

EFFECT OF FOLIAR X FERTILIZER ON THE GROWTH AND FLOWERING
CHARACTERS OF Chrysanthemum morifolium Ram. PLANTS.

M.M. Mazrou, M.M. Afify and M.A. Eraki

Faculty of Agriculture, Minufiya University, Shebin El-Kom,
EGYPT

تأثير الرش بالفولييار اكس على النمو وخواص الأزهار فى نباتات الأراولا

متولى مسعد مزروع - محمد موسى عفيثى - محمد عبد الله عراقى
كلية الزراعة - جامعة المنوفية

ملخص البحث

أجريت التجربة بمزرعة كلية الزراعة بشبين الكوم فى موسمى ١٩٨٦ ، ١٩٨٧ ،
لدراسة تأثير رش نباتات الأراولا صنف "مارى ماس" بتركيزات صفر ، ١٥ ، % ،
٣٠ ، % ، ٤٥ ، % من السماد المركب "فولييار اكس" . وكانت أهم النتائج
كالآتى :-

١ - أى رش نباتات الأراولا بتركيز ٤٥ ، % فولييار اكس الى زيادة كل من طول
الساق وعدد الأوراق وكذلك الوزن الطازج والجاف لكل من الأوراق والسيقان
والنورات فى كلا الموسمين عن نباتات الكنترول .

٢ - ازادات النسب المئوية لكل من النيتروجين والفوسفور والبوتاسيوم والمغنسيوم
فى الأوراق عند الرش بتركيز ٤٥ ، % فوليياراكس ، وكان أعلى محتوى من
المنجنيز فى الأوراق فى حالة رش النباتات بتركيز ١٥ ، % فولييار اكس .

٣ - أى رش نباتات الأراولا المراه على فرعين بتركيز ٣٠ ، % فولييار اكس الى
زيادة محتوى الأوراق من الكلوروفيل والكاربوهيدرات الكلية ، بينما أى
الرش بتركيز ٤٥ ، % الى زيادة هذا المحتوى فى حالة النباتات المراه
على ثلاثة أفرع .

٤ - أوضحت النتائج تفوق نباتات الأراولا المراه على ثلاثة أفرع فى الصفات
التي تم دراستها عن تلك المراه على فرعين .

ABSTRACT

At the experimental farm of the Faculty of Agriculture at Shebin El-Kom, the present investigation was carried out to study the effect of spraying Chrysanthemum morifolium Ram. cv. "Marie Masse" with different concentrations of foliar X fertilizer, which contains both macro and micro nutrients, on the growth and flowering of this important ornamental plant. The plants were sprayed six times during the growing season with foliar X fertilizer at concentrations between 0.0 and 0.45%. Moreover the effect of the number of chosen branches per plant on the growth and flowering characters. The obtained results of the two experimental seasons showed that using foliar X fertilizer at its suitable concentration 0.45% increased the stem length, number of leaves per plant as well as both fresh and dry weights of leaves, stems and inflorescences in the two seasons. The results of the chemical analysis showed also that spraying Chrysanthemum plants with 0.30% or 0.45% foliar X in the two seasons raised the percentages of N, P, K, and Mg in the leaves, whereas the highest Mn content in the leaves was obtained by spraying the plants with 0.15% foliar X fertilizer. Spraying Chrysanthemum plants with two branches with 0.30% foliar X produced the highest Chlorophyll and total Carbohydrate content, whereas the highest concentration of 0.45% foliar X resulted in the highest values in this respect in the case of plant with three branches.

Generally the plants with three branches showed a superiority in the most studied characters than those with two branches.

INTRODUCTION

Chrysanthemum morifolium is known to have a large nutrient requirements for nitrogen, phosphorus and potassium. Moreover the presence of micronutrient at suitable rates are very necessary for improving both growth and flowering. Chrysanthemum as a pot plants must be well fertilized in adequate quantities from both macro and micro elements. Fertilizer applications to pots as a confined medium may be fixed and become unavailable for plant, also the added nutrients to the medium could be used by microorganisms or leached

away by frequent watering (Paparozzi and Tukey, 1979). Therefore foliar application of fertilizers could be used as an alternative method to conventioned soil application method. Wittwer and Teubner (1959), reported that foliar nutrition offers advantages of more rapid and efficient absorption as well as well utilization of nutrients as compared to nutrient applied to the root medium. Koriesh (1984) reported that using commercial fertilizer, Complesal, Folie-Fertile and Over-growth as a foliar application caused a markedly improvement in both vegetative growth and flower characters. Mousa (1979) mentioned that the foliar application of the commercial fertilizer (Folie-Fertile) lead to an increase of Flower production in Jolie Madam roses.

From the above mentioned results obtained by the different authers, it could be noticed that researches on adequate fertiliation of Chrysanthemum plants are still needed. Therefore this study was carried out to determine the optimum concentration from the commercial fertilizer "Foliar X", which contains both macro-and micro nutrients on the growth and flowering characters of Chrysanthemum plants.

MATERIALS AND METHODS

Rooted cutting of Chrysanthemum morifolium (Ram.) cv. "Marie Masse" were planted during the second week of January in the seasons of 1986 and 1987 in seed pans using two parts of loamy soil and one part of "peat moss" by volum. In April of the two experimental seasons the plants were transferred to 10 cms diameter pots using the same medium used before. In the second week of May the plants were pinched and transferred to the final pots of 25 cms. diameter pots using loamy soil. In the second week of June in the two seasons the plants were divided in two groups. In the first group (A) two branches per plant were selected, whereas in the second one

(B) three branches per plant were chosen and the other branches were removed. Thereafter, the plants of each group were sprayed with the commercial fertilizer "Foliar X", which contains the following nutrient elements: 12% N, 12% P₂O₅, 12% K₂O, 5000 p.p.m. Zn, 2500 p.p.m. Fe, 350 p.p.m. Mn, 1000 p.p.m. Mg, 5000 p.p.m. Cu and 2000 p.p.m. Bor. The plants of each group were sprayed with 0, 0.15%, 30% and 0.45% Foliar X. The spraying treatments were applied 6 times i.e. at 15, June; 30, June; 15, July; 30, July; 15, August; and 30, August in the two seasons.

The experiment lay out was in a complete randomized design with three replicates, each replicate was presented by ten plants.

The following data were recorded at the end of the experiments, stem length, stem diameter at base, number of leaves, inflorescence diameter, as well as Fresh and dry weights of leaves, stem and inflorescence.

The following elements were determined in the dried leaves:

- Total nitrogen percentages were determined by using the micro Kjeldahl methods as described by A.O.A.C. (1970).
- Phosphorus percentages were determined according to Frie et al. (1964).
- Potassium was determined by Flame photometer.
- Magnesium and Manganese were determined by Perkin-Elmer Atomic Absorption Spectrophotometer.
- Chlorophyll and Carotenoides content in the fresh leaves were determined according to Wettstein (1957).
- Total Carbohydrate percentages were determined in the dried leaves, stems and flowers according to Dubios et al. (1956).

RESULTS AND DISCUSSION

The reported data in Table (1) and Table (2) indicate clearly that the stem length of Chrysanthemum plants increased gradually with increasing the spraying concentrations of the complete fertilizer "Foliar X" and reached its maximum by using the highest concentration of 0.45% for the plants with two or three branches in the two experimental seasons of 1986 and 1987. It could be also noticed that all fertilization treatments resulted in significantly taller plants compared to the control. These results may be due to the presence of both macro and micro elements in "Foliar X" fertilizer, especially nitrogen and zinc, which are required for the synthesis of tryptophan as a precursor for Indole acetic acid formation at optimum level and consequently increasing the rates of stem elongation (Salami and Kenefick, 1970).

Generally the plants with three branches, were taller than those with two branches in the two experimental seasons, as shown in Table (1) and Table (2).

From the previous results it could be concluded that Foliar X fertilizer at its optimum concentration 0.45% was very effective in increasing the stem length of Chrysanthemum plants as an important character for this commercial cut flower.

The data in Table (1) and Table (2) show clearly that the diameter of Chrysanthemum stems was significantly increased by the application of different concentrations of Foliar X in the two experimental seasons, meanwhile the treatment of 0.15% Foliar X resulted in insignificantly thicker stems for the plants with two branches in the first season 1986, as well as for the plants with three branches in the season of 1987. The increment in the stem diameter of Chrysanthemum plants as a result of using Folair X

Table 1: Effect of spraying *Chrysanthemum morifolium* cv. "Marie Masse" with different concentrations of "Foliar X fertilizer" on the vegetative growth during the season of 1986.

Foliar X concent. in %	Stem length in cms.	No. of leaves/ plant	Inflor.		Fresh weight in gms/plant			Dry weight in gms/plant		
			Diam. in mm.	Diam. in cms.	Leaves	Stems	Inflor.	Leaves	Stems	Inflor.
0	85.33	73.67	4.67	9.33	73.55	30.25	29.33	12.35	10.45	4.77
0.15	90.11	80.00	5.33	12.00	82.33	35.85	34.97	14.45	11.33	6.10
0.30	91.44	85.33	5.83	13.67	89.50	38.18	37.67	16.23	12.32	6.40
0.45	93.67	85.00	5.67	13.33	88.33	38.92	37.87	15.93	12.17	6.37
L.S.D. 5%	4.36	5.53	0.84	2.16	6.08	4.81	5.75	3.21	1.16	1.17
L.S.D. 1%	6.52	8.27	1.28	3.23	9.11	7.20	8.61	3.31	1.74	1.76
A) Plants with two branches										
0	78.00	92.67	4.33	8.00	90.97	31.85	27.05	13.33	10.80	4.27
0.15	94.00	117.00	5.33	11.67	100.53	41.80	38.67	16.17	13.57	6.10
0.30	99.67	118.33	5.67	12.33	102.70	44.03	40.43	18.53	14.38	7.42
0.45	101.00	122.00	6.00	13.00	104.77	46.35	42.63	19.43	14.75	7.55
L.S.D. 5%	6.83	4.93	0.70	1.62	4.46	4.83	5.42	1.90	1.22	1.13
L.S.D. 1%	10.23	7.38	1.04	2.42	6.68	7.24	8.11	2.85	1.83	1.69
B) Plants with three branches										

Table 2: Effect of spraying *Chrysanthemum morifolium* cv. "Marie Masse" with different concentrations of "Foliar X fertilizer" on the Vegetative growth during the season of 1987.

Foliar X concent. in %	Stem length in cms.	No. of leaves/ plant	Stem Diam. in mm.	Inflor. Diam. in cms.	Fresh weight in gms/plant			Dry weight in gms/plant		
					Leaves	Stems	Inflor.	Leaves	Stems	Inflor.
A) Plants with two branches										
0	77.78	69.20	4.17	08.67	67.05	25.47	20.28	10.62	08.03	4.05
0.15	81.11	74.75	4.67	11.00	76.80	28.90	25.50	12.57	09.22	5.27
0.30	83.33	78.00	5.00	12.33	83.17	30.50	26.42	14.07	10.00	5.47
0.45	85.00	77.30	5.00	12.00	83.92	30.60	29.88	13.72	10.00	5.63
L.S.D.	4.37	1.79	0.34	1.51	5.03	4.88	4.96	1.81	0.85	0.74
L.S.D.	6.55	2.68	0.50	2.26	7.53	7.30	7.43	2.70	1.27	1.10
B) Plants with three branches										
0	72.33	86.33	3.83	07.33	85.00	27.55	21.02	11.27	08.75	3.78
0.15	87.33	109.67	4.67	11.00	95.32	39.17	32.95	13.65	12.78	5.42
0.30	94.33	112.00	5.33	11.67	97.90	41.70	34.22	16.25	13.68	5.85
0.45	96.00	116.33	5.67	12.33	99.67	42.17	36.70	18.10	13.80	6.10
L.S.D.	4.41	4.66	0.94	1.62	3.29	3.74	5.33	1.89	1.77	0.62
L.S.D.	6.60	6.97	1.40	2.41	4.93	5.59	7.98	2.83	2.65	0.93

fertilizer could be attributed to the presence of the required nutrients at optimum rates especially nitrogen, which controls the growth rate of the plants, through its effect on protein and cytokinin Synthesis (Wagner and Michael, 1971). These results were in harmony with the findings of El-Gamasy and El-Shafie (1967) on roses, Koriesh (1984) on *Chrysanthemum* and Afify (1986) on *Gladiolus* plants who reported that the application of complete fertilizers increased the diameter of the flowering stems.

Generally there were no clear differences in stem diameter between the plants of two or three branches in the seasons of 1986 and 1987.

The recorded data in Table (1) and Table (2) indicate clearly that using the complete fertilizer "Foliar X" at its different concentrations in the two experimental seasons resulted in highly significant more leaves per plant than the control. The highest number of leaves per plant was obtained by spraying the plants with 0.45% Foliar X. These results could be explained by physiological role of each elements in Foliar X fertilizer especially N, which is important for the formation of new cells. Similar results were obtained by Khattab et al. (1984) on *Monstera deliciosa* and Afify (1986) on *Gladiolus* plants.

The plants with three branches of all treatments produced more leaves per plant than those with two branches in the two seasons as shown in Table (1) and Table (2).

Maximum increases in the diameter of inflorescences were obtained at the highest Foliar X concentration (0.45%) as shown in Table (1) and Table (2). These results may be due to the increase in the number of ray and disc florets per inflorescences by using a specific level of the complete fertilizer. Similar results were obtained by Kumar et al. (1983).

Generally there were no clear differences in the inflorescences diameter between the plants with two branches and those with three branches Table (1) and Table (2).

It is evident from the data in Table (1) and Table (2) that both fresh and dry weights of leaves, stems, and inflorescences in the two seasons increased gradually with increasing the fertilization level and reached their maximum by using the highest concentration (0.45%) of Foliar X fertilizer. This increase in both fresh and dry weights of leaves, stems and inflorescences could be attributed to using Foliar X fertilizer at optimum rates 0.45%, which caused a large portion of carbohydrates to be made into protein and protoplasm for more meristematic cells for the best growth and production of the plant.

Generally the plants with three branches produced heavier leaves stems and inflorescences than those with two branches as shown in Table (1) and Table (2). These results could be attributed to the differences in the number of leaves between the two groups of *Chrysanthemum* plants. As the plants with three branches had more leaves than those with two branches and consequently produced more metabolic products, which were reflected as an increase in both fresh and dry weights of the different plant organs.

From the previous mentioned results it could be concluded that using the complete fertilizer Foliar X at the concentration of 0.45% was very effective in improving both growth and flowering characters of *Chrysanthemum morifolium* (Ram.) cv. Marie Masse. Moreover, it could be noticed that the plants with three branches are preferable for the commercial production of *Chrysanthemum* flowers than those with two branches.

Chemical analysis:a) Mineral content:

It is evident from the data in Table (3) that spraying *Chrysanthemum morifolium* plants with different concentrations of the commercial fertilizer "Foliar X" affected the N, P, K, Mg and Mn content in the leaves of the plants with two or three branches in the two experimental seasons. The content of N, P, K, and Mg in the leaves of the plants with two or three branches increased gradually with increasing the concentration of Foliar X fertilizer and the highest values were recorded, when the plants were sprayed with 0.30% or 0.45% in the two seasons. The highest Mn content in the leaves was obtained when the plants were sprayed with the low concentration 0.15% Foliar X. The mineral content of the leaves of all fertilization treatments was higher than the control.

From the above mentioned results it could be noticed that there was a close relationship between the nutrient content in the leaves of *Chrysanthemum* plants and their growth and flowering characters. For example, when the plants were sprayed with suitable concentrations of 0.30% or 0.45% from the complete fertilizer "Foliar X", the mineral content of the leaves was raised to a certain level, which improved both growth and flowering characters of *Chrysanthemum* plants. These results may be due to the presence of nitrogen as well as the other plant nutrients in balanced and adequate concentrations in the leaves. As nitrogen is very necessary for the synthesis of protein and cytokinin, which affect to a large extent the plant growth (Wagner and Michael, 1971). Besides nitrogen the presence of other nutrients such as Potassium, Phosphorus, Magnesium and Manganese which may have affected the synthesis of protein, nucleic acids as well as chlorophyll content and consequently improved both growth and flowering characters. These results are in agreement with those obtained by Shoushan *et al.* (1978) on *Hippistrum vittatum*, Herb, Koriash (1984) on *Chrysanthemum morifolium* and Afify (1986) on

Table 3: Effect of spraying Chrysanthemum morifolium cv. "Marie Mease" with different concentration of "Foliar X fertilizer" on the mineral composition of leaves during the seasons of 1986 and 1987.

Foliar X concent, in %	1986					1987				
	N %	P %	K %	Mg %	Mn p.p.m.	N %	P %	K %	Mg %	Mn p.p.m.
	A) <u>Plants with two branches</u>									
0.00	1.30	0.18	5.72	0.29	223	1.50	0.16	5.80	0.32	237
0.15	1.40	0.24	5.64	0.31	340	1.65	0.18	6.00	0.33	375
0.30	1.65	0.29	5.94	0.32	305	1.80	0.20	6.30	0.36	321
0.45	1.60	0.30	5.90	0.37	296	1.78	0.20	5.90	0.40	329
	B) <u>Plants with three branches</u>									
0.00	1.07	0.20	5.72	0.39	211	1.37	0.20	5.90	0.44	249
0.15	1.50	0.24	6.16	0.40	355	1.60	0.26	6.20	0.46	245
0.30	1.80	0.29	6.22	0.45	334	1.80	0.28	6.35	0.52	369
0.45	1.79	0.24	5.94	0.39	300	1.90	0.29	6.45	0.47	310

Gladiolus plant, who mentioned that using the complete fertilizers at suitable rates improved growth and flowering characters of these plants.

b) Chlorophyll and Carotenoids content:

The reported data in Table (4) indicate clearly that the total chlorophyll content in the leaves of Chrysanthemum morifolium plants increased with increasing the fertilization level and reached its maximum value, when the plants received Foliar X fertilizer at a concentration of 0.45% in the case of the plants with two branches, meanwhile the highest chlorophyll content in the leaves of the plants with three branches was obtained by spraying the plants with 0.30% Foliar X fertilizer. On the other hand spraying Chrysanthemum plants with different concentration from Foliar X fertilizer showed no constant trend in the Carotenoids content in the leaves as shown in Table (4).

From the previous mentioned results it could be noticed that using the complete fertilizer Foliar X at suitable rates of 0.3% or 0.45% increased the total chlorophyll content in the leaves, which led to an improvement in both growth and flowering characters of Chrysanthemum plants. These results may be due to the role of Mg at certain concentration which is closely associated with chlorophyll synthesis. Besides its function in the chlorophyll molecule, magnesium is considered as co-factor in almost all enzymes activating phosphorylation processes (Mengel and Kirkby, 1982).

c) Total carbohydrate content:

The recorded data in Table (5) show clearly that spraying Chrysanthemum morifolium plants with different concentration from Foliar X fertilizer affected the total carbohydrate content in the different plant organs. The total carbohydrate content in the leaves

Table 4: Effect of spraying *Chrysanthemum morifolium* cv. "Marie Masse" with different concentration of "Foliar X fertilizer" on the chlorophyll and carotenoides content in the leaves during the seasons of 1986 and 1987, (mg/100 gm fresh weight).

Foliar X concn.	First season 1986				Second season 1987			
	Chlorophyll A	Chlorophyll B	Total chlorophyll	Carotenoides *	Chlorophyll A	Chlorophyll B	Total chlorophyll	Carotenoides
0.00	246.00	197.33	443.33	109.00	193.33	129.67	323.00	91.67
0.15	207.33	139.00	346.33	142.67	190.00	130.00	320.00	110.33
0.30	251.00	223.00	474.00	108.67	293.67	133.00	426.67	113.33
0.45	438.33	175.67	614.00	48.00	438.00	190.00	628.00	107.00
A) Plants with two branches								
0.00	118.67	55.33	174.00	133.67	120.33	79.67	200.00	120.00
0.15	209.33	159.00	368.33	129.00	250.00	111.67	361.67	130.67
0.30	230.67	253.67	484.34	58.67	342.33	179.33	521.66	135.67
0.45	314.33	95.00	409.33	86.67	282.00	110.33	392.33	130.33
B) Plants with three branches								

Table 5: Effect of spraying Chrysanthemum morifolium cv. "Marie Masse" with different concentration of "Foliar X fertilizer" on the total carbohydrate percentages during the seasons of 1986 and 1987.

Foliar X concn. in %	First season 1986.			Second season 1987.		
	Leaves	Stems	Inflor.	Leaves	Stems	Inflor.
	%	%	%	%	%	%
<u>A) Plants with two branches</u>						
0.00	21.88	37.50	26.25	21.25	36.88	26.88
0.15	24.38	33.75	31.88	23.75	33.75	32.50
0.30	25.75	32.75	33.13	24.38	33.38	32.50
0.45	24.13	26.88	34.25	25.13	26.88	31.88
<u>B) Plants with three branches</u>						
0.00	26.88	30.00	29.38	26.25	30.63	30.00
0.15	26.25	35.63	30.63	26.88	36.25	29.38
0.30	24.38	38.00	37.50	24.38	39.63	38.50
0.45	21.88	39.25	39.38	21.88	38.88	40.00

====

of Chrysanthemum plants with two branches increased gradually with increasing the fertilization level and reached its maximum, when the plants were sprayed with 0.30% Foliar X fertilizer, then decreased by using the high concentration of 0.45% Foliar X fertilizer in the two experimental seasons. The obtained results showed also that all fertilization treatments resulted in higher carbohydrate percentages in the leaves of the plants with two branches than the control in the seasons of 1986 and 1987. On the other hand the total carbohydrate content in the stems of the plants with two branches decreased with increasing the fertilization level in the two seasons. In the case of the plants with three branches an opposite trend was observed as the total carbohydrate percentage in the leaves decreased with increasing the spraying concentration of Foliar X fertilizer, whereas the total carbohydrate content in the stems increased by raising the fertilization level in the two seasons as shown in Table (5). These results may be due to the differences in the translocation rate of photosynthates products from the leaves to the stems, which depends on the physiological age of the leaves. This discussion depends on the interpretation of Mengel and Kirkby (1982), who reported that the mature leaves export about 50% of their photosynthates.

The obtained results showed that the total carbohydrate content in the flowers of Chrysanthemum plants with two or three branches increased with increasing the fertilization level and reached its maximum when the plants were sprayed with 0.45% Foliar X fertilizer, as shown in Table (5). These results could be attributed to the role of all nutrients in this commercial fertilizer at their suitable rate in raising the physiological activity of the plant and consequently increasing the photosynthates products of the flowers. Similar results were obtained by Mantrova and Nikitina (1972), who stated that the optimum N P K rates with doubling the phosphorus rate stimulated carbohydrate synthesis and accumulation in rose plants.

In general the total carbohydrate content in the flowers of *Chrysanthemum* plants with three branches was higher than those with two branches in the two seasons as shown in Table (5). These results could be explained through the differences in number of leaves in the two groups, as the plants with three branches had more leaves than those with two branches (Table 1 and Table 2) and consequently more carbohydrate production in the case of the plants with three branches.

From the previous mentioned results it could be concluded that using Foliar X fertilizer at 0.45% raised the total carbohydrate content, which is very necessary for the elongation of the vase life of this important commercial cut flower.

REFERENCES

- Afify, M.M. (1986). Effect of some cultural treatments and growth regulators on the growth, flowering and characters of gladiolus plants. Ph.D. Thesis Fac. of Agric. Minufiya Univ.
- A.O.A.C. (1970). Official Methods of Analysis of the Association of Official Agriculture Chemists. Washington, D.C.
- Dubios, A.; A. Gilles; J.K. Hamelton; P.A. Robers and P.A. Smith (1956). A colorimetric method for determination of sugar and related substances. Anal. Chem. 28: 350.
- El-Gamassy, A.M. and S.A. El-Shafie (1967). Effect of the fertilizer level, time and number of dressings on the growth and flowering of rose plants in the field. Ann. of Agric. Sci. Fac. of Agric. Ain Shams Univ. Cairo. Vol. XIII-No. 1 June.
- Frie, E.; K. Peyer and E. Schutz (1964). Phosphorus determination. Schw. Landwirtschaft Forschung Heft, 3: 318-328.
- Khattab, M.; H. Kamel and M. Yacout (1984). Nitrogen and Potassium nutrition of *Monstera deliciosa* Liebm. accept for Publ. in Alex. J. Agric., Res.
- Koriesh, E.M. (1984). Foliar application of some commercial fertilizers on *Chrysanthemum morifolium* Ram. Ann. of Agric. Sci., Moshtohor Vol. 21: 977-84.
- Kumar, N.; R. Aurumugam and O. Kandasamy (1983). The effect of NPK on flower production of Pyrethrum (*Chrysanthemum cinerarifolium*). Hort. Abst. 53: 2879.

- Mantrova, E.Z. and G.N. Nikitina (1972). The characteristics of nutrition and carbohydrate metabolism in roses growing on their own roots in relation to winter hardiness. Hort. Abst. Vol. 44: 2670.
- Mengel, K. and E.A. Kirkby (1982). Principles of plant nutrition, publisher. International potash Institute P.O.Box. CH-3048 Worblaufen-Bern/Switzerland.
- Mousa, G.T. (1979). Studies on foliar application of certain commercial fertilizer on rose production during winter and spring periods. Ann. Agric. Sci. Moshtohor Vol. 11:149-157.
- Paparozzi, E.T. and H.B. Tukey (1979). Foliar uptake of nutrients by selected ornamental plants. J. Amer. Soc. Hort. Sci. 104(6): 843-846.
- Salami, U.A. and D.G. Kenefick (1970). Stimulation of growth in Zinc deficient corn seedlings by the addition of tryptophan. Crop. Sci. 10: 291-294.
- Shoushan, A.M.; A.M. Abou-Dahab; R.S. El-Dabh and A. Auda (1978). Mineral nutrition of *Amaryllis* (*Hippstrum vittatum* Herb.). II: Effect of fertilizer on bulb growth bulblet production and nitrogen and sugar contents in leaf and bulb. Fac. Agric. Ain Shams Univ. Res. Bull. 966.
- Wagner, H. and G. Michael (1971). Effect of varied nitrogen supply on the synthesis of cytokinin in roots of sun flower; Biochem. Physiol. Pflanzen (Bpp). 162: 147-158.
- Wettstein, D. (1957). Chlorophyll, Let al und der submikrovopische Formmech shell-den Plastiden. Exptl. Cell. Res. 12: 427-433.
- Wittwer, S.H. and F.G. Teubner (1959). Foliar absorption of mineral nutrients. Annu. Rev. Plant Physiol. 10: 13-32.