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RESPONSE OF *Magnolia grandiflora* L. SEEDLINGS TO FOLIAR APPLICATION OF MAGNESIUM, ZINC AND BORON

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ABSTRACT

A pot experiment was carried out in the glass house of the Experimental Nursery of Ornamental Horticulture Department, Cairo University, Giza during 24 months -After a month from transplanting- from 2006 to 2008. The aim of this study was to investigate the response of *Magnolia grandiflora* L. seedlings to foliar spray with magnesium at 25 and 50 ppm, zinc at 25 and 50 ppm and boron at 10 and 20 ppm. Data recorded on vegetative growth such as plant height, stem diameter, leaf area, number of leaves/plant, fresh and dry weights of leaves, stems and roots and root length were significantly affected by the aforementioned treatments which were used in this study. As well as all the treatments of magnesium, zinc and boron had a clear effect on the chemical composition such as chlorophyll-a, b, carotenoids mg/gm F.W. in the leaves, carbohydrates % D.W. in the different organs of plants and the contents of nitrogen, phosphorus and potassium % D.W. in the different organs of *Magnolia grandiflora* L. seedlings, as compared with control treatment in most cases. Foliar application of Mg at 25 ppm significantly promoted plant height, Zn at the rate of 50 ppm gave the highest values of stem diameter, leaf area, number of leaves/plant as well as Mg at 50 ppm produced the tallest root length, compared with control plants. Fresh and dry weights of the plant organs were significantly affected by application of the aforementioned application of treatments, compared with control plants. Chemical constituents, *i.e.*, chlorophyll (a), chlorophyll (b), caroteniods, mineral content of N, P and K % and total carbohydrate content of different plant organs were increased by application of the aforementioned treatments as compared with the control .

Key words: *boron (B), foliar application, magnesium (Mg), magnolia grandiflora L., zinc (Zn).*

1.INTRODUCTION

Magnolia trees (*Magnolia grandiflora* L.) are large, broad-leaved evergreen trees that can grow 18-27 m in height with a trunk up to 0.6-0.9 m in diameter (Radford *et al*. 1968). It has been planted for a shade and as ornamental tree in gardens, houses and along streets, etc (Milne and Milne, 1975). Magnolia is widely planted as an ornamental tree because of its showy, fragrant, ivory flowers and large evergreen leaves and the wood is limited in its uses, but may be made into furniture, paneling, veneer, creates, and cabinets (Brown and Kirman,1990). Magnolia trees (*Magnolia grandiflora* L.) Mangnolia belongs to Family Magnoliaceae. There are more than 100 cultivars common and native to North America (Odenwald and Turner, 1996).

Micronutrients are the elements a plant requires for proper growth but because these elements are needed in small amounts, they are often referred to as micronutrients (Kohnk and Franzmier, 1995). There are many beneficial effects of macro and micro elements on plants and their involvement in the other processes, carbohydrate and nitrogen metabolism, as well as resistance of plant to diseases and adverse environmental conditions. Macro and micro elements are also essential for the organization and rapid alternation of nutrition compounds within the plant owing to their great importance in contribution to direct the enzymes way in metabolism (Marschner, 1995 and Massoud *et al*. 2005). Mosquera *et al*. (2002) found that foliar application of zinc at the rate of 50 ppm stimulated the vegetative growth of *Hedera helix* plants. Khalil *et al*. (2002) on *Tagetes erecta*, L. stated that the combined effects of compost and Zn + Mn recorded the best results on chlorophyll a, b, carotenoids content, total carbohydrates, N, P, and K content. Dorgham (2005) on *Dieffenbachia* and *Syngonium podophylum*, found that spraying with Mg and B gave the tallest plants ,thickest stems ,and increased the number of leaves, leaf area, fresh and dry weights of stems, leaves and roots. Also, the treatment with Mg at the rate of 50 ppm gave the highest values of chlorophyll, total carbohydrates, phosphorus and magnesium in the leaves. Mazhar *et al*. (2006) on *Taxodium disticum*, observed that all growth parameters as well as the total sugars, chlorophyll a, b and carotenoids tended to increase by increasing the concentration of boron up to 20 ppm as compared with the untreated one. Farahat *et al*. (2007) on *Cupressus sempervirens* L. revealed that, Zn at 40 ppm application significantly increased all tested morphological parameters compared with those obtained by low level (20ppm) and untreated plant. Also, they found that spraying the plants with Zn gradually increased pigment content of leaves, total soluble sugars as well as N, P contents in the leaves by increasing Zn concentration from 20 to 40 ppm.

The present study was conducted aiming at investigating the effect of Magnesium (25, 50 ppm), Zinc (25, 50 ppm) and Boron at (10, 20 ppm) treatments on the vegetative growth and some chemical constituents of *Magnolia grandiflora* L. seedlings. The information provided by this study may help in elucidating the response of *M. grandiflora* for the applications of these elements.

2. MATERIALS AND METHODS

The present study was carried out in the greenhouse of the Experimental Nursery of Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza, during 24 months-After a month from transplanting- from April, 2006 to April, 2008.

The objective of this study was to investigate the response of *Magnolia grandiflora* L. seedlings to magnesium and some trace elements (zinc and boron) on growth and chemical constituents.

Uniform seedlings of *Magnolia grandiflora* L. plants. (obtained from Forestry Department, Horticulture Research Institute, Agricultural Research Centre, Giza) with an average of 4 - 5 leaves and 12 - 16cm height were used in this investigation.

On the 8th of March, 2006 the small plants were transplanted in plastic pots of 20 cm in diameter filled with a mixture of peat moss + sand + clay (1:1:1 V/V/V). After a month from transplanting a mixture of NPK (1:1:1) at 2gm/pot was added at monthly intervals, the plants were sprayed with the solution of nutritional elements until run off point; the treatment was applied every two month intervals. Bio-film agent was added at 1 ml/l to the solution as a wetting agent for the different treatments. The seedlings received a regular irrigation.

Magnesium, zinc and boron nutrient solutions were prepared using the following salts, as sources for magnesium, zinc and boron: -

-Magnesium (Mg) at 25 and 50 ppm (Mg – chelated, EDTA 12%).

-Zinc (Zn) at 25 and 50 ppm (Zn– chelated, EDTA 13%).

-Boron (B) at 10 and 20 ppm (borax 11.4%).

After 24 months from transplanting the following data were recorded: plant height (cm), stem diameter (mm) (5cm from soil surface), leaf area (cm^2) (using leaf area meter) and number of leaves / plant, fresh and dry weights of leaves, stems and roots (gm/plant), root length (cm), chlorophyll a & b and caroteniods contents in leaves (mg/gm. F.W.), total carbohydrates content in leaves, stems and roots (%D. W.) and nitrogen, phosphorus and potassium contents in the leaves, stems and roots (%D. W.)

The different foliar treatments of Mg, Zn and B were replicated three times and each replicate contained three plants (3 pots). The layout of the experiment was a complete randomized design. The differences between the means of the different treatments of each experiment were compared by using L.S.D. test at 5% probability (Sendecor and Cochran, 1980). Chlorophyll a, b and carotenoid contents were determined in fresh green leaves according to Wettstein (1957). Total carbohydrates content in dried material of leaves, stems and roots were determined according to Dubois *et al*. (1956). The content of nitrogen (%D.W.) was determined by modified micro-Kjeldahl method as described by Pregl (1945). Phosphorus content was determined according to Snell and Snell (1949). The content of potassium% was determined by flame spectrophotometer according to Chapman and Pratt (1961).

3.RESULTS AND DISCUSSION

3.1. Vegetative growth

3.1.1. Plant height

The data presented in Table (1) indicate that, spraying the plants, with Mg, Zn and B increased significantly the height of magnolia seedlings, compared with the control. Using Mg at 25 ppm, B at 10 ppm, and Zn at 50 ppm were the best treatments in this concern compared with the other treatments. These treatments gave the tallest plants, *i.e.*, 55.00, 52.67 and 46.00 cm, respectively when compared with the other treatments.

The positive effect of B on plant height may be attributed to the role of boron on cell elongation (Shaaban *et al.* 2004). Zinc plays an important role in plant physiology, where it activates some enzymes. Zinc functions are related to metabolism of carbohydrates and proteins, which are essential multiple processes, critical to development and differentiation of cells, (Vallee, 1976). These results are in agreement with those obtained by Mazhar *et al*. (2006) on *Taxodium disticum* and Esmail (2008) on *Codiaeum variegatum* 'Gold Star'.

3.1.2. Stem diameter

The data presented in Table (1) on stem diameter of magnolia seedlings reveal that, 9.3, 9.2 and 9.2 mm in stem diameter were recorded due to the application of Zn at 50 ppm, Mg at 50 ppm and B at 20 ppm, respectively, while the control plants recorded 5.3 mm. The results are in agreement with those obtained by Farahat *et al*. (2007) on *Cupressus sempervirens* L.

3.1.3. Leaf area

As shown in Table (1), spraying the plants with Mg, Zn and B significantly increased the average value of leaf area for magnolia seedlings. Treating plants with Zn 50 ppm was the most effective for increasing the leaf area as compared with all other treatments. Also, using B at 20 ppm and Mg at 25 ppm were more effective in increasing the leaf area than the other level used; similar results were obtained by Dorgham (2005) on *Dieffenbachia amoena* and *Syngonium podophylum* plants.

3.1.4. Number of leaves/plant

As shown in Table (1) the data reveal that there were significant effects with application of Mg and trace elements (Zn, B) on the number of leaves in most cases. The lower level of both Mg and B were more effective in increasing the number of leaves per seedling; the treatment gave 24.0 and 23.7 leaves / seedling respectively, compared to 21.0 and 20.7 leaves / seedling for the higher level. On the other hand, increasing the level of Zn from 25 to 50 ppm, significantly increased the number of leaves from 21.9 to 24.5 leaves / seedling, whereas the control plants produced 17.0 leaves / seedling. These results are in accordance with those obtained by Mazhar *et al*. (2006) on *Taxodium distichum* and Abd El-Aziz and Balbaa (2007) on *Salvia farinacea* seedlings.

3.1.5. Fresh and dry weights of leaves

The data in Table (2) reveal that the application of Mg and trace elements (Zn and B) significantly affected the fresh and dry weights of leaves. Concerning the effect on leaves fresh weight, it is clear that the application of Mg and trace elements increased the fresh weight / plant for all treatments giving the heaviest weight (53.23 gm / plant) for the plant treated with Zn at 50 ppm followed by Mg at 50 ppm which gave 42.00 gm / plant then B at 10 ppm which produced 41.42 gm / plant as compared with the untreated plants which gave 19.35 gm / plant. The data indicate that raising the level of both Mg and Zn from 25 to 50 ppm had a significant effect on increasing the fresh weight of leaves. Regarding the response of leaves dry weight to the treatments, the data indicate that treating the plants with Zn at 50 ppm, Mg at 50 ppm and B at 10 ppm were the most effective treatments in increasing leaves dry weights which resulted in 19.43, 18.15 and 16.11 gm / plant, respectively, as compared with the untreated plants 7.95 gm / plant. The application of Mg and Zn at the two levels used on magnolia seedlings were the most effective treatments on increasing the leaves dry weight as compared with the control, whereas B 20 ppm had no significant effect on the dry weight of leaves. These results are in agreement with those obtained by El-Khateeb and El-Hanafy (2001) on *Hippeastrum vittatum* plants and Dorgham (2005) on *Dieffenbachia amoena* and *Syngonium podophylum.*

3.1.6. Fresh and dry weights of stems

The data in Table (2) show that the application of Mg and trace elements on magnolia seedlings had a significant effect on stems fresh weight. It is clear that the application of Mg and trace elements increased fresh weight of stems / plant for all treatments giving the heaviest stem weight 24.90, 20.75 and 20.21 gm / plant, for the plant treated with Zn at 50 ppm, Mg at 50 ppm and B at 20 ppm, respectively as compared with the control 3.78 gm / plant. Regarding the effect of Mg and trace elements treatments on stem dry weight, the obtained data indicate that treating magnolia seedlings with Zn at 50 ppm, Mg at 50 ppm and B at 20 ppm were the most effective, which resulted in 10.92, 8.83 and 8.60 gm / plant, respectively, stems dry weight, as compared with the untreated plants 2.35 gm / plant. There are many beneficial effects of micronutrients on plants and their involvement in the other processes, carbohydrate and nitrogen metabolism, as well as the resistance to diseases and adverse environmental conditions. Microelements are also essential for the organization and rapid alternation of nutrition compounds within plant owing to their great importance in contribution to direct the enzymes in metabolism (Massoud *et al.,* 2005).These results are in agreement with Esmail (2008) on *Codiaeum variegatum* 'Gold Star'.

3.1.7. Fresh and dry weights of roots

Table (1):Effect of Mg and some trace elements (Zn and B) on some growth parameters of *Magnolia grandiflora* L. seedlings during 24 months from April,2006 to April,2008.

Growth parameters / Treatments (ppm)	Plant height (cm)	Stem diameter (mm)	Leaf area (cm^2)	Number of leaves/plant
Control	25.30	5.3	33.63	17.0
Mg 25	55.00	8.3	83.23	24.0
Mg 50	45.67	9.2	72.81	21.0
Zn 25	38.33	8.0	67.06	21.9
Zn 50	46.00	9.3	93.23	24.5
B 10	52.67	6.0	41.54	23.7
B 20	39.67	9.2	88.30	20.7
LSD at 5%	2.08	1.3	3.91	1.6

Table (2): **Effect of Mg and some trace elements (Zn and B) on the fresh and dry weights (gm.) of leaves, stems and roots and root length for *Magnolia grandiflora* L. seedlings, during 24 months from April, 2006 to April, 2008.**

Characters / Treatments (ppm)	Fresh weight of leaves/plant (gm)	Dry weight of leaves/plant(gm)	Fresh weight of stems/plant (gm)	Dry weight of stems/plant (gm)	Fresh weight of roots/plant (gm)	Dry weight of roots/ plant (gm)	Root length (cm)
Control	19.35	7.95	3.78	2.35	2.99	1.50	12.60
Mg 25	25.72	10.87	13.41	5.23	5.44	2.91	19.80
Mg 50	42.00	18.15	20.75	8.83	7.94	4.03	25.20
Zn 25	20.83	9.62	11.28	4.39	3.68	2.68	17.00
Zn 50	53.23	19.43	24.90	10.92	7.58	3.34	23.30
B 10	41.42	16.11	10.90	3.68	7.54	3.91	24.50
B 20	25.05	8.96	20.21	8.60	3.15	2.15	16.60
LSD at 5%	3.00	2.30	1.60	1.20	0.88	0.40	2.20

The data in Table (2) reveal that fertilizing the plants with Mg and trace elements (Zn and B) affected significantly in some cases the roots fresh weight, as compared with the untreated plants. Spraying the seedlings with high level of Mg at 50 ppm, Zn at 50 ppm and low level of B at 10 ppm increased significantly the roots fresh weight 7.94, 7.58 and 7.54 gm / plant, respectively. Whereas, application of Mg at 25 ppm and Zn at 25 ppm were less effective than the application of high levels, which resulted in 5.44 and 3.68 gm / plant, respectively. Concerning the effect of Mg and trace elements on roots dry weight, the obtained results indicated that, Mg at 50 ppm, B at 10 ppm and Zn 50ppm resulted in 4.03, 3.91 and 3.34 gm / plant, respectively. Similar results were reported by Farahat *et al*. (2007) on *Cupressus sempervirens* L.

3.1.8. Root length

The data in Table (2) show that treating magnolia seedlings with high level of Mg at 50 ppm, low level of B at 10 ppm and Zn at 50 ppm increased significantly the root length which produced 25.20, 24.50 and 23.30cm, respectively, as compared with the control plants at 12.60 cm. These results are in agreement with those obtained by Farahat *et al*. (2007) on *Cupressus sempervirens* L.

3.2. Chemical composition

3.2. 1. Pigments content

As shown in Table (3), the data indicate that Mg at 25, 50 ppm, Zn at 25, 50 ppm and B at 10, 20 ppm increased the content of chlorophyll-a, than the control plants and the highest value 1.29 mg/gm F.W. was recorded with Mg at 25 ppm treatment. Also the highest content of chlorophyll-b 0.83 mg / gm F.W. was produced by the application of Mg at 25 ppm, followed by Mg at 50 ppm 0.80 mg / gm F.W. and Zn at 25 ppm which resulted in 0.71 mg/ gm F.W. The highest content of careteniods in the fresh leaves of

Table (3): Effect of Mg and some trace elements (Zn and B) on the contents of chlorophylls-a, b, carotenoids mg/gm F.W. in the leaves and carbohydrates %D.W. in the different organs of *Magnolia grandiflora* **L. seedlings, during 24 months from April, 2006 to April, 2008.**

Characters / Treatments (ppm)	Chlorophyll content mg/gm F.W.			Carbohydrates %D.W.		
	Chl. a	Chl. b	Carotenoid	Leaves	Stems	Roots
Control	0.70	0.40	0.59	30.94	29.30	30.27
Mg 25	1.29	0.83	1.05	33.04	39.89	40.48
Mg 50	1.16	0.80	0.89	44.01	39.23	30.80
Zn 25	1.17	0.71	0.96	47.03	36.89	31.47
Zn 50	0.90	0.58	0.68	46.81	33.69	42.66
B 10	0.91	0.41	0.76	42.87	30.81	33.70
B 20	0.75	0.54	0.62	46.82	31.23	38.14

Table (4):Effect of Mg and some trace elements (Zn and B) on the contents of nitrogen, phosphorus and potassium (% D.W.) in the different organs of *Magnolia grandiflora* **L. seedlings, during 24 months from April, 2006 to April, 2008.**

Characters / Treatments (ppm)	Nitrogen(%D.W.)			Phosphorus(%D.W.)			Potassium(%D.W.)		
	Leaves	Stems	Roots	Leaves	Stems	Roots	Leaves	Stems	Roots
Control	0.86	0.97	0.97	0.18	0.17	0.20	1.63	0.57	0.73
Mg 25	1.18	1.08	0.99	0.24	0.23	0.22	1.14	0.59	0.97
Mg 50	1.61	1.34	1.99	0.22	0.18	0.29	1.23	0.74	1.09
Zn 25	1.18	1.29	1.08	0.21	0.19	0.22	1.00	0.68	1.19
Zn 50	1.51	0.99	1.77	0.23	0.22	0.24	1.38	0.61	0.99
B 10	1.24	1.09	1.08	0.27	0.19	0.21	1.47	0.58	1.12
B 20	1.08	1.18	1.88	0.24	0.21	0.29	1.21	0.79	0.83

magnolia seedlings 1.05, 0.96 and 0.89 mg/gm F.W. had been determined in plants treated with Mg at 25 ppm, Zn at 25 ppm and Mg at 50 ppm, respectively, compared with the control plants which gave the lowest value 0.59 mg/gm F.W.

Boron at both concentrations caused an increase in chlorophyll a, b and caroteniods; boron helps transport vital sugars through plant membranes and promotes proper cell division and development. These results are in agreement with those obtained by Dorgham (2005) on *Dieffenbachia amoena* and *Syngonium podophylum* plants.

3.2.2. Total carbohydrates content (%D.W.)

The effect of Mg, Zn and B on the contents of the carbohydrates in the different parts of magnolia seedlings, as shown in Table (3) indicates that the highest contents of total carbohydrates in the leaves were produced, 47.03, 46.82, 46.81 and 44.01 % D.W. resulted from treated seedlings with Zn 25 ppm, B 20 ppm, Zn 50 ppm and Mg 50 ppm, respectively, compared with untreated plants (30.94 %D.W.).Concerning, the effect of Mg, Zn and B on total carbohydrates in stems, the data reveal that the application of Mg at 25 ppm and 50 ppm resulted in the highest carbohydrates content in the stem 39.89 and 39.23 % D.W., respectively, This was followed by the treatment of Zn at 25 ppm and Zn at 50 ppm, resulting in 36.89 and 33.69 % D.W., respectively. The treatments of B at 10 and 20 ppm cause slightly increase in carbohydrates of stem, compared with control plants. In case of the roots, the application of Zn at 50 ppm, Mg at 25 ppm and B at 20 ppm resulted in the highest values of carbohydrates root content 42.66, 40.48 and 38.14 % D.W., respectively, while the lowest values 30.27, 30.80 and 31.47 % D.W were obtained with control, Mg at 50 ppm and Zn at 25 ppm, respectively.These results are in agreement with those obtained by Sakr (2001) on *Iris tingitana* plant and Dorgham (2005) on *Dieffenbachia amoena* and *Syngonium podophylum* plants.

3.2.3. Nitrogen, phosphorus and potassium contents

3.2.3. 1. Nitrogen content (%D.W.).

The data in Table (4) show great variable effects on the content of nitrogen in the different parts of magnolia seedlings.

In the leaves, the determined values showed that application of Mg at 50 ppm, Zn at 50 ppm and B at 10 ppm increased the N%; *i.e*. 1.61, 1.51 and 1.24 %, respectively, as compared with other treatments. The other treatments varied in their effect, giving its lowest value 1.08% for B at 20 ppm, 1.18 and 1.18 % for Mg at 25 ppm and Zn at 25 ppm, respectively as compared with the control plants (0.86%).

In the stem, the highest values of nitrogen contents 1.34, 1.29 and 1.18%, resulted in Mg at 50 ppm, Zn at 25 ppm and B at 20 ppm respectively than untreated plants 0.97%.

In the roots, the determined values for N content % were the highest 1.99, 1.88, 1.77, 1.08, 1.08 and 0.99% resulted from Mg at 50 ppm, B at 20 ppm, Zn at 50 ppm, Zn at 25 ppm, B at 10 ppm and Mg at 25 ppm, respectively compared with the control plants which produced 0.97% nitrogen content in the roots of magnolia plants.

3.2.3. 2. Phosphorus content (%D.W.)

The results in Table (4) reveal that, treating the plants with B at 10 ppm, B at 20 ppm, Mg at 25 ppm, Zn at 50 ppm, Mg at 50 ppm and Zn at 25 ppm increased the phosphorus content of the leaves, *i.e*., 0.27, 0.24, 0.24, 0.23, 0.22 and 0.21%, respectively as compared with the control plants which produced 0.18%.

Whereas treating the plants with levels of Mg, Zn and B increased the phosphorus content of the stems, as compared with the control plants. Also, in roots, the same trend was found in phosphorus content and the highest phosphorus content 0.29 and 0.29% were produced with Mg at 50 ppm and B at 20 ppm, respectively.

3.2.3. 3. Potassium content (%D.W.)

The data in Table (4) reveal that the content of potassium in the leaves of treated plants was decreased as a result of using all levels of Mg, Zn and B, compared with the control plants 0.73%. Whereas treating the plants with B at 20 ppm, Mg at 50ppm, Zn at 25ppm, Zn 50ppm, Mg 25ppm and B 10 ppm resulted in 0.79, 0.74, 0.68, 0.61, 0.59 and 0.58%, respectively in content of the stems of magnolia plants, compared with the control plants which produced 0.57%. The content of K in the roots, reached to the highest value at the low level of Zn 25ppm, B 10 ppm and Mg 50 ppm; *i.e*., 1.19, 1.12 and 1.09%, respectively compared with the control plants 0.73%.

The formentioned results are in agreement with those obtained by El-Khateeb and El-Hanafy (2001) on *Hippeastrum vittatum* plants, Hussien (2004) on *Iris* plant, Dorgham (2005) on *Dieffenbachia amoena* and *Syngonium podophylum* plants and Khalil *et al*. (2002) on *Tagetes erecta*, L.

Conclusion

It could be stated that the foliar application of Zn at 50 ppm was the most effective treatment for increasing the stem diameter, leaf area, number of leaves/plant and fresh and dry weights of leaves and stems. Spraying the seedling with high level of Mg at 25ppm increased the pigments content in the fresh leaves (chlorophyll A&b and caroteniods).

Treating the seedling with Mg at 50ppm increased nitrogen contents in leaves,stems and roots,also increased the phosphorus contents in roots.

Whearas the content of potassium in the stems,reached the heighest value when treated with B at 20ppm.

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إستجابة شتلات الماجنوليا للرش الورقي بإستخدام الماغنسيوم و الزنك و البورون

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ملخص

أجريت هذه الدراسه داخل الصوب الزجاجية لقسم بساتين الزينة بكلية الزراعة ، جامعة القاهرة ، لمدة 24 شهرا خلال الفترة من ٢٠٠٦ إلي ٢٠٠٨ لدراسة استجابة شتلات الماجنوليا للرش الورقي بالماغنسيوم بتركيز 25 و 50 جزء في المليون و الزنك بتركيز 25 ، 50 جزء في المليون و البورون بتركيز 10 ، 20 جزء في المليون وأثره على النمو الخضري لشتلات الماجنوليا (طول النبات ، قطر الساق ، مساحة الورقة ، عدد الأوراق للنبات ، الوزن الغض و الجاف لأجزاء النبات المختلفة و طول الجذور) ، وكذلك أثره على التركيب الكيميائي من حيث (محتوى الأوراق من كلوروفيل أ- ب و كاروتينيدات و محتوى أجزاء النبات من العناصر (النيتروجين- الفوسفور-البوتاسيوم) و الكربوهيدرات الكلية.

أظهرت الدراسة وجود استجابة معنوية للمعاملات السابقة. أدى الرش الورقي بالمغنسيوم 25 جزء في المليون إلى زيادة معنوية في أرتفاع النبات، و أدت المعاملة بالزنك 50 جزء في المليون إلى زيادة قطر الساق لأعلى قيمة و كذلك مساحة الورقة و عدد الأوراق/النبات. أيضاً أدى الرش الورقي بالمغنسيوم بمعدل 50 جزء في المليون إلى زيادة طول الجذور مقارنة بالكنترول، و قد أظهر الوزن الغض والجاف لأجزاء النبات استجابة معنوية للمعاملات السابقة مقارنة بالكنترول ، و كانت هناك زيادة في محتوى الأوراق من كلوروفيل أ- ب والكاروتينيدات و محتوى أجزاء النبات من العناصـــر (النيتروجين- الفوسفور-البوتاسيوم) و الكربوهيدرات الكلية عند معاملة النبات بالمعاملات السابقة مقارنة بالكنترول.