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EFFECT OF IRRIGATION REGIMES ON CHRYSANTHEMUM FLOWERING UNDER NITROGEN FERTILIZATION LEVELS .

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ABSTRACT

This study was carried at Antoniadas Research Branch, Hort. Res. Instit., Alex., Egypt. During two successive seasons of 2005 and 2006. The aime of this study was to study the effect effect of N-fertilization and irrigation regime on growth, flowering and chemical composition of chrysanthemum morifolium .The fertilization was added in five levels of nitrogen (ammonium sulphate 20.5% N), as 0, 1, 3, and 5g / pot. Potassium and phosphorus fertilizers were added as constant rate of 0.5 and 2g / plant from potassium sulphate (48% K_2O) and calcium super phosphte (15.5% P_2O_2) respectively .The fertilizer devoted to each pot was monthly repeated for four times at one month interval. The first was added one month after transplanting while the last was before flowering .The irrigation regimes (sprinkler and furrow irrigation) with four levels (25% , 50%, 75%, 100%). The obtained results led to the following :

To produce the best chrysanthemum (Dendranthema grandiflorum, (Ramat)) plant having the tallest plant, the highest number of leaves / plant, heaviest fresh and dry weight of vegetative parts, longest roots, and dry weight of roots, earliest flowering, largest inflorescence diameter and heaviest dry weight of inflorescence / plant as well as highest N, P, K% in the leaves they should be fertilized with 9 ammonium sulphate (20.5% N) / pot four times during growth interval at one month the first was added one month after transplanting while the last was befor flowering

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prolonging the irrigation regimes (sprinkler and furrow irrigation) at 75% with 3g nitrogen .

INTRODUCTION

The interactive effects of nitrogen and water availabilities on plant growth and leaf photosynthesis have been well documented (e.g., Radin and Ackerson 1981, Ghashghaie and saugler 1989). In contrast, few studies have examined the interactive effects of nitrogen and water availability on whole plant (Wilson et al. 1980, Morgan 1984, Dickmann et. al. 1992).

It is difficult to isolete the effects of nitrogen and water availabilities because water provides the medium for nitrogen uptake by roots. Often, interactions have been studied by cessation of nutrient applications to all plants when drought treatments have been imposed (Radin and Ackerson 1981, Reich et al 1989). This approach makes the isolation of treatment effects difficult because the nitrogen status of plants will change differentially through time, according to treatment .

There has been much discussion of the problems associated with interpreting plant physiological responses when plant internal nutrient status is changing (Ingestad 1982, linder and rook 1984, Ingestad and Agren 1995; Hellgren and Ingestad 1996) .

We have examined the interaction of water and nitrogen availabilities on whole-plant in Chrysanthemum grown under conditions mani problems were obtained of either nitrogen at water supply. Also, that faces the nutrition processes of floriculture crops, specially in Alexandria region .

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MATERIALS AND METHODS

A series of pot experiments was carried at Antoniades Research Branch, Hort. Res. Instit., Alex., Egypt during two successive seasons of 2004 and 2006. The cuttings of Chrysanthemum plant (Dendranthema grandiflorum, Ramat. CV. Wilson's white) were taken in uniform size with an average length of 8.0cm and placed in seed pans on February 9,2005 using an equal mixture of sand and peat – moss and placed in the green house. Two months later (on April, 11, 2005), The rooted cuttings were transplanted in 10cm diameter pots using a mixture of clay and sand at the rate 1 : 1 by volume (one plant per pot). To accelerate basal branching, the growing point of all the plants was pinched on May 11, 2005. The final transplanting to 30cm diameter pots was carried out on 27, May 2005 using the same soil mixture mentioned before.

A three well formed and distributed branches on each plant were chosen on June 18, 2005 (after three weeks from the final transplanting) for the experimental purposes. The disbudding process was done for each branch to allow one terminal bud to develop for each stem .

Fertilizer treatments included four levels of nitrogen (ammonium sulphate 20.5% N) as 0, 1, 3, and 5g 1.3 and 5g / pot potassium and phosphorus fertilizers were added as constant rate of 0.5 and 2g/ plant of potassium sulphate (48.5% K_2O) and calcium superphosphate (15.5% P_2O_5), respectively for each treatment as the quantity of the fertilizers devoted to each pot was monthly repeated for four times at one month interval. The first was added one month after transplanting while the last was before flowering. Irrigation and agricultural practices were done whenever plants needed (Kandeel, Y.M., et al, 2002) .

Two regime of irrigation (sprinkler and furrow irrigation) were carried out with four level (25% , 50% , 75% , 100%).

The statistical loyout used was a split plot Design of two regimes of irrigation as main plot , whereas, the four treatment, of fertilization expressed subplots .

Every treatment was replicated three times , three pots were used as a plot. Analysis of variance was calculated according to Snedecor and Cochran (1974).

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The vegetative growth measurements included : plant height (cm), leaves number, and dry weight (g).

Dry weight of leaves (g), root length (cm) and dry weights of roots / plant (g) . Flowering time (days) was calculated as the number of days from planting to the first inflorescence open .

Number of inflorescence / plant, and dry weight (g) / plant . Inflorescence diameter . (cm).

Chemical analysis of the leaves after being dried in an electric oven at 70° for 48 hr, 0.1g of the dried sample was ground and used to determine N, P and K% as follows :

Total nitrogen (%) was determined by the modified microkeldahl method as described by Piper (1947), phosphorus (%) was estimated colorimetrically as recommended by Troug and Meyer (1939) and K was determined by using flame photometer Brown and Lilliland (1946).

The physical and chemical analysis of used soil before the final transplanting are shown in Table (A). The chemical analysis of both was determined to according to Jackson (1967) .

The chemical and physical analyses for the used soil in both seasons are presented in table (A) :

The chemical and physical analysis of experimental soil in both seasons such as, Ec, PH , cations and anions was carried out after Black (1965). Nand P contents in the soil were determined according to king (1951) while K was determined according to Jackson (1967) .

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Table (A) : Some initial soil physicochemical characteristics of the experimental soil .

Soil characteristics	Clay soil	Sand soil
Soil pH (1 : 2.5)	8.1	7.30
Soil Ec , ds m^{-1}	0.76	1.7
Soluble cations (meq L^{-1})		
Ca^{++}	1.78	8.0
Mg^{++}	0.70	5.1
Na^{+}	3.9	3.2
K^{+}	0.90	0.4
Soluble anions (meq L^{-1})		
CO_3^{--}	-	-
HCO_3^{-}	1.87	2.5
Cl^{-}	5.25	9.2
SO_4^{--}	0.38	5.0
Particle size distribution		
Sand %	33.110	85.99
Silt %	13.06	1.5
Clay %	54.84	1.5
Organic matter, %	1.81	0.07
Total nitrogen, %	12.4	12.4

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RESULTS AND DISCUSSION

A- Effect on vegetative growth :

1- Plant height .

Data presented in Table (1) revealed that all fertilization treatments significantly increased plant height over control in both seasons. The highest increment was obtained from N_1 and N_3 treatments respectively in two seasons. The remainder nitrogen treatment gave less value in two seasons. The control gave the least values in the two seasons .

As shown in Table (1), the plant height increased during the growing season with increase levels of irrigation and applied nitrogen fertilizer. The highest reduction in plant height given (51cm) by less amount of irrigation amount of irrigation water treatment 25% (furrow and sprinkler) along irrigation followed by 50% (55cm). The maximum values of plant height during the growing season at 75% with the sprinkler and furrow irrigation .

The plants fertilized with nitrogen gave higher values than those of non-fertilized ones which may be attributed to that nitrogen is of extreme importance because it is a constituent of proteins and nucleic acids (Bidwell, 1974).

Also the increase in plant height may be due to that ammonium sulphate enhanced the absorption of minerals, mainly nitrogen and this might in turn account much for the increase in building up the metabolites necessary for plant growth. Similar trend of results was found by El-Mahrouk (1996) on Chrysanthemum carinatum Schoub, who found that, the different nitrogen levels enchanced plant height and fresh weights of the foliage and roots especially the rate of 4g N/plant of ammonium sulphate which gave the highest values. Attia and Ahmed (1997) on Chrysanthemum morifolium declared that plant height, number of branches and dry wight of leaves were increased by addition of 2 g N/Pot. Osman et al., (2001) on Ambrosia maritime L. declared that significant increases in plant height, number of branches, fresh and dry weights per plant were obtained by adding high level of fertilizer of 150 kg/fed. Calcium

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super phosphate. 150 kg/fed. Ammonium sulphate and 75kg/fed, potassium sulphate.

Table (1) : Effect of nitrogen ferlitizer and irrigation regimes (sprinkler and furrow) on plant height, leaves number of chreysanthemum plants in two season (2004– 2006)

Plant Height, "cm"								
2004 – 2005								
	Sprinkler				**Furrow**			
Irrigation Treatments / fertilization	**100%**	**75%**	**50%**	**25%**	**100%**	**75%**	**50%**	**25%**
N_0	55	55	53	47	59	58	55	54
N_1	59	75	64	51	74	7	66	58
N_3	82	77	70	60	95	78	67	59
N_5	55	67	58	53	63	71	62	54
L.S.D $_{0.05}$ = 18.65								
2005 - 2006								
N_0	85	84	80	70.51	56	55	52	50
N_1	87	86	82	85.90	75	72	64	56
N_3	89	88	85	78.80	93	77	66	58
N_5	84	85	81	73	62	70	60	41
L.S.D $_{0.05}$ = 95.51								
Leaves Number								
2004 – 2005								
N_0	34	37	38	28	33	35	34	20
N_1	44	58	58	54	41	56	59	45
N_3	50	60	63	60	50	60	55	35
N_5	40	57	51	32	37	43	33	30
L.S.D $_{0.05}$ = 18.65								
2005 - 2006								
N_0	53	68	60	48	43	45	34	30
N_1	58	70	62	56	50	75	49	34
N_3	60	75	68	65	60	76	55	45
N_5	57	67	64	55	54	63	50	39
L.S.D $_{0.05}$ = 60.35								

- Irrigation levels (100% , 75% , 50% , 25%)
- **Fertilization levels (N_0 , N_1 , N_3 , N_5)**

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2- Number of leaves / plant :

From the presentation in Table (1), data indicated that all ferilization treatments increased number of leaves per plant over control in both seasons. The increment was the highest significant for N_3 and N_1 treatments in two seasons. These result indicated that leaves number by nitrogen fertilizer when compared to irrigation treatments. However there was significant effect by interaction between irrigation and nitrogen treatment .

Abdel-Hafiez (2002) evaluated the sprinkler irrigation for sun flower, he found that by decreasing the amount of water applied, the number of leaves decreased significantly by 5.75%

3- Leaf area / Plant :

It appears from Table (2) that all fertilization treatments significantly increased leaf area / plant (L.A) over the control in both seasons. The highest increment was obtained from N_5 treatments followed by N_3 treatment while the majority of the treatments gave less values in two seasons. The control treatment gave the least values in two seasons .

The data reveled that there was increasing L.A due to increase the available moisture and nitrogen fertilizer in root zone. Irrigation treatments (furrow and sprinkler) by adding 3g (N_3) give greatest values during the growing season especially at 75% Irrigation water followed by 100% , 50% and 25% at same levels of N, respectively .

The maximum values given by irrigation treatment (75%) sprinkler irrigations at the N_3 of fertilizer. On other hand the lowest values of L.A were given by sprinkler 25% irrigation under nitrogen fertilizer rate 3g (N_3) / pot .

The increase in leaf area due to nitrogenous fertilization might be attributed to the increase in the amount of metabolites synthesized by plants leading to more growth in response to nitrogen fertilizer which enhances cell division and enlargement. The obtained findings are in agreement with those mentioned by many workers using nitrogen fertilization such as El-Gahadban (1994) who stated that fertilization of Mentha viridis with NPK mixture at the level of 25

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: 10 : 10 increased plant height, herb fresh and dry weights and gave larger than control .

4- Leaf dry Weight :

From the Table (2) data indicated that all nitrogen treatments increased dry weight of plant over the control in both seasons. The increment was highest for N_5 and N_3 treatments with nonsignificant differences among themselves in both seasons, the remainder in nitrogen treatments gave less value in the two seasons the lower values were resulted from the control (N_o) in two seasons .

These results indicated that dry weight of leaves have been affected by nitrogen fertilizer treatment when compared to the irrigation water treatments. However there was significant effect by interaction between irrigation and nitrogen treatments. The highest values of leaves dry weight were obtained from N_3 with furrow and sprinkler irrigation . However, the lowest values resulted from the untreated plants (N_0) during both seasons .

The increase in leaves dry weight due to that nitrogen enhanced the parameters of leaf area . Similar results were recorded by Khalafalla et al., (1994) on Jasminum grandiflorum who reviwed that fertilization generally caused significant increases in plant dry weight of the vegetative parts.

Also. Lebrun et al., (2000) found that with different levels of NPK, Chamaerops plant produced the heaviest dry weight for both aerial and root system .

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Table (2) : Effect of nitrogen fertilizer and irrigations regime (sprinkler and furrow irrigation) on leaf area and leaf dry weight of chrysanthemum plants in two seasons (2004 – 2006)

Leaf area / plant "cm^2"								
2004 – 2005								
	Sprinkler				**Furrow**			
Irrigation treatments / fertilization	100%	75%	50%	25%	100%	75%	50%	25%
N_0	1065.2	1194.8	1026.3	1008.5	1065.5	1199.8	106.5	1006.5
N_1	1373.6	1402.5	1345.7	1209.9	1340.9	1400.4	1270.4	1209.9
N_3	1388.5	1406.6	1367.5	1284.3	1347.2	1407.1	1355	1248.6
N_5	1389.8	1516.7	1356.5	1256.4	1355.5	1405.8	1304	1286.4
L.S.D $_{0.05}$ = 786.83								
2004 - 2005								
N_0	1199.8	1195.4	1025.5	1007	1064.9	1100.9	1025.6	1005.7
N_1	1304.4	1343.8	1247.7	1209.8	1374.9	1403.3	1348.9	1218.3
N_3	1340.4	1348.7	1270.4	1226.1	1389.3	1407.6	1348.7	1255.9
N_5	1346	1553.6	1277.3	1228	1380.5	1656.1	1308.3	1288.4
L.S.D $_{0.05}$ = 586.192								
Leaf dry weight, "g"								
2004 - 2005								
N_0	2.15	2.71	2.42	2.57	2.22	2.12	1.65	1.24
N_1	4.94	4.20	4.15	3.51	3.41	2.33	2.16	3.72
N_3	5.80	53.50	5.15	4.89	5.06	5.30	4.86	3.86
N_5	3.64	3.34	300	2.44	2.27	2.29	7.96	1.17
L.S.D $_{0.05}$ = 5.95								
2005 - 2006								
N_0	2.57	2.71	2.50	2.34	2.21	2.12	1.75	1.56
N_1	4.80	4.21	3.76	3.15	3.10	3.38	2.16	2.38
N_3	5.93	5.89	4.54	4.50	5.15	5.40	4.88	3.41
N_5	3.64	3.00	3.42	2.45	2.40	2.85	2.28	1.95
L.S.D $_{0.05}$ = 5.967								

- Irrigation levels (100% , 75% , 50% , 25%)
- Fertilization levels (N_0 , N_1 , N_3 , N_5)

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5- Stem dry weight :

From Table (3) data indicated that all nitrogen treatments increased dry weight of stem over control in both seasons. The increment was highest for N_1,N_3,N_5 treatments with non significant differences among them selves in both seasons. The remainder nitrogen treatments gave less values in two seasons. The lowest values were resulted from control (N_0) in the two seasons .

Showed the response of stem dry weight different amount of irrigation water and nitrogen fertilizer management Data indicated that decrease of the amount of irrigation water and nitrogen fertilizer added to plants. Irrigation treatment 25% had lowest values of dry weight under different levels of nitrogen. However, 75% irrigation treatment had maximum dry weight .

The increase in the dry weight of the vegetative parts with the increase in the added nitrogen rate may be attributed to the increase of the leaf area as a result of increasing the cell number and size. It is well known that nitrogen has outstanding importance, since it comprises 40 - 50% of the dry weight of the protoplasm in the plant cells. Nitrogen also takes part in chlorophyll composition and its constituents of proteins, hence, encourages the development of the vegetative growth as mentioned by Bidwell (1974).

The obtained findings are in agreement with those mentioned by many workers using nitrogen fertilization such as Attia and Ahmed (1997) on Chrysanthemum morifolium, Schuch et al., (1998) on Dendranthema grandiflora who mentioned that plants fertilized with 80mg L^{-1} had lower leaf and stem dry mass, less leaf area as were deficient in leaf compared with plant fertilized with twice the amount of N. The highest stem dry mass was produced with 160mg L^{-1}. Similar results were obtained by Badran et al., (2001a) on Tropaeolum majus.

6- Root Length :

It is clear from Table (2) that all fertilization treatments increased root length per plant over control during the two seasons. In the second one the increment was highest for N_1 and N_3 treatments. The remainder nitrogen treatments gave less values in the two seasons. The control gave the least values, in the two seasons.

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It is noteworthy that the medium nitrogen level (N_3) gave the longest roots in both seasons as this may result of a balanced nitrogen level for root growth .

It can be seen from Table (3) that root length was decreased when plant subjected to less amount of furrow and sprinkler irrigation .

The reduction in root length also due to decrease the nitrogen fertilizer rate. The maximum values of root length depended on increase the available water from soil .

Hence all treatments have the same rank. It is clear that the differences among irrigation water applied under the same level of N were higher than those of N under the same amount of irrigation water (El-Ganayni 2000)

The increase in root length due to nitrogen fertilization may be due to that nitrogen enhanced the parameters of plant height, number of branches per plant, leaf area and fresh weight of the vegetative parts which reflected on root length .

A similar trend of results was found by Kander and Zearche (1997) on Chrysanthemum morifolium who found that high N supply of 200 mg/litre resulted in good rooting .

Also, El-Shakhs, (2002) on Livisitona chinensis and Ptychosperma elegans found that increasing NPK fertlization rates caused a progressive increment in root length .

7- Dry weight of roots per plant :

It is evident Table 3 from that the addition of N at any rate resulted in a significant increment in dry weight of roots over the control during both seasons. The treatments which gave the highest dry weight of roots, in the two seasons, were N_3 followed by N_1, N_5, control treatment gave the least dry weight in the two seasons.

The reduction in dry weight obtained from sprinkler irrigation (25% and 50%) from the plant growth more than furrow irrigation (25% and 50%) the maximum values of dry weight from irrigation treatment were (100% and 75%) under nitrogen rates N_1 and N_3. The lowest values which given by sprinkler after furrow (25% and 50%) irrigation under different doses of nitrogen fertilizer (N_0, N_1, N_3, N_5)

The increase in dry weight of roots per plant due to that nitrogen fertilization treatments may be interpreted as was in case of the fresh weight of roots .

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Table (3) : Effect of nitrogen fertilizer and irrigation regimes (sprinkler and furrow) on stem dry weight, root length and root dry weight on chrysanthemum plants in two seasons (2004 – 2006)

Stem dry weight "g"								
2004 – 2005								
	Sprinkler				**Furrow**			
Irrigation treatments / fertilization	100%	75%	50%	25%	100%	75%	50%	25%
N_0	5.24	5.06	4.5	3.44	5.30	5.60	4.91	3.20
N_1	6.27	6.33	5.71	5.03	6.61	6.70	5.76	5.72
N_3	7.47	8.27	5.88	5.50	7.51	7.83	6.70	6.50
N_5	5.28	5.61	4.96	4.14	5.39	5.22	4.56	5.59
L.S.D $_{0.05}$ = 5.99								
2005 – 2006								
N_0	5.60	5.23	4.96	3.20	5.06	5.24	4.96	4.50
N_1	6.61	6.70	5.72	5.01	5.03	6.28	5.8	5.60
N_3	7.51	7.83	6.50	5.50	7.47	8.27	6.98	6.33
N_5	5.72	8.50	5.17	4.5	5.61	5.61	5.50	3.44
L.S.D $_{0.05}$ = 6.48								
Root length, "cm"								
2005 - 2006								
N_0	10	8	7.5	7.5	13	12.5	12	12
N_1	25	22	17	16	20	20	17	16
N_3	26	24	18	18	21	20	19	18
N_5	19	18	14	11	15	15	14	13.5
L.S.D $_{0.05}$ = 17.89								
2005 - 2006								
N_0	10	8	7.5	7.5	13.03	12.34	12.20	12.14
N_1	25	24	18	17	20.24	20	16.40	15.17
N_3	26	26	19	18	21.34	20.70	19.80	18.75
N_5	16	16	15	14	20.10	15.50	14.90	14.41
L.S.D $_{0.05}$ = 18.945								
Root dry weight, "gm"								
2004 - 2005								
N_0	7.07	7.00	5.42	3.35	6.56	6.16	5.63	7.3
N_1	10.55	11.08	9.70	9.04	11.76	11.49	11.72	10.85
N_3	13.87	11.87	10.86	9.04	14.77	14.13	12.68	12.28
N_5	12.34	8.55	8.39	7.66	8.82	9.25	8.73	8.44
L.S.D $_{0.05}$ = 53.203								
2005 - 2006								
N_0	7.19	6.49	4.66	4.30	10.60	10.89	5.63	4.15
N_1	7.45	11.55	1.36	7.45	11.44	11.88	8.55	5.63
N_3	9.36	13.18	10.35	9.91	14.14	14.75	9.20	9.50
N_5	7.01	8.50	7.40	7.39	12.67	12.70	8.1	5.20
L.S.D $_{0.05}$ = 3.362								

- Irrigation levels (100% , 75% , 50% , 25%)
- Fertilization levels (N_0 , N_1 , N_3 , N_5)

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These results are in agreement with those of El-Mahrouk (1996) on Chrysanthemum carinatum, Schoub and El-Mahrouk and Kandeel (1997) on Calendula officinalis.

B- Effect on flowering :

1- Inflorescence diameter per plant :

Data in Table (4) revealed that all fertilization treatments increased inflorescence diameter per plant over the control during both seasons. The highest values were obtained from the treatment of N_3 followed by N_1 then N_0 in the two seasons . The remainder nitrogen treatments gave less values in the two seasons, while the control gave the least diameter in the two seasons .

The maximum diameter of inflorescence was obtained by adding N_3 with using the furrow and sprinkler irrigation comparing with other treatments. These results may be probably due to the increases in the florets number or enlargement or both in the inflorescence .

Similar trend of results was found by Mostafa (2000) on Chrysanthemum morifolium . These data agree with those obtained by, Attia (1994) on Chrysanthemum morifolium, Belgaonker et al., (1997) on annual Chrysanthemum and Badran et al., (2001b) on Gladious who mentioned that the highest values of spike length and diameter, flowering part of spike length, fresh and dry weights of spike and florets number, diameter and fresh and dry weights were obtained by the high nitrogen rate (99kg / feddan) .

2- Dry weight of inflorescence per plant :

From Table (4) data indicated that dry weight of infloresecnces per plant was significantly increased over the control due to the different fertilization treatments. The highest dry weight of flowers was obtained from the treatments of N_3 and N_1 in the first season and second season . The remainder nitrogen treatments gave less values in the two seasons. The lowest values were resulted from the control treatment in the two seasons .

The reduction in dry weight obtained from furrow irrigations (25% and 50%) which consider the critical and sensitive periods from the plant growth more than sprinkler irrigations (25% and 50%) at the same doses of nitrogen fertilization . The highest of dry weight of

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Table (4) : Effect of nitrogen fertilizer and irrigation regimes (sprinkler and furrow) on Inflorescence diameter and Inflorescence dry weight of chrysanthemum plants in two seasons (2004 – 2006)

Inflorescence diameter								
2004 – 2005								
	Sprinkler				**Furrow**			
Irrigation treatments / fertilization	100%	75%	50%	25%	100%	75%	50%	25%
N_0	12.90	12.7	12.6	10.00	11.2	11.13	10.89	10.8
N_1	13.4	13.40	13.3	13.10	12.9	12.8	12.4	12.1
N_3	13.70	13.41	13.41	12.40	13.4	13.2	13.1	13.0
N_5	13.2	13.2	13.1	12.11	11.6	11.6	11.4	11.2
L.S.D $_{0.05}$ = 1.24								
2005 - 2006								
N_0	12.3	12.20	11.90	11.10	11.23	11.02	10.96	10.8
N_1	13.45	13.41	13.4	13.1	13.30	13	12.5	11.6
N_3	13.75	13.50	13.2	13.10	13.9	13.5	12.8	12.4
N_5	13.0	12.91	12.9	12.70	12.01	12.00	11.9	11.5
L.S.D $_{0.05}$ = 1.415								
Inflorescence dry weight "g"								
2004 – 2005								
N_0	2.68	2.66	2.5	2.10	2.22	2.02	1.90	1.88
N_1	5.25	3.20	3.1	2.56	6.55	4.80	4.16	3.31
N_3	6.21	4.80	3.31	2.89	9.86	5.82	5.25	3.20
N_5	5.22	2.87	2.56	2.27	4.52	2.89	2.77	2.66
L.S.D $_{0.05}$ = 3.854								
N_0	2.63	2.50	2.54	2.11	2.18	1.89	1.43	1.43
N_1	4.43	4.32	2.88	2.62	3.09	15.63	5.34	5.34
N_3	5.89	5.50	3.28	2.70	5.70	8.30	5.77	5.77
N_5	5.12	4.16	2.82	2.55	2.29	1.27	1.55	1.55
L.S.D $_{0.05}$ = 14.73								

- Irrigation levels (100% , 75% , 50% , 25%)
- Fertilization levels (N_0 , N_1 , N_3 , N_5)

flower was obtained from the treatment of N_3 under sprinkler at 75% of irrigation .

This result may be attributed to the reasons mentioned before in case of the other flowering parameters .

The obtained results are similar to those reported by Rao et al., (1983) on Pyrethrum, who found that N fertilization caused increase in plant height, branches, number flower number and flower dry weights .

C- Effect on chemical composition :

1- Nitrogen percentage :

As shown in Table (5), it is clear that all fertilization treatments containing nitrogen increased N% in the leaves over control during the two seasons. The highest values were obtained from N_5 treatment, followed by N_3 treatment. However, the majority of treatments gave less values while control gave the least values in the two seasons. Generally, nitrogen percentage was gradually increased by increasing the rate of nitrogen fertilization .

There was increasing in nitrogen concentration (%) and N - uptake of shoot system and total nitrogen (%) in leaves .

It is clear that the highest percentage nitrogen N_1 in the leaves of chrysanthemum plant was given by application the furrow and sprinkler irrigation with adding N comparing with other treatment, these results may be due to that reduced the leached amounts of N as NH_4 and less .

Similar trend of results was stated of by klock – Moore (2000) on Salvia splendens plant .

This result was probably due to that the used soil medium had insufficient amount of N, consequently any increment of N to the soil could be absorbed and translocated to the leaves .

The obtained results are in close agreement with those reported by Rao et al., (1983) on Pyrethrum (Chrysanthemum cineraricfolium), Menesi (1995 a and b) on Ammi majus and Ammi visnaga, El-Mahrouk (1996) on Chrysanthemum carinaturm, Schoub, and Badran et al., (2001a) on Tropaeolum majus, who reported that to increasing nitrogen in fertilizer led to increase its percentage in the leaves of plants .

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Table (5) : Effect of nitrogen fertilizer and irrigation regimes (sprinkler and furrow) on nitrogen, phosphorus and potassium content (%) on leaves of chrysanthemum plants in two seasons (2004 – 2006)

Nitrogen content (%)								
2004 – 2005								
	Sprinkler				**Furrow**			
Irrigation treatments / fertilization	100%	75%	50%	25%	100%	75%	50%	25%
N_0	3.18	2.76	2.63	1.98	3.35	2.93	2.67	2.64
N_1	3.41	2.82	2.74	2.11	3.37	2.98	2.78	2.67
N_3	3.55	2.84	2.77	2.21	3.55	3.02	2.91	2.82
N_5	3.59	2.90	2.81	2.37	3.59	3.30	2.98	2.91
L.S.D $_{0.05}$ = 1.176								
2005 - 2006								
N_0	3.19	2.19	2.77	2.93	2.95	2.94	2.93	2.83
N_1	3.40	2.41	2.96	2.94	3.18	2.97	2.94	2.85
N_3	3.56	2.60	2.98	2.95	3.20	3.03	2.95	2.87
N_5	3.59	2.90	2.22	2.97	3.25	3.10	2.98	2.89
L.S.D $_{0.05}$ = 0.5399								
Phosphorus content (%)								
2004 – 2005								
N_0	0.61	0.51	0.51	0.51	0.57	0.54	0.53	0.51
N_1	0.65	0.53	0.53	0.57	0.65	0.59	0.54	0.52
N_3	0.66	0.50	0.57	0.62	0.63	0.63	0.56	0.53
N_5	0.65	0.56	0.55	0.60	0.64	0.56	0.56	0.55
L.S.D $_{0.05}$ = 0.4177								
2005 - 2006								
N_0	0.61	0.47	0.52	0.52	0.59	0.55	0.54	0.52
N_1	0.65	0.55	0.54	0.58	0.63	0.59	0.55	0.54
N_3	0.68	0.58	0.58	0.65	0.64	0.61	0.56	0.56
N_5	0.66	0.56	0.56	0.62	0.65	0.63	0.57	0.57
L.S.D $_{0.05}$ = 0.181								
Potassium content (%)								
2004 – 2005								
N_0	2.01	1.72	1.81	1.06	1.88	1.83	1.67	1.63
N_1	2.04	1.81	1.83	1.62	1.91	1.86	1.80	1.73
N_3	2.07	1.92	1.88	1.98	1.93	1.89	1.84	1.78
N_5	2.17	1.82	1.78	1.89	1.97	1.91	1.87	1.81
L.S.D $_{0.05}$ = 2.513								
2005 - 2006								
N_0	2.01	1.86	1.70	1.61	1.89	1.85	1.69	1.65
N_1	2.05	1.92	1.74	1.63	1.97	1.88	1.81	1.74
N_3	2.07	1.94	1.85	1.95	1.98	1.90	1.84	1.73
N_5	2.17	1.88	1.78	1.86	1.92	1.92	1.88	1.79
L.S.D $_{0.05}$ = 0.363								

- Irrigation levels (100% , 75% , 50% , 25%)
- Fertilization levels (N_0 , N_1 , N_3 , N_5)

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2- Phosphorus percentage :

The results shown in Table (5) revealed that all fertilization treatments significantly increased P% in the leaves over control during the two seasons. The highest values were obtained from $N_1$and N_3 treatments , there was a gradual and slight decrease in P% at the N levels more than N_3 which may be due to that there was an antagonism between phosphorus and the high levels of nitrogen .

The highest phosphorus level (%) in the leaves was obtained by adding N_3 in combination with using furrow and sprinkler irrigation (75% and 100%) as compared with other treatment (50% and 25%).

The increase in phosphorus percentage due to nitrogen fertilization treatments may be interpreted as was in case of nitrogen percentage .

These results are parallel with those obtained by and El-Mahrouk and Kandeel (1997) on Calendula officinalis who reported that increasing nitrogen in fertilization led to increase N, P and K % of leaves .

3- Potassium percentage :

Data presented in Table (5) clearly revealed that all fertilization treatments increased K% in the leaves over control during the two seasons. The highest values were obtained from N_3 treatment. The remainder treatments gave less values in the two seasons. The lowest values resulted from the control plants during both seasons.

The highest percentage of potassium content in the leaves was found by the addition of the medium rate of N_3 under the two regimes (Sprinkler and furrow) comparing with other treatments during the two seasons.

From the above mentioned results it can be concluded that N_3 fertilization increased the capacity of plants to absorb nutrients well as the high capacity of the plants supplied with nitrogen in building metabolites, which in turn contribute much to the increase of the dry matter content and nutrients uptake.

The obtained results are in conformity with the findings of Selim (1990) on Pelargonium zonale who mentioned that nitrogen fertilization increased N, P, and K in the leaves. Also, were the results of El-Mahrouk (1996) on Chrysanthemum carinatum, Schoub.

Generally, with using the different levels of nitrogen the NPK% increased in the leaves of Chrysanthemum. potassium is important as a structural part on many compounds notably nucleic acids and phospholipids, in addition to its indispensable role in energy

metabolism and K is important in respiration, carbohydrate metabolism and over all metabolism of plants (Bidwell, 1974).

Also, the increase in the contents of NPK in the leaves of plants might be understood in the light of the vital and physiological roles of these macrountrients in plant growth and development as discussed earlier. In addition, the increase in these contents could be resulted from the increase in the uptake of N, P and K due to the increase in root system. Which becomes more capable of absorbing more amounts of these nutrients.

Sprinkler irrigation system was successful to save the nitrogen fertilizer in soil however, furrow irrigation was leached it to the bottom layer and plants was higher efficient in using it .

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الملخـص العربـى

تأثير نظم الرى على الأراولا تحت مستويات من التسميد النتروجينى

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مركز البحوث الزراعية – معهد بحوث البساتين – فرع بحوث الزينة

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2- الجيزة – القاهرة – مصر .

3- جامعة الإسكندرية – كلية الزراعة – فرع دمنهور .

أجرى هذا البحث بالمزرعة البحثية بحدائق انطونيادس بالإسكندرية خلال عامى (2004 / 2005) ، (2006/2005) على نباتات الأراولا الصنف ويلسون وايت بغرض دراسة التأثيرات المتبادلة والمتداخلة لنظم الرى تحت مستويات من التسميد النتروجين على النمو والأزهار والتركيب الكيماوى لنبات .

- وقد تم استخدام نوعين مختلفين من أنظمة إضافة مياه الرى وهى الرى السطحى والرى بالرش مع أربع مستويات من كل منهما الرى السطحى (25% - 50% - 75% - 100%) من السعة الحقلية وقد تم إضافة السماد النتروجينى فى أربع مستويات فى صورة سلفات أمونيوم (20.5%) صفر ، 1 ، 3 ، 5جم سلفات أمونيوم / أصيص . أضيف التسميد الفوسفورة والبوتاسى لكل النباتات بمعدل 2جم / نبات من سوبر فوسفات الكالسيوم (15.5% فو$_2$ أ5) وبمعدل 0.5 جم / نبات من سلفات البوتاسيوم (48.5% بو$_2$أ) تمت السماد النتروجينى المخصص لكل أصيص على أربعة دفعات متساوية بفاصل شهرين بين كل دفعة والتالية لها حيث أضيفت الجرعة الأولى بعد شهر من تفريد النباتات (22 ديسمبر) والأخيرة فقد تم إضافتها قبل التزهير (22 مارس) وقد استخدم تصميم القطاعات المنشقة فى ثلاث مكررات فى الدراسة . وقد أظهرت النتائج ما يلى :

- أدت المعاملات السمادية إلى زيادة فى ارتفاع النبات وعدد الأوراق وطول الجذر والوزن الجاف للأجزاء الخضرية والجذرية لكل نبات مقارنة بالكنترول .

- كانت أفضل معاملة هى المستوى الثالث من التسميد النتروجينى .

- أما التفاعل بين معاملات الرى والتسميد كانت معنوية على جميع الصفات المقاسة باستخدام نظام الرى السطحى ونظام الرى بالرش حيث زادت كل من كفاءة استخدام المياه والاستفادة منها بزيادة معدل التسميد النتروجينى المضاف حتى 3جم / أصيص لجميع معاملات الرى .

- كفاءة الاستفادة من المياه أعلى القيم موجودة فى معاملة الرى بالرش تليها معاملة الرى السطحى .