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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(6): 286-289

www.thepharmajournal.com
Received: 01-04-2019
Accepted: 05-05-2019

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Effect of micronutrients on plant growth and flower yield of jasmine (*Jasminum grandiflorum* L.) cv. double Mogra

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Abstract
The present experiment was carried out during September, 2018 to March, 2019 in Research Field of Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in Randomized Block Design (RBD), with twelve treatments of Micronutrients, the treatments were replicated thrice. The treatments were T_0 (Control), T_1 (Boron 0.2% + RDF), T_2 (Boron 0.4% + RDF), T_3 (Boron 0.6% + RDF), T_4 (Zinc 0.2% + RDF), T_5 (Zinc 0.4% + RDF), T_6 (Zinc 0.6% + RDF), T_7 (Iron 0.2% + RDF), T_8 (Iron 0.4% + RDF), T_9 (Iron 0.6% + RDF), T_{10} (Iron 0.2% + Zinc 0.2% + RDF) and T_{11} (Iron 0.2% + Zinc 0.4% + RDF). From the present investigation it is found that the treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) found to be best in terms of plant growth and yield parameters of Jasmine. In terms of cost benefit ratio maximum Gross Return, Net Return and Cost Benefit ratio was also found in treatment T_{11} followed by treatment T_{10} (0.2% Iron + 0.2% Zinc + RDF) where as minimum plant growth, yield and quality attributes was recorded in treatment T_0 (Control) in all the parameters.

Keywords: Jasmine, micronutrients, boron, zinc and iron

Introduction

Jasmine is one of the oldest of fragrant flowers and is specially appreciated in India, where most people have a love for the fragrant flowers. The word Jasmine has been derived from Persian word. 'Yasmyn' meaning fragrance since time immemorial, it is considered as a spiritual flower of India. The scent emitted by jasmine is so well liked that the word jasmine has become a synonym for fragrance and we have climber such as Solanum jasminoides, Trachelospermum jasminoides and Pandorea jasminoides (*Tecoma jasminoides*), which are totally unrelated to jasmine, except for their sweet fragrance. For the past many centuries jasmines have adorned the gardens of Central Asia, Afghanistan, Iran, Nepal and many other tropical and sub-tropical countries and many of the jasmine species are native of India and have their origin in the Southern Foothills of the Himalayas.

The jasmine belongs to family 'Oleaceae' and the Genus Jasminum comprises of about 300 species, which are dispersed in the warmer parts of Europe, Asia, Africa and the Pacific region (Bhattacharjee, 1980). More than 40 species have been identified in India and in South India about 20 species are in cultivation.

In India, jasmines are commercially cultivated in the states of Tamil Nadu, Karnataka and West Bengal. Although, correct statistics of the area and production are not available, it is estimated that in India, jasmines occupy an area of 8000 ha with an annual production of flower worth Rs. 80 to 100 million. In India, Tamil Nadu has the largest area under jasmine cultivation followed by Karnataka, which together account for 98 per cent of the total cultivated area. In Karnataka, they occupy an area of more than 3978 ha with an estimated production of nearly 26253 tonnes of fresh flowers, and ranks first among the commercial flowers crops of the state followed by chrysanthemum and marigold.

Materials and Methods

The Experimental was conducted in Randomized Block Design (RBD) with 12 treatments of Micronutrients with three replications in the Departmental Research field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during September, 2018 to March, 2019. Total number of treatments were twelve *viz.* T_0 (Control), T_1 (Boron 0.2% + RDF), T_2 (Boron 0.4% + RDF), T_3 (Boron 0.6% + RDF), T_4 (Zinc 0.2% + RDF), T_5 (Zinc 0.4% + RDF), T_6 (Zinc 0.6% + RDF), T_7 (Iron 0.2% + RDF),.

T_8 (Iron 0.4% + RDF), T_9 (Iron 0.6% + RDF), T_{10} (Iron 0.2% + Zinc 0.2% + RDF) and T_{11} (Iron 0.2% + Zinc 0.4% + RDF), four year old plants of Jasmine were used for research.

Climatic condition in the experimental site

The area of Prayagraj district comes under subtropical belt in the south east of Utter Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46° C- 48° C and seldom falls as low as 4°C- 5°C. The relative humidity ranges between 20 to 94 %. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

Results and Discussion

The present investigation entitled "Effect of Micronutrients on Plant Growth and Flower yield of Jasmine (*Jasminum grandiflorum* L.) cv. Double Mogra" was carried out during September 2018 to March, 2019 in Research Field of Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) India. The results of the present investigation, regarding the effect of micronutrients for plant growth and yield of Jasmine, have been discussed and interpreted in the light of previous research work done in India and abroad. The experiment was conducted in Randomized block design with 12 treatments, and three replications.

The results of the experiment are summarized below.

Growth parameters

In terms of Plant Height, treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) recorded maximum (84.92, 91.56, 97.43 and 100.78 cm) plant height at Initial, 60, 120 and 180 days respectively after application of Micronutrients, followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with (80.06, 85.83, 91.60 and 94.51 cm) at Initial, 60, 120 and 180 days respectively, where as minimum Plant height (60.78, 66.93, 73.04 and 75.44 cm) was recorded in treatment T_0 (Control) at Initial, 60, 120 and 180 days respectively. The increased plant height with application of micronutrients might be due to its role in synthesis of tryptophan which is a precursor of auxin (IAA) and it is essential in nitrogen metabolism which stimulates growth. Similarly iron acts as an important catalyst in the enzymatic reactions of the metabolism and would have helped in larger biosynthesis of photo assimilates thereby enhancing growth of the plants. Similar results were also reported by Muthumanickam *et al.* (1999) [9] and Jadhav (2004) [6] in gerbera, Juhari *et al*. (2005), Balakrishnan (2005) [2] in Marigold, Rao (2005) in Gladiolus and Pal. *et al.* (2016) [12] in Gerbera.

In terms of Plant Spread, treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) recorded maximum (62.04, 64.99, 67.54 and 69.27 cm) plant spread at Initial, 60, 120 and 180 days respectively after application of Micronutrients, followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with (60.44, 62.98, 65.03 and 66.59 cm) at Initial, 60, 120 and 180 days respectively, where as minimum Plant spread (41.05, 42.46, 44.66 and 45.85 cm) was recorded in treatment T_0 (Control) at Initial, 60, 120 and 180 days respectively. The plant sprayed significantly influenced with application of micronutrient ferrous sulphate is an essential components of several dehydrogenase, proteinase, peptidase and promotes growth hormones and closely associated with plant growth, all these factors contributed to cell multiplication, cell division and cell differentiation resulting in increased photosynthesis and translocation of food material which enhanced the plant spread and is also encouraged due to the $ZnSO_4$ could be attributed to improved root system of plants resulting in absorption of more water and nutrients and its utilization. Moreover, micronutrients activate several enzymes (catalase, carbonic dehydrogenize, tryptophane synthates etc.) and involved various physiological activities. Similar results were also obtained by Kakade *et al.* (2009) [7] in china aster, Balakrishnan (2005) [2] in marigold and Ahmad *et al.* (2010) [1] in Rose.

In terms of Number of Branches/plant, treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) recorded maximum (15.07, 17.10, 19.19 and 20.27) Number of Branches, at Initial, 60, 120 and 180 days respectively after application of Micronutrients, followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with (14.04, 15.97, 17.93 and 19.21) at Initial, 60, 120 and 180 days respectively, where as minimum Number of Branches (7.94, 9.85, 11.31 and 12.06) was recorded in treatment T_0 (Control) at Initial, 60, 120 and 180 days respectively. Increased the number of Branches might be due to micronutrients like $ZnSO_4$ and $FeSO_4$ is essential component of several dehydrogenase, proteinase, peptidase and promotes growth of hormones and closely associated with growth, all these factors contributed to cell multiplication, cell division and cell differentiation resulting in increased photosynthesis and translocation of food material which enhanced the number of Branches, The above result was confirmed by Pal. *et al.* (2016) [12] in Gerbera.

In terms of Days taken for flower bud initiation, treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) recorded minimum (95.33 days) for flower bud initiation, after application of Micronutrients, followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with (99.74 days), where as maximum Days for flower bud initiation (119.48 days) was recorded in treatment T_0 (Control). Micronutrients like zinc and iron favour to storage of more carbohydrates through photosynthesis, which may be enhanced to flower earlier flower bud initiation and Similar results were also reported by Muthumanickam *et al.* (1999) [9], Senthamizhselvi (2000) [13] and Jadhav (2004) [6] in Gerbera.

In terms of Days taken for flower bud development, treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) recorded minimum (15.08 days) for flower bud development, after application of Micronutrients, followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with (16.67 days), where as maximum Days for flower bud development (24.30 days) was recorded in treatment T_0 (Control). Micronutrients like zinc and iron favour the storage of more carbohydrates through photosynthesis, which may be the attributing factor for the positive effective of micronutrients on early flowering. The similar results were reported by the Jadhav (2004) [6] in Gerbera.

In terms of Flowering period, treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) recorded maximum (84.10 days) for flowering period, after application of Micronutrients, followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with (82.22 days), where as minimum Days for flowering period (68.33 days) was recorded in treatment T_0 (Control). The positive impact of micronutrients like zinc and iron might be due to the ability of these nutrient in activating several enzymes and its involvement in chlorophyll synthesis and various physiological activities ultimately increase the Flowering period, as observed by Bhattacharjee *et al.* (1993) [4] in cut rose.

Yield parameters

In terms of weight of 50 flower bud, treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) recorded maximum (94.14 g) for weight of 50 flower bud, after application of Micronutrients, followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with (91.56 g), where as minimum weight of 50 flower bud (71.18 g) was recorded in treatment T_0 (Control). The result might be due to the association of micronutrients such as zinc and iron in regulating semi permeability of cell walls, thus mobilizing more water into flowers and also increase the synthesis of iron which promotes the flower size and weight of the flowers. Similar results were also reported by Nag and Biswas (2003) [10] and Hardeep Kumar *et al.* (2003) [5] in tuberose.

In terms of Number of flowers/plant, treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) recorded maximum (138.49) flower bud/plant, after application of Micronutrients, followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with (127.49), where as minimum Number of flower bud (91.93) was recorded in treatment T_0 (Control). Application of iron and zinc relieved the plants from chlorosis and produced healthy green leaves which resulted in higher assimilate synthesis and partitioning of the flower growth which may in turn increase the flower production and ultimately flower yield. Similar results were also obtained by Nath and Biswas (2002) [11] in tuberose and pal *et al.* (2016) [12] in Gerbera.

In terms of Yield of flower/plant, treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) recorded maximum (259.50 g) flower bud yield/plant, after application of Micronutrients, followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with (232.25 g), where as minimum Yield of flower bud (129.17 g) was recorded in treatment T_0 (Control).

In terms of Yield of flower/ha, treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) recorded maximum (10.36 q) flower bud yield/ha, after application of Micronutrients, followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with (9.27 q), where as minimum Yield of flower bud/ha (5.15 q) was recorded in treatment T_0 (Control). Application of iron and zinc relieved the plants from chlorosis and produced healthy green leaves which resulted in higher assimilate synthesis and partitioning of the flower growth which may in turn increase the flower production and ultimately flower yield. Similar results were also obtained by Nath and Biswas (2002) [11] in tuberose and pal *et al.* (2016) [12] in Gerbera.

Economics of cultivation

In terms of Economics, treatment T_1 (0.2% Iron + 0.4% Zinc + RDF) recorded maximum Rs. 518000.00 Gross Return, Rs. 300899.00 Net Return and 1:2.38 Cost Benefit ratio followed by T_{10} (0.2% Iron + 0.2% Zinc + RDF) with Rs. 463500.00 Gross return, Rs. 258520.00 Net return and 1:2.26 Cost benefit ratio, where as minimum Gross return, Net Return and Cost Benefit ratio Rs. 353000.00, Rs. 113525.30 and 1:1.47 respectively was recorded in treatment T_0 (Control).

Table 1: Effect of Micronutrients on Plant height (cm), Plant spread (cm) and Number of Branches/plant of Jasmine (*Jasminum grandiflorum* L.) cv. Double Mogra

Treatment Symbol	Treatment Combinations	Plant Height (cm)				Plant Spread (cm)				Number of Branches/plant			
		Initial	60 DAS	120 DAS	180 DAS	Initial	60 DAS	120 DAS	180 DAS	Initial	60 DAS	120 DAS	180 DAS
T_0	Control	60.78	66.93	73.04	75.44	41.05	42.46	44.66	45.85	7.94	9.85	11.31	12.06
T_1	0.1% Boron + RDF	74.33	80.77	86.65	89.57	54.37	56.96	57.54	59.12	10.05	12.01	13.92	15.44
T_2	0.2% Boron + RDF	76.25	81.78	87.77	90.56	56.36	59.14	60.88	62.56	10.90	12.79	14.43	15.72
T_3	0.3% Boron + RDF	73.19	78.74	84.63	87.48	53.20	55.92	58.24	59.78	9.86	11.85	13.74	15.18
T_4	0.2% Zinc + RDF	70.53	76.60	82.33	84.74	56.25	58.30	60.48	61.97	12.48	14.45	16.23	17.45
T_5	0.4% Zinc + RDF	72.57	78.64	84.29	86.67	53.74	55.81	57.95	59.45	11.97	13.94	15.64	16.81
T_6	0.6% Zinc + RDF	78.84	84.62	90.55	93.55	59.19	61.86	63.93	65.44	13.29	15.36	17.04	18.13
T_7	0.2% Iron + RDF	72.40	77.37	83.25	86.04	52.11	54.45	56.45	57.98	10.18	12.18	13.90	15.35
T_8	0.4% Iron + RDF	74.01	79.37	85.03	87.65	55.22	57.74	59.81	61.26	11.85	13.79	15.54	16.53
T_9	0.6% Iron + RDF	71.50	76.69	82.37	84.49	51.21	53.93	55.97	57.58	11.32	13.37	15.08	16.64
T_{10}	0.2% Iron + 0.2% Zinc + RDF	80.06	85.83	91.60	94.51	60.44	62.98	65.03	66.59	14.04	15.97	17.93	19.21
T_{11}	0.2% Iron + 0.4% Zinc + RDF	84.92	91.56	97.43	100.78	62.04	64.99	67.54	69.27	15.07	17.10	19.19	20.27
F-test		S	S	S	S	S	S	S	S	S	S	S	S
SE(d)		0.917	0.962	0.991	1.032	0.528	0.546	0.720	0.687	0.413	0.478	0.448	0.416
C.V.		1.515	1.475	1.416	1.429	1.185	1.173	1.493	1.390	4.365	4.317	3.577	3.072
C.D. at 5%		1.913	2.008	2.069	2.154	1.102	1.140	1.502	1.435	0.861	0.997	0.935	0.867

Table 2: Effect of Micronutrients on Days to first Flower bud Initiation, Flower bud development, Flowering Period (days), Weight of 50 flower bud, Number of flowers/plant, Flower yield/plant, Flower Yield q/ha and Cost Benefit ratio of Jasmine (*Jasminum grandiflorum* L.) cv. Double Mogra

Treatment Symbol	Treatment Combinations	Days to first flower bud initiation	Flower bud development (days)	Flowering period (days)	Weight of 50 flower bud (g)	Number of flowers/ plant	Flower yield/plant (g)	Flower yield q/ha.	Cost benefit ratio
T_0	Control	119.48	24.30	68.33	71.18	91.93	129.17	5.15	1:1.51
T_1	0.1% Boron + RDF	113.50	20.23	75.76	84.48	102.60	172.25	7.21	1:1.95
T_2	0.2% Boron + RDF	112.77	18.64	74.93	87.56	108.59	188.96	7.55	1:1.89
T_3	0.3% Boron + RDF	114.13	19.56	76.36	83.82	106.55	177.53	7.09	1:1.65
T_4	0.2% Zinc + RDF	104.67	18.55	79.43	82.52	112.25	183.82	7.34	1:2.01
T_5	0.4% Zinc + RDF	110.12	19.48	78.43	81.29	111.51	179.83	7.18	1:1.85
T_6	0.6% Zinc + RDF	102.13	17.66	81.59	90.15	121.62	217.45	8.68	1:2.10
T_7	0.2% Iron + RDF	107.89	19.43	75.25	85.27	104.61	176.81	7.05	1:1.82
T_8	0.4% Iron + RDF	105.25	19.28	77.35	87.34	111.63	193.07	7.70	1:1.78
T_9	0.6% Iron + RDF	108.50	20.14	73.74	84.86	105.13	177.13	7.06	1:1.47
T_{10}	0.2% Iron + 0.2% Zinc + RDF	99.74	16.67	82.22	91.56	127.49	232.25	9.27	1:2.26
T_{11}	0.2% Iron + 0.4% Zinc + RDF	95.33	15.08	84.10	94.14	138.49	259.50	10.36	1:2.38
F-test		S	S	S	S	S	S	S	
SE(d)		1.576	0.605	0.804	1.775	1.779	4.817	0.184	
C.V.		1.791	3.879	1.274	3.330	2.141	4.403	4.464	
C.D. at 5%		3.289	1.262	1.679	3.704	3.714	10.055	0.385	

Conclusion
Based on the present investigation it is concluded that the treatment T_{11} (0.2% Iron + 0.4% Zinc + RDF) found to be best in terms of plant growth and yield parameters of Jasmine. In terms of cost benefit ratio maximum Gross Return, Net Return and Cost Benefit ratio was also found in treatment T_{11} followed by treatment T_{10} (0.2% Iron + 0.2% Zinc + RDF) where as minimum plant growth, yield and quality attributes was recorded in treatment T_0 (Control) in all the parameters.

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