inhibitory effect on anthocyanin formation. On the other hand, the combination of medium "M_2" and the ratio of (75/25) resulted in the maximum anthocyanin content. Similar trend of these results was obtained on poinsettia by Jin and Dong (1994).

Total carbohydrates:

Data in Tables (9) indicated that the total carbohydrate contents in both leaves and bracts were considerably affected by different planting media. The highest carbohydrate concentrations in leaves and bracts were found in plants grown in medium "M_2" followed by medium "M_3". However, the other growing media resulted in higher carbohydrate percentages than clay medium "M_1". Meanwhile, root carbohydrates content was not affected by various potting mixtures. Similar results were obtained by Mohamed and Khalil (1992) on *Pelargonium zonal*, Hassan *et al.* (1994) on *Cupressus sempervirens*, Mansour *et al.* (1994) on *Syngonium podophyllum*, Abou Dahab (1996) on *Brassaia arboricola*, El-Sallami and Mahros (1997) on *Thuja orientalis*, and Saleh *et al.* (2000) on *Ficus benjamina* "Starlight".

Taking in consideration data of the nutrient contents, it could be observed a direct relationship between the amounts of P and K absorbed by the plant and carbohydrates content. The medium "M_2" showed the highest carbohydrates content which related with the highest concentrations of P and K. Bidwell (1974) stated that phosphorus and potassium stimulated the physiological activity of the plant and enhanced carbohydrate assimilation so reflected in more accumulation of carbohydrates in plant organs.

In the meantime, it could be observed a positive relation between total carbohydrates and anthocyanin content. In this connection, Woodrow and Grodzinski (1987) concluded that there was a positive

Table (9): Effect of planting media and varied NO_3^-/NH_4^+ ratio in the nutrient solution on total carbohydrates content in plant organs of poinsettia and leaf C/N ratio during 2000 and 2001 seasons.

Media	NO_3^-/NH_4^+ ratios (% in solution)													
	2000 season							2001 season						
	Control	100/0	75/25	50/50	25/75	0/100	Mean	Control	100/0	75/25	50/50	25/75	0/100	Mean
Total carbohydrates in bracts (%)														
M_1	13.9	17.0	20.3	18.2	12.6	10.1	15.4	14.2	16.9	20.9	18.7	11.9	10.7	15.6
M_2	19.2	22.3	27.8	24.7	15.5	13.2	20.5	20.1	23.8	28.8	26.2	16.2	13.0	21.4
M_3	16.4	19.7	25.6	22.5	12.3	11.9	18.1	17.3	20.7	26.9	24.1	12.8	10.8	18.8
M_4	14.9	18.4	23.5	20.9	13.1	11.6	17.1	15.4	19.3	25.8	23.5	12.0	10.6	17.8
M_5	14.6	18.5	25.0	21.0	13.9	10.9	17.3	15.9	19.4	24.0	20.9	11.7	10.3	17.0
M_6	15.3	18.7	26.7	21.2	11.8	11.4	17.5	14.8	20.5	26.0	22.8	11.0	10.1	17.5
Mean	15.7	19.1	24.8	21.4	13.2	11.5		16.3	20.1	25.4	22.7	12.6	10.9	
LSD 5%	Media: 2.3		NO_3^-/NH_4^+: 2.3		Media x NO_3^-/NH_4^+: 5.6			Media: 2.4		NO_3^-/NH_4^+: 2.4		Media x NO_3^-/NH_4^+: 5.9		
Total carbohydrates in leaves (%)														
M_1	13.1	15.7	19.4	18.3	11.8	9.5	14.6	12.0	12.8	18.6	16.5	10.1	9.1	13.2
M_2	18.0	21.1	26.3	23.5	14.6	11.9	19.2	17.6	20.0	26.8	21.6	13.2	11.8	18.5
M_3	14.1	18.4	24.4	20.8	12.3	10.6	16.8	13.8	17.6	24.2	18.2	11.8	9.4	15.8
M_4	14.6	17.8	23.7	18.9	11.6	10.1	16.1	13.1	15.6	22.9	17.8	10.5	9.9	15.0
M_5	14.0	17.3	23.1	19.7	12.0	10.3	16.1	13.3	15.4	22.3	18.6	11.0	9.4	15.0
M_6	15.6	16.6	24.2	19.5	12.8	9.4	16.4	12.4	15.9	22.6	18.4	10.6	9.2	14.0
Mean	14.9	17.8	23.5	20.1	12.5	10.3		13.7	16.2	22.9	18.5	11.2	9.8	
LSD 5%	Media: 1.7		NO_3^-/NH_4^+: 1.7		Media x NO_3^-/NH_4^+: 4.2			Media: 1.5		NO_3^-/NH_4^+: 1.5		Media x NO_3^-/NH_4^+: 3.7		
Total carbohydrates in roots (%)														
M_1	11.1	14.8	19.3	16.1	10.2	9.1	13.4	10.9	15.1	17.4	15.6	10.1	8.5	12.9
M_2	13.1	16.1	19.4	17.1	11.0	9.2	14.3	11.7	15.8	18.8	16.9	10.0	8.3	13.6
M_3	12.0	15.6	19.0	16.6	10.8	8.9	13.8	10.9	14.2	18.1	16.2	9.8	8.0	12.9
M_4	12.6	15.7	18.4	15.7	10.5	8.7	13.6	10.7	14.1	18.7	16.6	9.5	7.9	12.9
M_5	11.3	15.7	18.9	16.5	9.9	8.5	13.5	10.4	14.8	17.5	15.0	9.3	8.0	12.5
M_6	11.7	15.0	18.3	16.2	9.7	8.4	13.2	10.1	14.5	18.0	15.5	8.2	7.8	12.4
Mean	12.0	15.5	18.9	16.4	10.4	8.8		10.8	14.8	18.1	16.0	9.5	8.1	
LSD 5%	Media: N.S.		NO_3^-/NH_4^+: 1.4		Media x NO_3^-/NH_4^+: N.S.			Media: N.S.		NO_3^-/NH_4^+: 1.3		Media x NO_3^-/NH_4^+: N.S.		
C/N ratio in leaves														
M_1	4.60	5.38	5.39	5.37	3.78	3.93	4.74	4.35	4.25	5.22	4.74	3.31	3.94	4.30
M_2	5.07	5.25	6.05	5.99	4.00	3.77	5.02	4.88	4.87	5.97	5.31	3.66	3.69	4.73
M_3	4.53	4.88	6.08	5.68	3.53	3.77	5.08	4.57	4.74	5.89	4.87	3.45	3.48	4.50
M_4	5.00	4.93	6.12	5.34	3.52	3.75	4.78	4.58	4.26	5.84	4.88	3.22	4.04	4.47
M_5	5.00	5.01	6.18	5.30	3.69	4.20	4.90	4.93	4.28	5.64	4.89	3.49	3.76	4.50
M_6	5.49	4.62	6.11	5.13	3.95	4.07	4.90	4.44	4.31	5.61	4.74	3.32	3.95	4.40
Mean	4.95	5.01	5.99	5.47	3.75	3.92		4.63	4.45	5.70	4.91	3.41	3.81	

correlation between total anthocyanin content and the amounts of carbohydrates accumulation in bract tissues of poinsettia.

From the foregoing results presentation it could be observed that medium "M_2" produced the best growth and flowering characters of poinsettia which correlated with high total carbohydrates content.

As for NO^-_3/NH^+_4 nutrition effect on carbohydrates percentage (Table 9), it is quite evident that (75/25) ratio was the superior for carbohydrates accumulation in plant tissues (bracts, leaves and roots) followed by (50/50) ratio, but the reverse was true with the ratios of (25/75) and (0/100). These results are in agreement with those reported by Kirkby (1968) on white mustard plants. He stated that total carbohydrates content was found in higher concentrations in the leaves and stems of plants supplied with NO^-_3-N than in those with NH^+_4-N.

The interaction between planting media and N-form nutrition (Table 9) declared that carbohydrates content in poinsettia plants was the highest when they grown in pots contained medium "M_2" and supplied with both N forms of (75/25). Such increase in total carbohydrates content in leaves might be attributed to the increase in photosynthetic area on the plant causing more photosynthesis activity, consequently producing more photosynthetic compounds leading to more carbohydrates accumulation in leaves and more translocation inducing higher carbohydrate contents in bracts and roots.

Leaf C/N ratio:

Data in Table (9) appeared that C/N ratio in leaves was affected by different treatments. Clearly, all growing media increased this ratio compared with medium "M_1", however, medium "M_2" was the most effective. On the other hand, N-nutrition with the ratios of (100/0), (75/25) and (50/50) increased C/N ratio whereas (75/25) ratio was the superior. In contrast, the ratios of (25/75) and (0/100) decreased C/N ratio in leaves. The increment C/N ratio in leaves reflected the increase of total carbohydrates content in relation to nitrogen concentration. This may lead to improve the growth characters of plants producing best qualities of foliage and flowering as mentioned by Nofal *et al.* (1998) on *Schinus terebenthifolius* and *Celosia plumosa*.

It could be concluded that the medium contained 2 clay + 1 sand combined with NO^-_3/NH^+_4 ratio of (75/25) was the superior treatment regarding its promising stimulation effects on different growth and flowering characteristics. So, it could be recommended to use this combination which preferable for commercial production of poinsettia.

References

Abou-Dahab, T.A. (1996): Effect of growing media, nitrogen sources and commercial fertilizers on growth and chemical composition of *Brassaia arboricola* cv. "Gold capella" plants. Ph.D. Thesis, Fac. Agric., Cairo Univ., Egypt.

Barker, A.V. (1966): Root environment acidity as a regulatory factor in ammonium assimilation by bean plant. Plant Physiol. 41: 1193-1199.

Beevers, L. and R.H. Hageman (1969): Nitrate reduction in higher plants. Annu. Rev. Plant Physiol. 20: 495-522.

Bidwell, R.G. (1974): Plant Physiology. Macmillan Publishing Co., Inc., N.Y.

Bierman, P.M.; C.J. Rosen and H.F. Wilkins (1990): Leaf edge burn and axillary shoot growth of vegetative poinsettia plants: Influence of calcium, nitrogen form and molybdenum. J. Amer. Soc. Hort. Sci., 115 (1): 73-78.

Bunt, A.C. (1974): Some physical and chemical characteristics of loamless pot-plant substrates and their relation to plant growth. Acta Horticultura 37: 1954-1965.

Conover, C.A. and R.T. Poole (1988): Growth of foliage plants in differentially compacted potting media. J. Amer. Soc. Hort. Sci., 113 (1): 65-70.

Cox, D.A. and J.G. Seeley (1984): Ammonium injury to poinsettia: Effects of NH_4-N: NO_3-N ratio and pH control in solution culture on growth, N absorption, and N utilization. J. Amer. Soc. Hort. Sci., 109 (1): 57-62.

Danwitz, H. and F. Escher (1988): Poinsettia mother plants-soilless culture has advantages. Gb+Gw 88 (7): 280-282. (C.F. Hort. Abst. Vol. 58 (11): 7928).

El-Sallami, I.H. (1996): Response of *Ficus benjamina* L. to different potting media and doses of nutrient solution. Assiut J. Agric. Sci., 27 (3): 61-76.

El-Sallami, I.H. and O.M. Mahros (1997): Growth response of *Thuja orientalis* L. seedling to different potting media and NPK fertilization. Assiut J. Agric. Sci., 28 (1): 3-20.

Fonteno, W.C.; D.K. Cassel and R.A. Larson (1981): Physical properties of three container media and their effect on poinsettia growth. J. Amer. Soc. Hort. Sci., 106 (6): 736-741.

Fuleki, T. and J.F. Francis (1968): Quantitative methods for anthocyanins. J. Food Sci., 33: 72-76.

Gaffney, J.M.; R.S. Lindstrom; A.R. McDaniel and A.J. Lewis (1982): Effect of ammonium and nitrate nitrogen on growth of poinsettia. HortScience 17 (4): 603-604.

Hansen, J. and I. Moller (1975): Percolation of starch and soluble carbohydrates from plant tissue for quantitative determination with anthrone. Analytical Biochemistry 68: 87-94.

Hartley, D.E. (1992): Poinsettias, 305-331. In: R.A. Larson (ed.), Introduction to Floriculture, 2nd Ed. Academic Press, New York.

Hassan, H.A.; S.M. Mohamed; E.M. Abo El-Ghait and H.H. Hammad (1994): Growth and chemical composition of *Cupressus sempervirens* L. seedlings in response to growing media. Annals of Agric. Sci., Moshtohor, 32 (1): 497-510.

Ingestad, T. (1979): Mineral nutrient requirements of *Pinus silvestris* and *Picea abies* seedlings. Physiol. Plantarum 45: 373-380.

Jin, B. and H.R. Dong (1994): Studies on the colour of *Euphorbia pulcherrima*, Willd. Acta Horticulturae Sinica, 21 (1): 87-90. (C.F. Hort. Abst. Vol. 65: 4369).

Kirkby, E.A. (1968): Influence of ammonium and nitrate nutrition on the cation-anion balance and nitrogen and carbohydrate metabolism of white mustard plants grown in dilute nutrient solutions. Soil Sci., 105 (3): 133-141.

Lawton, K.A.; G.L. McDaniel and E.T. Graham (1989): Nitrogen source and calcium supplement affect stem strength of poinsettia. HortScience 24 (3): 463-465.

Lee, C.W.; K.L. Goldsberry and J.J. Hanan (1987): Evaluation of loose rockwool as a growing medium for poinsettia: Comparison with peatlite and soil mixes. Res. Bull., Colorado Greenhouse Growers' Association, 441: 1-2. (C.F. Hort. Abst. Vol. 57 (7): 5781).

Lucas, R.E. and J.F. Davis (1961): Relationships between pH values of organic soils and availabilities of 12 plant nutrients. Soil Sci., 92: 177-181.

Mansour, H.A.; E.I. El-Maadawy and A. El-Tantawy (1994): Growth and chemical composition of *Syngonium podophyllum* as affected by growing media and the foliar fertilizer "Greenzit". Egypt. J. Appl. Sci., 9 (3): 244-273.

Margolis, H.A.; L.P. Vezina and R. Ouimet (1988): Relation of light and nitrogen source to growth, nitrate reductase and glutamine synthetase activity of jack pine seedlings. Physiol. Plantarum 72: 790-795.

Martin, F.; M. Chemardin and P. Gadal (1981): Nitrate assimilation and nitrogen circulation in Austrian pine. Physiol. Plantarum 53: 105-110.

Mastalerz, J.W. (1977): The Greenhouse Environment. John Wiley & Sons, Inc., N.Y.

Maynard, D.N. and A.V. Barker (1969): Studies on the tolerance of plants to ammonium nutrition. J. Amer. Soc. Hort. Sci., 94: 235-239.

Mehne-Jakobs, B. and M. Gulpen (1997): Influences of different nitrate to ammonium ratios on chlorosis, cation concentrations and the binding forms of Mg and Ca in needles of Mg-deficient Norway spruce. Plant and Soil 188: 267-277.

Mertens, W.C. and R.D. Wright (1978): Root and shoot growth rate relationships of two cultivars of Japanese holly. J. Amer. Soc. Hort. Sci., 103 (6): 722-724.

Mohamed, S.M. (1988): Effect of media and foliar nutrition on the growth of some greenhouse plants. Egypt. J. Appl. Sci., 3 (2): 236-246.

Mohamed, S.M. and M.M. Khalil (1992): Effect of media and urea on growth and flowering of *Pelargonium zonal*, L. Red and Rose cvs. Egypt. J. Appl. Sci., 7 (9): 104-116.

Nell, T.A. and J.E. Barrett (1985): Nitrate-ammonium nitrogen ratio and fertilizer application method influence bract necrosis and growth of poinsettia. HortScience 20 (6): 1130-1131.

Nofal, E.M.; M.A. El-Tarawy; F.A. Menesi and E.A. Attia (1998): Effect of CCC, Morphactin and Pix on the growth and chemical composition of *Schinus terebenthifolius*, Radd and *Celosia plumosa*, Hort. Proc. 2nd Conf. of Ornamental Hort. p. 173-186, Ismailia, Egypt.

Patnaik, R.; A.V. Barker and D.N. Maynard (1972): Effects of ammonium and potassium ions on some physiological and biochemical processes of excised cucumber cotyledons. Physiol. Plant., 27: 32-36.

Pertuit, A.J. and A.R. Mazur (1981): Development of growth media for poinsettias. HortScience 16 (2): 216-218.

Pierpont, R.A. and P.L. Minotti (1977): Effects of calcium carbonate on ammonium assimilation by tomato seedlings. J. Amer. Soc. Hort. Sci., 102: 20-23.

Piper, C.S. (1967): Soil and Plant Analysis. 2nd Ed. Asia Pub. House, Bombay.

Purtich, G.S. and A.V. Barker (1967): Structure and function of tomato leaf chloroplasts during ammonium toxicity. Plant Physiol., 42: 1229-1238.

Rose, M.A. (1992): Growth of poinsettia stock plants with high ammonium fertilizer. Bull. Pennsylvania Flower Growers 411: 3-4. (C.F. Hort. Abst. Vol. 63 (2): 1410).

Saleh, S.I. (2000): Effect of different planting media on the growth and chemical composition of *Ficus benjamina* "Starlight" plants grown under two locations "outdoor and plastichouse" conditions. Egypt. J. Hort., 27 (4): 543-568.

Scharpf, H.; E. Grantzau and L. Hendriks (1981): Quality requirements of bark substrates for horticulture. Deutscher Gartenbau 36 (15): 618-620. (C.F. Hort. Abst. Vol. 52 (2): 1000).

Scoggins, H.L.; H.A. Mills (1998): Poinsettia growth, tissue nutrient concentration and nutrient uptake as influenced by nitrogen form and stage of growth. J. Plant Nutrition 21 (1): 191-198.

Smirnoff, N.; P. Todd and G.R. Stewart (1984): The occurrence of nitrate reduction in the leaves of woody plants. Ann. Bot. 54: 363-374.

Snedecor, G.W. and W.G. Cochran (1989): Statistical Methods. 8th Ed., Iowa State Univ., Press, Iowa, USA.

Tesi, R. and D. Tosi (1987): The use of expanded clay for pot culture of poinsettias. Colture Protette 16 (12): 31-35. (C.F. Hort. Abst. Vol. 58 (10): 6846).

Van Den Driessche, R. (1971): Response of conifer seedlings to nitrate and ammonium sources of nitrogen. Plant and Soil 34: 421-439.

Vernon, L.P. (1960): Spectrophotometric determination of chlorophylls and pheophytins in plant extracts. Annal Chem., 32: 1144-1150.

Whipker, B.E. and P.A. Hammer (1998a): Comparison of hydroponic solutions for poinsettia nutritional studies. J. Plant Nutrition 21 (3): 531-543.

Whipker, B.E. and P.A. Hammer (1998b): Nutrient uptake in vegetative poinsettias grown with two fertilizer concentrations and two pinching dates. J. Plant Nutrition 21 (3): 545-559.

Wilcox, G.E.; C.A. Mitchell and J.E. Hoff (1977): Influence of nitrogen form on exudation rate, and ammonium, amide, and cation composition of xylem exudate in tomato. J. Amer. Soc. Hort. Sci., 102: 192-196.

Wingsle, G.; T. Nasholm; T. Lundmark and A. Ericsson (1987): Induction of nitrate reductase in needles of Scots pine seedlings by NO_x and NO^-_3. Physiol. Plantarum 70: 399-403.

Woodrow, L. and B. Grodzinski (1987): Ethylene evaluation from bracts and leaves of poinsettia (*Euphorbia pulcherrima*, Willd.). J. Experimental Botany, 38 (197): 2024-2032. (C.F. Hort. Abst. Vol. 58: 1636).

Yandow, T.S. and R.M. Klein (1986): Nitrate reductase of primary roots of red spruce seedlings. Plant Physiol. 81: 723-735.

Yashie, S. and H. Watanbe (1966): Effect of some organic materials on the physical properties of pot plant compost and the growth of chrysanthemum. Tech. Fac. Hort. Chiba 14: 35-41. (C.F. Hort. Abst. Vol. 38 (2): 3692).

Yelanich, M.V. and J.A. Biernbaum (1993): Root-medium nutrient concentration and growth of poinsettia at three fertilizer concentrations and four leaching fractions. J. Amer. Soc. Hort. Sci., 118 (6): 771-776.

تقييم بيئات الزراعة ونسب خلط النترات والأمونيوم المختلفة فى دراسات غذائية على بنت القنصل

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أجريت هذه الدراسة فى مشتل نباتات الزينة بكلية الزراعة - جامعة أسيوط - خلال العامين ٢٠٠٠ ، ٢٠٠١ على شتلات بنت القنصل بالأصص لتقييم ملائمة بعض أنواع بيئات الزراعة وإضافة النترات أو الأمونيوم أو خلطهما معا بنسب مختلفة للنمو والإزهار والتركيب الكيماوى . وشملت البيئات المستعملة الطمى منفردا (للمقارنة) ، مخلوط الطمى والرمل بنسبة (١:٢) ، بالإضافة إلى مخاليط (الطمى + الرمل) مع أى من فوم Foam ، بيت موس ، بيرليت ، فرميكيوليت بنسب حجمية متساوية . كذلك أضيف المحلول المغذى (يحتوى على العناصر الكبرى والصغرى) بمعدل ١,٥ لتر/ اصيص / أسبوع حيث قسمت الكمية المضافة الى ٣ جرعات تناوبت مع ماء الرى . وكان تركيز النيتروجين الكلى بالمحلول المغذى ١٢ مليمكافئ / لتر حيث اختلفت فيها نسبة النترات / الأمونيوم (ن أ$_{٣}^{-}$% / ن يد$_{٤}^{+}$ %) وكانت معاملات النسب المستعملة هى : (١٠٠/صفر) ، (٧٥/٢٥) ، (٥٠/٥٠) ، (٢٥/٧٥) ، (صفر/١٠٠) ، هذا بجانب إضافة ماء الصنبور للمقارنة .

وكانت أهم النتائج ما يلى :

- أظهرت النتائج تفوقا واضحا للبيئة المكونة من مخلوط الطمى والرمل (١:٢) على غيرها من البيئات المختبرة فى تحسن مواصفات النمو الخضرية والجذرية حيث أعطت أعلى القيم فى قياساتها (ارتفاع النبات ، عدد الفروع الجانبية والأوراق ، قطر الساق ، مساحة الأوراق ، الأوزان الطازجة والجافة لكل من الفروع والأوراق والجذور ، ونسبة الفروع / الجذور) .

- أدت البيئة السابقة أيضا إلى تبكير الإزهار (٢٨-٣٠ يوما) ، وزيادة محصول النورات (٧٦% زيادة عن المقارنة) التى أظهرت تحسنا واضحا فى مواصفاتها وجودتها حيث أعطت أعلى القيم فى قياساتها (قطر النورة ووزنها الطازج والجاف ، عدد ومساحات قناباتها ، والمساحة الكلية للقنابات بالنبات) .

- أعطت البيئة المحتوية على طمى فقط أدنى قيم للقياسات الخضرية والزهرية . بينما بيئات النمو الأخرى أظهرت نتائج وسطية بمقارنتها بالبيئتين السابقتين .

- أوضحت التغذية النيتروجينية أن نسبة ن أ$_{٣}^{-}$ / ن يد$_{٤}^{+}$ (٧٥/٢٥) كانت الأكثر فاعلية فى تحسين جودة النبات حيث أظهرت زيادة واضحة فى القياسات الخضرية والجذرية ، كما أدت الى تبكير الإزهار (٢٤ يوما) وزيادة محصول النورات (٩٢% زيادة عن المقارنة) وتحسين مواصفاتها. بينما تلت نسبة ن أ$_{٣}^{-}$ / ن يد$_{٤}^{+}$ (٥٠/٥٠) النسبة السابقة فى تأثيراتها على النمو والإزهار .

- أظهرت التغذية بالأمونيوم منفردا (صفر/١٠٠) تأثيرا مثبطا أدى إلى نقص كبير فى النمو الخضرى والإزهار بجانب ظهور الأعراض الخاصة بضرر الأمونيوم - زيادة كبيرة فى تركيز الأمونيوم بالأنسجة ، أصفرار فيما بين العروق بالأوراق مع موت حوافها - بينما لم تظهر هذه الأعراض فى أى من المعاملات الأخرى .

- أظهر التحليل الكيماوى أن الزيادة فى محتوى الأوراق من النيتروجين الكلى ، النترات ، الفوسفور ، البوتاسيوم ، الكالسيوم ، المغنسيوم ، الكلوروفيل (أ ، ب) وأيضا محتوى الانثوسيانين بالقنابات ، والكربوهيدرات الكلية بأعضاء النبات ، ونسبة الكربوهيدرات/النيتروجين C/N ratio فى الأوراق كانت مرتبطة بتحسن مواصفات النمو والإزهار .

- أظهر نشاط أنزيم أختزال النترات اتجاها مماثلا فى كل من الأوراق والجذور ، بينما كان النشاط أكبر فى الجذور عنه فى الأوراق . كما زاد نشاط الانزيم فى نباتات بنت القنصل النامية فى البيئة المكونة من الطمى والرمل (١:٢) ، وزاد أيضا فى الأوراق والجذور بزيادة تركيز النترات فى المحلول المغذى المضاف .

- وجد أن المعاملة المشتركة وهى البيئة المكونة من الطمى والرمل (١:٢) + ن أ$^{-}$٣ / ن يد$^{+}$٤ (٢٥/٧٥) كانت أكثر فاعلية لإنتاج نباتات بنت القنصل ذات الجودة العالية ، ولذا يوصى بإستعمالها بهدف الإنتاج التجارى .