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EFFECT OF SOME PRE AND POSTHARVEST TREATMENTS ON THE KEEPING QUALITY OF POINSETTIA CUT FLOWERS:

I: EFFECT OF DIFFERENT FERTILIZATION REGIMES AND IRRIGATION LEVELS ON THE VEGETATIVE, ROOT GROWTH, FLOWERING AND CHEMICAL COMPOSITION OF PLANTS.

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ABSTRACT

The present investigation was carried out during two seasons of 1997/1998 and 1998/1999 at El-Baramon Ornamental Research Station and Laboratory of Veget. and Flor. Dept., Fac. of Agric., Mansoura Univ. The objective of this research aimed to study the effect of Super grow fertilizer at levels of 0.0, 0.3, 0.6 and 0.9 g/plant added once every week, irrigation with amounts of water once per 3 days at the levels of 150, 300, 450 and 600 ml/plant and their interactions on the vegetative and root growth, flowering and chemical composition of poinsettia plants.

The obtained results indicated that Super Grow fertilizer at 0.9 g/plant significantly increased plant height, number of leaves, dry weight of vegetative parts and roots, diameter of flowers, number of bracts and percentages of nitrogen, phosphorus and potassium in the leaves over control and the other treatments in both seasons.

In addition increments in plant height, number of leaves, dry weight of vegetative parts, diameter of flowers, number of bracts and potassium % in the leaves were achieved with irrigation level at 450 ml/plant. Data revealed also that increasing the level of irrigation to 600 ml/plant resulted significantly increased dry weight of roots and phosphorus % in the leaves over the other treatments in both seasons.

Concerning the interaction between the fertilization and irrigation treatments, the obtained results indicated that application of the fertilizer at 0.9 g/plant combined with the irrigation level at 450 ml/plant significantly increase vegetative and roots parts as well as flowers measurements, as well as the phosphorus and potassium % in the leaves over the other treatments in both seasons.

The obtained results revealed the superiority of the treatment of applying Super Grow fertilizer at 0.9 g/plant once every week combined with irrigation level at 450 ml/plant once per 3 days weekly to obtain the best vegetative growth and flowering characteristics of poinsettia plants.

INTRODUCTION

Poinsettia (*Euphorbia pulcherrima*, Willd) Fam-Euphorbiaceae is one of the most popular flowering pot plants elsewhere in the world, in Egypt, poinsettia plant is usually used as a flowering shrub in gardens in late fall and winter seasons. The plants show huge vegetation depending on genetic characters and prevailing conditions throughout summer and autumn.

Many experiments were conducted with various fertilizer regimes on poinsettia to determine the optimum one for maximum yields under various circumstances and correlate fertilization practices with nutrients content of the

foliage which may affect the subsequent beneficial effect on extending the vase-life of flowers.

The water supply of ornamental plants during cultivation is of great importance. Water should be applied in accordance with the conditions of plant growth (Hartge and Wiebe, 1977). The amount of water given to the substrate enables rooting of the cuttings and promotes the growth of the plants (Orton, 1979 and Witt, 1979).

The main objective of this investigation aimed to study the effects of fertilization, irrigation levels and their interactions on the vegetative growth, flowering characters and chemical composition of poinsettia plants.

MATERIALS AND METHODS

The present investigation was carried out during 1997/98 and 1998/99 seasons in El-Baramon Ornamental Research Station and the Experimental Station, Faculty of Agriculture, Mansoura University, Egypt.

Mechanical and chemical analyses of the used medium were carried out before planting in the two seasons. The chemical analysis of the soil (in water extract 1:2) was according to methods of Black (1965) and Page (1982) as recorded in Table (1).

Table (1): Mechanical and chemical analysis of the used experimental medium during 1997/98 and 1998/99 seasons.

Properties	Values 1997/98	Values 1998/99
Mechanical analysis (%) :		
Clay	49.13	49.06
Silt	25.88	25.65
Fine sand	21.47	22.05
Coarse sand	1.63	2.21
Organic matter	1.89	1.03
Chemical analysis		
Total nitrogen (ppm)	0.137	0.144
Available phosphorus (ppm)	7.950	8.750
Potassium (ppm)	229.00	243.00
pH	8.02	8.14
$CaCO_3$ (%)	2.80	2.75

The fertilizer examined was a commercial fertilizer (Super Grow) as a solution in irrigation water of which four concentrations were tested. The fertilizer consists of:

1. Macro elements: N(20%), P_2O_5 (20%) and K_2O (20%).
2. Micro elements: Zn (0.15%), Fe (0.15%), Mg (0.5%), Mn(0.5%), Ca (0.05%), Cu (0.5%), Mo (0.005%), B (0.02%) and S (0.2%).

A Local variety of poinsettia (*Euphorbia pulcherrima*, Willd), Fam-Euphorbiaceae was used in this study. Uniform rooted cuttings (about 1.0 cm thickness and 15 – 20 cm length) were planted in plastic bags (25 cm

diameter and 35 cm length), filled with a mixture of soil and sand (2:1 v/v) on February first, 1997 and 1998. The experiment started on March 23rd, 1997 and 1998 in the two seasons, the rooted plants (one/plastic bag) were pinched once leaving five leaves and treated with the fertilizer at 0.0, 0.3, 0.6 and 0.9 g/ plant, added weekly as a solution starting seven days after planting date. Irrigation levels were 150.0, 300.0, 450.0 and 600.0 ml/plant every 3 days alone or combined with fertilizer as follows:

1. Control fertilization (Super Grow) at zero g/plant + 150, 300, 450 and 600 ml water/plant.
2. Super Grow at 0.3 g/plant + 150, 300, 450, and 600 ml water/plant.
3. Super Grow at 0.6 g/plant + 150, 300, 450, and 600 ml water/plant.
4. Super Grow at 0.9 g/plant + 150, 300, 450, and 600 ml water/plant.

Data were recorded on December 25th (at flowering time) for both seasons. The following characters were determined: plant height (cm), number of leaves/plant, vegetative parts and roots dry weights (g). In addition, number and diameter of flowers (cm) and number of bracts/flower were evaluated. For chemical analysis, samples of leaves were taken for N, P and K determination at the beginning of blooming time. Leaves were dried at 70°C and ground and stored in tight bottles and were subsequently analyzed for N, P and K according to the following methods:

Nitrogen content was determined following Micro-Kjeldahl's method as described by Black (1965). Phosphorus was colorimetrically determined using the hydroquinone method as described by Snell and Snell (1967). Potassium was photometrically estimated as described by Brown and Lilliand (1946).

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the factorial experiment in randomized complete block design. The least significant difference (LSD) method was used to compare the differences between treatment means at 5% level probability as published by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Vegetative growth and roots characters:

Data in Table (2) showed that the fertilized plants were significantly taller than control plants in both seasons. The tallest plants (136.29 and 148.50 cm) resulted from treating with fertilizer at 0.9 g/plant in the first and second seasons, respectively. These results were in agreement with those obtained by Scott *et al*. (1984) on poinsettia who found that the plant height was increased as fertilizer rates were increased. In addition, Dale *et al*. (1991) reported that poinsettia plants supplied with no N showed little growth.

Concerning the irrigation levels, the data in the same Table showed that irrigation level at 450 ml/ plant produced the tallest plants (114.71 and 127.71 cm) in the first and second seasons, respectively. These results were in agreement with the results obtained by Rober and Horn (1993) on poinsettia, since they stated that there was a close correlation between continuos or intermittent watering and the plant height. Vegetative growth was increased with increasing amounts of water administrated, while reduced amounts of water reduced growth.

As regard to the interaction between fertilization and irrigation, the data in Table (3) showed that there were significant differences between the most of treatments. However, the tallest plants (140.67 and 157.23 cm) resulted from treating with 0.9 g/plant fertilizer combined with irrigation level at 450 ml/plant in the first and second seasons, respectively. These results were in agreement with those obtained by Criley and Parvin (1978) who reported that poinsettia plant height was greater for the combinations of liquid feed than for given water only.

Data presented in Table (2) showed also, significant increases in number of leaves of plants treated with any fertilizer level over control plants in both seasons. The highest number of leaves (123.12 and 126.05 leaves) was produced from treated plants with 0.9 g/plant in both seasons, respectively. In this concern Farnham (1936) stated that poinsettia grown at high fertility level kept their leaves longer than plants grown at low fertility. This effect could be attributed to retardation of leaves abscission due to fertilization treatment. In addition, the data showed that using irrigation level at 450 ml/plant produced the highest number of leaves (112.88 and 115.08 leaves) in both seasons, respectively, when compared with the irrigation level at 150 ml/plant.

Dealing with the interaction between fertilization and Irrigation treatments, the data in Table (3) showed that there were significant differences between the most treatments. The highest number of leaves (124.92 and 127.8 leaves) resulted from treated plants with 0.9 g/plant and irrigated with 450 ml / plant in the first and second seasons, respectively.

Data presented in Table (2) clearly showed that, plants treated with 0.9 g/plant had significantly more dry weight (127.25 and 129.37 g) comparing with other doses in both seasons, respectively. These results were in agreement with those obtained by Hamza (1972) who found that the higher level of fertilizers increased the dry weight of vegetative parts of carnation and Holcomb (1982) who stated that dry weight was increased by increasing the rate of fertilization while, the least values in this respect resulted from non-fertilized plants.

From the same Table, data showed that, dry weight of poinsettia plants was increased with increasing water amounts but to a limited extent. The highest dry weights (100.65 and 105.36 g) resulted from plants irrigated with 450 ml/plant comparing with the least amount of water in both seasons, respectively. These results were in agreement with those obtained by Morvant *et al*. (1998) since they found that poinsettia plants irrigated daily produced the greatest total dry mass.

Concerning the interaction between fertilization and irrigation treatments, data in Table (3) showed that the highest dry weight resulted from treating with 0.9 g/plant and irrigation with 450 ml/plant, while the lowest dry weight of vegetative growth (52.56 and 61.15 g) resulted from plants receiving the lowest quantity of water and non fertilized in the two seasons, respectively.

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The data in Table (2) showed that the heaviest dry weights of roots (40.08 and 42.11g) resulted from treated plants with 0.9 g/plant in the first and second seasons, respectively. This result may be due to the largest vegetative growth as aforementioned. These results were in agreement with results obtained by Gad (1987) who stated that the high level of fertilization resulted in significant increase in dry weight of roots of poinsettia plants.

Applying the highest irrigation level at 600 ml/plant induced significant increase in dry weight of roots (35.83 and 37.63 g) as compared with other treatments in both seasons, respectively as observed in Table (2).

Regarding the interaction between fertilization and irrigation, data in Table (3) showed differences between the different treatments. However, the heaviest dry weight of roots (41.53 and 43.54 g) resulted from treated plants with 0.9 g/plant and irrigated with 600 ml/ plant in the first and second seasons respectively.

Flowering characters:

Data in Table (4) showed that, fertilization and irrigation treatments had non significant effect on number of flowers when the effect of each was analyzed alone during the two seasons. These results might be due to the negative effect of treatments on branching and it is known that flowers develop on the top of each induced branch.

Table (4): Effect of different fertilization and irrigation levels on number of flowers/plant, flower diameter (cm) and number of bracts / flower of poinsettia plant during 1997/98 and 1998/99 seasons.

Characters / Treatments	Number of flowers/plant		Flower diameter (cm)		Number of bracts/flower	
	First season 1997/98	Second season 1998/99	First season 1997/98	Second season 1998/99	First season 1997/98	Second season 1998 / 99
Super Grow fertilizer (g/plant):						
0.0	4.96	5.27	13.26	14.08	11.84	13.93
0.3	5.00	5.62	15.11	16.35	13.65	15.69
0.6	5.34	5.81	18.66	20.43	14.20	16.25
0.9	5.36	5.07	19.05	21.84	16.06	18.05
L. S. D. at 5 %	N.S	N.S	0.74	0.44	0.67	0.71
Irrigation levels (ml/plant)						
150	5.29	5.28	15.28	17.32	12.93	15.03
300	5.00	5.53	16.79	18.04	13.44	15.50
450	5.23	5.79	17.25	18.21	15.27	17.31
600	5.00	5.64	16.76	18.15	14.11	16.08
L. S. D. at 5 %	N.S	N.S	0.74	0.44	0.67	0.71

Regarding the interaction, data in Table (5) showed that, the treated plants with fertilizer at 0.9 g/plant and irrigated with 450 ml/ plant resulted in the highest number of flowers (5.87 and 6.00 flower in the first and second seasons, respectively). These results coincided with the results obtained by Criley and Parvin (1978) on poinsettia who showed that the number of branches was greater for combinations of liquid feed and osmocote than for those given water alone.

The data in Table (4) showed that, the widest flower diameter (19.05 and 21.84 cm) resulted from plants treated with the highest fertilization level at 0.9 g/plant. These results were in accordance with the results obtained by Boodley (1977) who found that satisfactory bract diameter of poinsettia plants results from examined 3 fertilizer rates.

Also, data in the same Table showed that irrigation level at 450 ml/plant produced significantly the largest flower diameter of poinsettia plants when compared with irrigating at 150 ml/plant in the two seasons. This may be due to that watering will avoid accumulation of fertilizer and soluble salts injury to roots through removing salts excess.

Concerning the interaction, it was observed from the data indicated in Table (5) that the fertilization with 0.9 g/plant combined with irrigation level at 450 ml/plant gave the largest flower diameter.

Regarding number of bracts per flower, it was clear from data presented in Table (4) that the highest number of bracts (16.06 and 18.05 bracts) resulted from plants, which received 0.9 g/plant in both seasons, respectively. These results coincided with those of Scott *et al.* (1984) since they stated that poinsettia plants fertilized with 14.0 N, 6.1 P and 11.6 K and had the least bract loss.

Dealing with the effect of irrigation levels, data in the same Table showed that irrigation with 450 ml/plant produced the highest number of bracts (15.27 and 17.31 bracts in both seasons, respectively).

For the effect of the interactions, it was observed that, the largest number of bracts (17.38 and 19.42 bracts) resulted from treated plants with the fertilizer at 0.9 g/ plant plus irrigation at 450 ml/plant in both seasons, respectively as observed in Table (5).

N, P and K%:

The data in Table (6) showed that using the different treatments of fertilization and irrigation resulted in differences in N percentages in the leaves. However, the highest values of N percentage (2.83 and 3.07%) were achieved in fertilized plants with 0.9 g/plant and irrigated with 450 ml/plant when compared with the other treatments in both seasons, respectively. These results were compatible with the results obtained by Hendricks and Scharpf (1983) since they found that the N percentage in poinsettia plants was greatly increased as the NPK level of fertilizer increased. In addition, Wright *et al*. (1990) reported that N content in plants was increased by fertilization treatments. It is well known that poinsettia requires high levels of nitrogen, however soil fertility must be controlled.

The data of phosphorus percentage in the same Table showed that treated plants with fertilizer at 0.9 g/plant and irrigated with 450 ml/plant had the highest phosphorus percentage (0.66 and 0.69%) when compared with the other treatments in both seasons, respectively. These results were in accordance with the results obtained by Gad (1987) who stated that the poinsettia leaf percentage of phosphorus was increased by fertilization comparing to unfertilized plants.

Moreover, the highest potassium percentages (2.67 and 2.00%) resulted from treated plants with fertilizer at 0.9 g/plant and irrigated with 450 ml/plant in the first and second seasons, respectively.

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The increases were in-agreement with the findings of Morton and Boodley (1969) on *Chrysanthemum morifolium* using urea or complete fertilizer and Gad (1987) who fertilized poinsettia with NPK and reported that fertilization treatments increased poinsettia leaf content of potassium.

Hence, the main goal in this work is the production of flowers with high quality. It is a matter importance and advisable to be fertilized poinsettia plant with Super Grow 0.9 g/plant weekly and irrigated with 450 ml/plant (every 3 days).

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تأثير بعض معاملات ما قبل وما بعد الحصاد على صفات الحفظ للأزهار المقطوفة لنبات بنت القنصل (*Euphorbia pulcherrima* Willd).:

١: تأثير مستويات التسميد ومعدلات الرى المختلفة على صفات النمو الخضرى والجذرى والتزهير والمحتوى الكيماوى للنباتات٠

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أجرى هذا البحث بالمزرعة البحثية بالبرامون – مركز المنصورة ومعمل قسم الخضر والزينة – كلية الزراعة جامعة المنصورة خلال موسمى الزراعة المتتاليين ١٩٩٨/١٩٩٧، ١٩٩٩/١٩٩٨ وذلك بهدف دراسة تأثير مستويات مختلفة من السماد التجارى المعروف باسم Super Grow بمعدلات صفر، ٠,٣، ٠,٦، ٠,٩ جرام/ نبات أسبوعيا وكميات المياه المختلفة للرى بمعدل ١٥٠، ٣٠٠، ٤٥٠، ٦٠٠ ميللتر/ نبات مرة واحدة كل ٣ أيام كل منها منفرداً بالإضافة إلى دراسة نتائج معاملات التفاعل بين المستويات المختلفة من السماد التجارى وكميات المياه المختلفة للرى على صفات النمو الخضرى والجذرى والتزهير والمكونات الكيميائية للأوراق لنبات بنت القنصل.

وقد أظهرت النتائج أن المعاملة بالسماد التجارى بمعدل ٠,٩ جرام/ نبات أدت إلى زيادة معنوية فى قياسات النمو الخضرى والجذرى وأعطت أعلى زيادة فى كل من ارتفاع النبات وعدد الأوراق والوزن الجاف للنمو الخضرى والجذرى بالإضافة إلى ذلك أظهرت النتائج أن المعاملة كانت فعالة أيضاً فى زيادة قطر النورة الزهرية وعدد القنابات ومحتوى الأوراق من عناصر الأزوت والفوسفور والبوتاسيوم مقارنة بالتركيزات الأخرى من التسميد فى كلا الموسمين.

كما أظهرت النتائج أن معاملة نبات بنت القنصل بالرى بمعدل ٤٥٠ ميللتر/ نبات قد أعطت أعلى زيادة معنوية فى كل من ارتفاع النبات وعدد الأوراق والوزن الجاف للنمو الخضرى وقطر النورات الزهرية وعدد القنابات فى النورة الزهرية وأخيراً محتوى الأوراق من عنصر البوتاسيوم . بينما المعاملة بالرى بمعدل ٦٠٠ ميللتر/ نبات فقد أعطت أعلى زيادة فى الوزن الجاف للجذور ومحتوى الأوراق من عنصر الفوسفور مقارنة بالمعدلات الأخرى من مياه الرى فى كلا الموسمين.

ومن ناحية أخرى فقد أظهرت نتائج التفاعل بين معاملات التسميد والرى المختلفة أن المعاملة بالسماد التجارى بمعدل ٠,٩ جرام/ نبات مع الرى بمعدل ٤٥٠ ميللتر/ نبات قد أدت إلى زيادة ملحوظة فى قياسات النمو الخضرى والجذرى والتزهير بجانب إعطاء أعلى محتوى للأوراق من عناصر الفوسفور والبوتاسيوم مقارنة بالمعاملات الأخرى فى كلا الموسمين.

ويمكن التوصية من خلال نتائج هذه الدراسة باستخدام ٠,٩ جرام/نبات من السماد التجارى Super Grow مرة كل أسبوع والرى بكمية ٤٥٠ ميللتر/ نبات مرة كل ٣ أيام للحصول على أفضل نمو خضرى وجذرى وتزهير وأعلى محتوى من العناصر الغذائية لنبات بنت القنصل.

Table (2) Effect of different fertilization and irrigation levels on plant height (cm), number of leaves /plant, dry weight of vegetative parts and roots (g) of poinsettia during 1997/98 and 1998/99 seasons .

Characters / Treatments	Plant height (cm)		Number of leaves/plant		Dry weight of vegetative parts (g)		Dry weight of roots (g)	
	First season 1997/98	Second season 1998/99	First season 1997/98	Second season 1998/99	First season 1997/98	Second season 1998/99	First season 1997/98	Second season 1998/99
Super Grow fertilizer (g/plant):								
0.0	76.61	82.92	82.98	85.85	65.91	70.41	25.91	27.50
0.3	109.58	122.50	109.97	113.23	81.95	88.85	39.74	34.88
0.6	124.73	135.72	116.80	119.65	102.33	111.36	35.99	37.88
0.9	136.29	148.50	123.12	126.05	127.25	129.37	40.08	42.11
L.S.D. at 5 %	1.66	1.44	1.64	1.70	1.45	1.77	0.75	0.95
Irrigation Levels (ml/plant)								
150	108.30	118.87	101.27	104.18	84.44	92.24	30.61	32.66
300	112.99	126.01	108.51	111.31	92.74	101.64	33.17	35.33
450	114.71	127.71	112.88	115.84	100.65	105.36	35.09	36.75
600	111.41	117.05	110.20	113.04	90.62	100.75	35.83	37.63
L.S.D. at 5 %	1.66	1.44	1.64	1.70	1.45	1.77	0.75	0.95

Table (3) Effect of the interaction between fertilization and irrigation levels on plant height (cm), number of leaves/plant, dry weight of vegetative parts and roots (g) of poinsettia during 1997/98 and 1998/99 seasons.

Characters / Treatments	Plant height (cm)				Number of leaves/ plant				Dry weight of vegetative parts (g)				Dry weight of roots (g)			
	Super Grow fertilizer (g/plant)															
	0.0	0.3	0.6	0.9	0.0	0.3	0.6	0.9	0.0	0.3	0.6	0.9	0.0	0.3	0.6	0.9
Irrigation levels (ml/plant):	First season (1997 / 98)															
150	72.31	103.61	124.02	132.54	61.54	103.80	116.70	123.07	52.56	72.85	92.86	119.51	18.82	31.50	34.03	38.19
300	79.03	111.61	128.10	133.25	84.82	101.47	115.52	123.22	67.00	82.21	96.90	124.96	25.26	32.48	35.33	39.63
450	83.19	111.76	125.16	140.67	93.80	113.32	119.47	124.92	76.47	84.87	107.54	134.95	29.39	33.12	36.88	40.97
600	71.93	111.36	121.66	138.72	91.75	112.27	115.50	121.27	67.63	87.86	112.02	129.69	30.17	33.87	37.74	41.53
L.S.D. at 5%	3.34				3.27				2.89				1.50			
Irrigation levels (ml/plant):	Second season (1998/99)															
150	78.85	118.96	131.95	145.71	64.36	106.88	119.65	125.85	61.15	82.93	98.79	126.10	20.84	33.51	36.06	40.22
300	84.82	128.58	138.01	148.03	87.88	112.83	118.38	126.15	73.53	88.66	115.19	129.19	27.29	34.87	37.47	41.69
450	88.95	120.92	143.71	157.23	96.70	116.68	122.20	127.80	77.28	92.91	116.31	134.92	29.92	35.62	38.48	42.99
600	74.43	121.52	129.19	143.02	94.46	116.53	118.38	124.40	69.68	90.92	115.16	127.26	31.95	35.52	39.51	43.54
L.S.D. at 5%	2.7				3.41				3.54				1.90			

Table (5): Effect of interaction between different fertilization and irrigation levels on number of flowers/plant, flower diameter (cm) and number of bracts/flower of poinsettia plant during 1997/98 and 1998/99 seasons.

Characters / Treatments	Number of flowers/plant				Flower diameter (cm)				Number of bracts/flower			
	Super Grow fertilizer (g/plant)											
	0.0	0.3	0.6	0.9	0.0	0.3	0.6	0.9	0.0	0.3	0.6	0.9
Irrigation levels (ml/plant)	**First season (1997/98)**											
150	3.18	3.93	4.19	4.47	11.55	13.81	18.66	17.08	11.01	12.20	12.03	13.39
300	3.31	4.25	4.89	5.77	13.56	14.72	19.24	18.63	11.77	13.29	15.61	15.08
450	3.81	4.65	5.11	5.87	14.71	15.79	19.62	21.91	12.00	14.39	12.27	17.38
600	3.75	4.54	4.92	5.49	15.91	16.16	17.12	18.57	12.55	14.60	12.88	16.39
L. S. D. at 5%	0.18				0.48				1.33			
Irrigation levels (ml/plant)	**Second season (1998/99)**											
150	4.19	4.84	4.93	5.23	13.01	15.25	20.30	20.74	13.22	14.34	15.07	15.50
300	4.29	5.01	5.27	5.44	15.57	16.38	20.98	22.01	13.83	15.33	15.66	17.19
450	4.65	5.25	5.38	6.00	12.27	17.15	21.28	22.12	14.08	16.44	17.32	19.42
600	4.70	4.94	5.11	5.19	15.46	16.63	19.17	22.01	14.59	16.62	14.97	18.11
L. S. D. at 5%	0.20				0.87				1.41			

Table (6) Effect of interaction between different fertilization and irrigation levels on percentages of nitrogen, phosphorus and potassium % of poinsettia leaves during 1997/98 and 1998/99 seasons.

Characters / Treatments	Nitrogen percentage (%)				Phosphorus percentage (%)				Potassium percentage (%)			
	Super Grow fertilizer (g/plant)											
	0.0	0.3	0.6	0.9	0.0	0.3	0.6	0.9	0.0	0.3	0.6	0.9
Irrigation levels (ml/plant)	**First season (1997/98)**											
150	2.49	2.69	2.78	2.72	0.20	0.34	0.48	0.49	1.61	1.70	1.76	1.86
300	2.48	2.67	2.69	2.74	0.21	0.36	0.50	0.64	1.63	1.66	1.79	1.90
450	2.46	2.65	2.70	2.83	0.19	0.38	0.51	0.66	1.49	1.73	1.83	2.67
600	2.50	2.64	2.73	2.74	0.22	0.41	0.56	0.63	1.52	1.81	1.82	2.00
Irrigation levels (ml/plant)	**Second season (1998/99)**											
150	2.51	2.67	2.83	3.06	0.29	0.31	0.50	0.49	1.67	1.75	1.84	1.92
300	2.56	2.68	2.84	3.05	0.23	0.39	0.53	0.69	1.68	1.76	1.86	1.99
450	2.58	2.67	2.95	3.07	0.23	0.41	0.53	0.69	1.70	1.80	1.88	2.00
600	2.55	2.68	2.96	2.98	0.28	0.44	0.56	0.64	1.65	1.79	1.80	1.97

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