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Effect of Chemical and Biofertilization on Growth and Chemical Composition of *Ixora amabilis* L. Plant

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Abstract: An investigation was established in the open field at Experimental Farm of Horticulture Research Institute, Agricultural Research Center (ARC), Giza, Egypt during 2010 and 2011 seasons to study the effect of NPK chemical fertilizer (2:1:1) at 2 g/pot, as well as rhizobacterin (a biofertilizer contains a specific strain of *Rhizobium sp.* bacteria) and nitrobein (a biofertilizer contains a specific clone of *Azotobacter chroococcum* bacteria) at 5 g/pot from each on growth and quality of 6-months-old transplants of Ixora amabilis L. grown in 15-cm-diameter plastic pots filled with about 2 kg of sand, loam and peatmoss mixture (1:1:1, v/v/v) when applied as soil drench, 4 times with 2 months interval. Moreover, the effect of the two combined treatments arised from combining NPK mixture at 2g/pot with either rhizobium or nitrobein at 5g/pot for each, were studied. The obtained results showed that all vegetative and root growth traits were significantly increased in response to the various fertilization treatments employed in this work comparing with control plants which gave the least means in the two seasons. Nitrobein biofertilizer alone gave better results than the individual application of NPK mixture and rhizobacterin biofertilizer, each alone. Combining NPK mixture at 2g/pot with either rhizobacterin or nitrobein at 5g/pot from each doubled means of the different growth parameters, especially the combination of NPK mixture + nitrobein which recorded the highest values in both seasons. A similar trend was also obtained concerning contents of chlorophylls a b, carotenoids and N, P and K % in the leaves.

Key words: *Ixora amabilis* L. · NPK mixture · Rizobacterin · Nitrobein · Growth · Chemical composition

INTRODUCTION

Ixora amabilis L., a flowering shrub with pinkish flowers suffused with orange, belongs to Family Rubiaceae; native to tropic Asia and Africa, extending to Australia. It is a handsome plant in cultivation with bright coloured flowers and attractive foliage. It is grown in the greenhouse and in the open in warm climates. Propagated by cuttings, preferably with 3 or 4 joints, in spring and kept over bottom heat; also by seeds when produced [1]. Nowadays, using of biofertilizers has become one of the most important requirements to protect environments from pollution, besides getting a safe and clean product, especially if this product will be used by man indoors, as pot plant. Biofertilizers contain microorganisms, which may fix atmospheric N_2 in a free living state, e.g. *Azotobacter and Azospirillum*. These bacteria secrete some growth promoting factors, e.g. gibberellin, cytokinin-like substances, auxins and some vitamins such as thiamine, riboflavin, pyridoxine, nicotinic and pantothenic acids [2]. Azotobacter chroococcum bacteria synthesize antifungal antibiotics, which allow additional advantage for the use in field of production [3]. Phosphate-solubilizing microorganisms (PSM) release phosphate ions from rocks and organic materials to be available for plants [4]. Other benefits are also mentioned by many investigators. By looking up in the literature, we found a limited body of information about the effect of biofertilizers on growth and quality of *Ixora*, while on other ornamentals, there are many efforts such as those indicated on *Hibiscus rosa-sinenssi* [5], *Peperomia obtusifolia* cv. Variegata[6], *Ficus binnendikii* cv. Amstel King [7], *Ficus macrocarpa* var. Hawaii [8], *Nephrolepis exaltata* [9], Dracaena and Ruscus [10, 11], revealed that biogein greatly improved vegetative growth and flowering of Gladiolus sp cultivars White and Rose Prosperity, especially at the rate of 15g/ plant. Similarly, new corm diameter and its fresh and dry weights, as well as number

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of cormels/plant in both cultivars were also increased. On *Vinca rosea* cv. Major, it was reported that nitrobein and phosphorein at either 5 or l0 g/plant markedly improved vegetative and root growth and caused a progressive increment in the number of inflorescences/ plant, number of florets/inflorescence and stalk length as the rate of bioferbilizer was increased. Moreover, there was an increase in the leaf content of chlorophylls a and b, carotenoids, total carbohydrates, N, P and K [12].

However, this study aims to find out enhancing effect of both rhizobacterin and nitrobein biofertilizers, each alone or in combination with NPK chemical compound fertilizer, on growth and chemical composition of *Ixora* plant.

MATERIALS AND METHODS

This study was carried out in the open field at the Experimental Farm of Horticulture Research Institute, Agricultural Research Center (ARC), Giza, Egypt throughout the two successive seasons of 2010 and 2011 to explore the role of rhizobacterin and nitrobein biofertilizers, alone or in combination with NPK chemical fertilizer in improving growth performance and quality of *Ixora* plant. So, the 6-months-old uniform transplants of Ixora amabilis L. (9±1 cm height and carrns 6±1 leaves) were planted on April, 1st for the two seasons in 15-cm-diameter plastic pots (one transplant/pot) filled with about 2 kg of an equal mixture of sand, loam and peatmoss by volume (1: 1: 1, v/v/v). Some physical and chemical properties of the sand and loam used in both seasons are shown in Table 1, while those of peatmoss are illustrated in Table 2.

After 2 weeks from planting (April, 15th), the following treatments were applied:

No Fertilization, Referred to as Control: Chemical fertilization with a mixture of NPK (2:1:1) at the rate of 2g/pot.of ammonium sulphate (20.5%N), calcium superphosphate (15.5%P_2O_5) and potassium sulphate (48.5%K_2O) as the fertilizers were used to obtain the required ratio.

Biofertilization with either rhizobacterin (a commercial product that contains a specific strain of *Rhizobiusm sp*. which fixes atmospheric N_2, conc. 10^{6-7}cells/ml) or nitrobein (a commercial product contains a special clone of *Azotobacter chroococcum* bacteria, conc. 10^6cells/ml) at the rate of 5 g/pot for each.

The mixture of NPK at 2g/pot was combined with either rhizobacterin or nitrobein (each at 5g/pot) to form two interaction treatments.

The layout of the experiments in the two seasons was a complete randomized design [13] with 3 replicates, as each replicate contained 5 transplants. The various routine agricultural practices were conducted as recommended for such plantation.

At the end of each season (December, 15th), plant height (cm), number of branches and leaves/plant, leaves fresh and dry weights (g), number of roots/plant and the longest root length (cm) were determined. The plants did not reach to flowering phase during the period of study.

Table 1: Some physical and chemical properties of sand and loam during 2010 and 2011 seasons

		Particle size distribution (%)							Cations (meq/l)				Anions (meq/l)		
Soil type	Seasons	Coarse sand	Fine sand	Silt	Clay	S.P	E.C. (dS/m)	pH	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{--}
Sandy	2010	89.03	2.05	0.40	8.52	23.00	3.31	7.50	7.50	1.63	33.60	0.50	3.20	22.00	18.03
	2011	90.10	1.95	0.50	7.45	22.63	3.58	7.82	19.42	8.33	7.20	0.75	1.60	7.00	27.10
Loamy	2010	10.18	46.17	19.53	24.12	35.00	3.46	8.27	17.50	9.42	20.00	0.79	3.80	10.00	33.91
	2011	10.30	46.54	18.88	24.28	33.68	3.51	8.18	18.00	8.95	20.50	0.85	3.65	10.20	34.45

EC and soluble ions were determined in the soil paste extract

Table 2: Some physical and chemical properties of the used peatmoss in the two seasons

Variables	Value	Variables	Value
Organic matter %	90-95%	P %	0.23
Ash %	8-10%	K %	1.77
Density (vol. dry) mg/L	80-90	Fe ppm	421
pH value	3.4	Mn ppm	27
Water relation capacity%	60-75	Zn ppm	41
Salinity g/l	0.3	Cu ppm	8.8
N %	1.09	Mg ppm	3.3

So, no data were recorded about flowering. In fresh leaf samples taken from the middle parts of the plants, photosynthetic pigments (chlorophyll a, b and carotenoids as mg/g f.w.) were measured according to the method described by Moran [14], while in dry samples, the percentages of nitrogen using micro- Kjeldahle method [15], phosphorus colorimetrically as the method explained by Luatanab and Olsen [16] and potassium [17] were measured.

Statistical Analysis: Data were then tabulated and subjected to analysis of variance according to program of SAS [18], while Duncan's Multiple Range Tests [19] was used to verify the significant between the means of the different treatments.

RESULTS AND DISCUSSION

Effect of Fertilization Treatments On Vegetative and Root Growth: From data presented in Tables 3 and 4, it could be concluded that plant height (cm), No. branches and leaves/plant, No. roots/plant, the longest root length (cm), as well as leaves and roots fresh and dry weights (g) were markedly improved as a result of applying the different fertilization treatments employed in this study with significant differences compared to control plants which gave the least records in the two seasons. Data also exhibited that nitrobein biofertilizer gave better results than both NPK mixture and rhizobacterin biofertilizer, while combining between NPK mixture at 2g/pot and either biofertilizers used in the present work greatly doubled means of the various characters mentioned before, especially the combination of 2g NPK/pot+ 5g nitrobein/pot, which registered the utmost high means in the first and second seasons. This may indicate the role of both NPK chemical fertilizer in providing the plants with the main elements necessary for good growth and nitrobein biofertilizer which may fix more atmospheric N_2 and secrets more vitamins and growth promoting substances required for healthy growth [2]. Furthermore, *Azotobacter chroococum* bacteria synthesize antifungal antibiotics which gave a special advantage for the use in field of production [3]. Other observations were also noticed by Shahin *et al.* [5] on *Hibiscus rosa-sinensis*, Abdel-Fattah *et al.* [10] on Dracaena and Ruscus and El-Sayed *et al.* [11] on gladiolus.

Chemical Compositions: Data presented in Tables 5 and 6 indicated that a similar trend in case of vegetative and root growth parameters was also obtained in photosynthetic pigments content (mg/g f.w.) and the percentages of N, P and K in the leaves with fertilized plants, as the single application of NPK mixtures, rhizobacterin and nitrobein caused a slight increment in such constituents with non-significant differences in the

Table 3: Effect of fertilization treatments on vegetative and root growth of *Ixora amabilis* L. plants during 2010 and 2011 seasons

	Plant height (cm)		No. branches/plant		No. leaves/plant		No. roots/plant		Root length (cm)	
Fertilization treatments	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Control	12.0e	17.0e	1.0c	1.0c	7.3f	8.0d	6.7e	7.2d	7.5e	8.3d
NPK at 2g/pot (A)	18.4d	21.0d	2.0b	1.7bc	9.1e	10.0d	12.3d	10.7c	16.3c	17.5c
Rhizobacterin at 5g/pot (B)	17.5de	19.3de	2.0b	2.0b	12.9d	18.0c	12.1d	13.5cb	15.9cd	18.0c
Nitrobein at 5g/pot (C)	20.3c	23.1c	2.0b	3.0a	21.6c	22.5b	15.8c	14.6b	15.6d	21.9b
A + B	26.7b	27.6b	3.0a	2.5ab	27.3b	28.0ab	18.3b	19.1a	20.0b	20.0bc
A + C	32.1a	36.5a	3.1a	3.0a	31.6a	30.0a	21.9a	20.0a	23.4a	24.7a

Means within a column having the same letters are not significantly different at 5% level according to Duncan's Multiple Range Test (DMRT)

Table 4: Effect of fertilization treatments on leaves and roots fresh and dry weights of *Ixora amabilis* L. plants during 2010 and 2011 seasons.

	Fresh weight (g)				Dry weight (g)			
	Leaves		Roots		Leaves		Roots	
Fertilization treatments	2010	2011	2010	2011	2010	2011	2010	2011
Control	3.48d	2.98d	3.40c	3.88d	2.21c	1.70d	1.90c	1.97d
NPK at 2g/pot (A)	4.15c	4.17c	4.50b	4.20cd	2.50c	2.58c	1.99c	2.13cd
Rhizobacterin at 5g/pot (B)	5.12bc	5.63bc	4.11cb	4.20cd	3.10b	3.60b	2.10cb	2.71cb
Nitrobein at 5g/pot (C)	5.20b	6.00b	4.56b	4.67c	2.97bc	3.59b	2.32b	2.43c
A + B	5.70b	6.10b	5.33a	6.02b	3.00b	3.70b	2.60ab	2.80b
A + C	7.33a	8.22a	5.56a	7.23a	4.21a	4.96a	2.86a	3.38a

Means within a column having the same letters are not significantly different at 5% level according to Duncan's Multiple Range Test (DMRT)

Table 5: Effect of fertilization treatments on some active constituents of *Ixora amabilis* L. plants during 2010 and 2011 seasons

	Chlorophyll a		Chlorophyll b		Carotenoids	
Fertilization treatments	2010	2011	2010	2011	2010	2011
Control	1.01c	1.04c	0.55c	0.53c	0.72c	0.63c
NPK at 2g/pot (A)	1.26bc	1.28cb	0.58c	0.57c	0.75c	0.67c
Rhizobacterin at 5g/pot (B)	1.23cb	1.29cb	0.63c	0.59c	0.83c	0.69c
Nitrobein at 5g/pot (C)	1.27bc	1.37bc	0.80b	0.73b	0.87b	0.80b
A + B	1.39b	1.51b	0.93a	0.81a	0.89ab	0.86ab
A + C	1.92a	1.99a	0.98a	0.89a	0.93a	0.92a

Means within a column having the same letters are not significantly different at 5% level according to Duncan's Multiple Range Test (DMRT)

Table 6: Effect of fertilization treatments on N, P and K % of *Ixora amabilis* L. plants during 2010 and 2011 seasons.

	N%		P%		K%	
Fertilization treatments	2010	2011	2010	2011	2010	2011
Control	1.36d	1.28d	0.17c	0.20c	1.23c	1.20c
NPK at 2g/pot (A)	1.50c	1.50c	0.19c	0.21cb	1.50b	1.45bc
Rhizobacterin at 5g/pot (B)	1.48c	1.43c	0.16c	0.18c	1.24c	1.23c
Nitrobein at 5g/pot (C)	1.67bc	1.72b	0.26b	0.29ba	1.47bc	1.50b
A + B	1.83b	1.89ab	0.23b	0.27b	1.53b	1.48b
A + C	2.13a	2.04a	0.36a	0.38a	1.84a	1.76a

Means within a column having the same letters are not significantly different at 5% level according to Duncan's Multiple Range Test (DMRT)

two seasons, except for nitrobein treatment at 5g/pot that caused a significant increase in content of chlorophyll b and carotenoids in the 1st and 2nd seasons. The mastery in both seasons was also for the combination of 2g NPK mixture/pot+5g nitrobein/ pot which raised content of the various measured constituents to the maximum values comparing with control and other treatments. This was reasonable because nitrobein biofertilizer in presence of NPK may fix more atmospheric N_2 and mobilize phosphate and other nutrients to be more available for plants [3]. Similar findings were reported by El-Sayed *et al.* [6] on *Peperomia obtusifolia* and Abdel-Fattah *et al.* [10] on Dracaena and Ruscus.

CONCLUSION

From the aforementioned results, it could be recommended to dress the 6-months-old transplants of Ixora amabilis L. cultivated in 15-cm-diameter plastic pots filled with about 2 kg of sand, loam and peatmoss mixture (1:1:1, v/v/v) with NPK (2:1:1) chemical fertilizer (2g/pot) and nitrobein biofertilizer (5 g/pot) for healthy growth and high quality.

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