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Integrated nutrient management studies in *Jasminum sambac* L.

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Abstract
An investigation on integrated nutrient management studies in *Jasminum sambac* L. was carried out at Satpuda Botanic Garden, College of Agriculture, Nagpur during 2015-16 in randomised block design with ten treatments of integrated nutrient management *viz*., T_1 – 100 % N (Urea), T_2 – 100 % N (Urea) + *Azotobacter* + PSB, T_3 - 75% N (Urea) + *Azotobacter* + PSB, T_4 – 100 % N (Vermicompost) + *Azotobacter* + PSB, T_5 – 100 % N (Cow Dung Slurry) + *Azotobacter* + PSB, T_6 – 100 % N (Farm Yard Manure) + *Azotobacter* + PSB, T_7 – 50 % N (Vermicompost) + 50 % N (Cow Dung Slurry) + *Azotobacter* + PSB, T_8 – 50 % N (Cow Dung Slurry) + 50% N (Farm Yard Manure) + *Azotobacter* + PSB, T_9 - 50% N (Vermicompost) + 50% N (Farm Yard Manure) + *Azotobacter* + PSB and T_{10} - 100% N (Cow Dung Slurry). The treatments were imposed on already existing four year old plants of *Jasminum sambac* (L). The results revealed that, significantly maximum diameter of primary shoot, leaves primary shoot^{-1}, leaf area, productive shoots plant^{-1}, flower yield ha^{-1}, diameter of flower bud and mean corolla tubelength in *Jasminum sambac* L. were registered when the plants treated with 100 % N (Urea) + *Azotobacter* + PSB which was closely followed by 100 % N (VC) + *Azo*tobacter + PSB, whereas, the treatment of 100 % N (VC) + *Azo*tobacter + PSB recorded significantly earliest 50 per cent flowering and highest longevity of intact flower.

Keywords: jasmine, integrated nutrient management, growth, yield, quality

Introduction
Jasmine (*Jasminum sambac* L.) is a tropical or subtropical plant which belongs to the family *oleaceae*. It is an extremely fragrant and evergreen shrub grown on a large scale in different states for loose flower production. Jasmine finds a very important place in the perfume industry. Jasmine oils are used extensively in the manufacture of cosmetics, soaps, confectionary perfumes, perfumed tobacco, syrups, aerated water, ointments, disinfectants and detergents. Flowers are used for making garlands, hair adornment of women and religious and social functions.

The crop benefiting microbial inoculants generally called as bio-fertilizers help in augmenting the crop productivity through effective mobilization of nutrients to the crop. Therefore, for the maximization of yield and improving quality of any flower crop the integrated use of nutrient is need of the hour. The use of organic manures and bio-fertilizers along with balance use of chemical fertilizers is known to improve physico-chemical and biological properties of soil, besides improving the efficiency of applied fertilizers. The Integrated nutrient management approaches not only improve the quality of the produce but also help in improving the soil fertility including the biosphere by reducing the cost of production in agriculture.

In flower industry, the most important aspects are maximum production of better quality flowers in order to fetch more market prices and improve post-harvest handling in order to maintain flower's freshness and original colour for longer period. In spite of number of benefits of integrated nutrient management in flower production, its utilization in jasmine production under Vidharbha conditions has not been carried out on large scale. The present investigation is therefore, proposed on integrated nutrient management studies in *Jasminum sambac* L.

Materials and Methods
A field experiment was carried out at Satpuda Botanic Garden, College of Agriculture, Nagpur from December, 2015 to August, 2016 in randomised block design to study the effect of integrated nutrient management on growth, flower yield and quality of *Jasminum sambac* L. with ten treatments *viz.*, T_1 - 100% N (Urea), T_2 - 100% N (Urea) + *Azotobacter* + PSB, T_3 - 75% N (Urea) + *Azotobacter* + PSB, T_4 - 100% N (Vermicompost) + *Azotobacter* + PSB, T_5 - 100% N (Cow Dung Slurry) + *Azotobacter* + PSB, T_6 - 100% N (Farm Yard Manure) + *Azotobacter* +PSB, T_7 - 50% N (Vermicompost) + 50% N (Cow Dung Slurry) + *Azotobacter* + PSB, T_8 - 50% N (Cow Dung Slurry) + 50% N (Farm Yard Manure) + *Azotobacter* + PSB, T_9 - 50% N

(Vermicompost) + 50% N (Farm Yard Manure) + *Azotobacter* + PSB and T_{10} - 100% N (Cow Dung Slurry) replicated thrice. The treatments were imposed on four year old plants of *Jasminum sambac* (L).

The bushes of jasmine were pruned to a level of 30 cm length above the ground during first week of January, 2016. Recommended dose of phosphorus (240 kg ha^{-1}) and potassium (120 kg ha^{-1}) was then applied uniformly through chemical fertilizers to each treatment plot 15 cm deep in rings and 30 cm away from the main stem immediately after pruning.The recommended dose of nitrogen required for jasmine i.e. 120 $kgha^{-1}$ was applied as a control treatment. Half dose of nitrogen was applied immediately after pruning of the plants and the remaining half dose of nitrogen was applied at the stage of flower bud initiation. The nitrogen content of organic manures was calculated after analysing vermicompost, cow dung slurry and farm yard manure and according to their nitrogen content exact dose of each organic manure to supply recommended dose of nitrogen was calculated and applied to each plot as per the treatment. Cow dung slurry was prepared by mixing 20 kg fresh cow dung in 200 lit water + 4 lit fresh cow urine + 2 kg jaggery + 1 kg gram flour and allowed it to decompose up to 4 days by stirring the mixture once a day and then the fresh slurry was applied once in 15 days interval from pruning up to flower bud initiation. *Azotobacter* and PSB were applied to the soil @20 kg ha^{-1} each by mixing with organic manures.

All the cultural operations *viz*., weeding, irrigation, pest control etc. were carried out as and when required. Observations on various vegetative characters *viz.*, diameter of primary shoot, leaves primary $shoot^{-1}$, leaf area, productive shoots $plant^{-1}$ and flowering parameters likedays for 50 per cent flowering, flower yield ha^{-1} and quality parameters *viz*., diameter of flower bud, mean corolla tube length and flower bud index were recorded at proper stages and analysed statistically by the method suggested by Panse and Sukhatme (1967) [3].

Results and Discussion

The data presented in table 1 revealed that, different treatments of integrated nutrient management had significant effect on all growth, yield and quality parameters of jasmine studied in this experiment except flower bud index.

Table 1: Growth, yield and quality of *Jasminum sambac* L. as influenced by integrated nutrient management

Treatments	Dia-meter of primary shoot (cm)	Leaves primary $shoot^{-1}$	Leaf area (cm^2)	Productive shoots $plant^{-1}$	Days for 50 per cent flowering (days)	Longevity of intact flower (days)	Flower yield ha^{-1} (q)	Dia-meter of flower bud (mm)	Means corolla tube length (cm)	Flower bud index
T_1- 100%N(Urea)	5.07	33.70	23.22	22.56	104.67	1.80	14.56	8.19	0.87	1.07
T_2- 100%N(Urea)+Azo.+ PSB	6.67	46.01	26.75	26.74	102.67	2.48	17.03	9.77	1.06	0.99
T_3- 75%N(Urea)+Azo.+ PSB	6.14	43.67	25.10	25.11	101.00	2.04	15.52	9.51	1.03	1.00
T_4- 100%N(VC)+Azo.+ PSB	6.30	44.24	25.60	26.59	92.67	2.62	16.91	9.77	1.06	0.99
T_5- 100%N(CDS)+Azo.+ PSB	6.52	45.88	26.59	25.63	93.67	2.54	16.78	9.59	1.05	0.99
T_6- 100%N(FYM)+Azo.+ PSB	6.27	44.07	25.63	25.61	99.33	2.22	16.63	9.55	1.04	0.99
T_7- 50%N(VC)+50%N(CDS)+Azo.+ PSB	5.94	40.93	24.66	24.66	94.33	2.30	15.39	9.40	1.03	0.98
T_8- 50%N(CDS)+50%N(FYM)+Azo.+ PSB	5.92	38.80	24.65	24.64	94.67	2.24	15.38	9.07	1.00	1.00
T_9- 50%N(VC)+50%N(FYM)+Azo.+ PSB	5.62	38.83	24.02	24.02	102.33	2.32	15.26	8.78	0.98	1.04
T_{10}- 100%N(CDS)	5.15	37.51	23.60	23.60	94.00	2.00	14.82	8.56	0.95	1.06
SE(m)±	0.32	2.30	0.39	0.34	1.67	0.06	0.54	0.20	0.03	0.04
CD at 5%	0.94	6.84	1.17	1.00	4.97	0.18	1.60	0.59	0.08	-

Azo.-Azotobacter
PSB- Phosphate Solubilising Bacteria
VC- Vermicompost
CDS- Cow Dung Slurry
FYM- Farm Yard Manure

Growth

The vegetative growth parameters like diameter of primary shoot, leaves primary $shoot^{-1}$, leaf area and productive shoots $plant^{-1}$ in jasmine were recorded significantly highest with the plants treated with the treatment T_2 i.e. 100% N (Urea) + *Azotobacter* + PSB (6.67 cm, 46.01, 26.75 cm^2 and 26.74, respectively) which was found statistically at par with the treatments T_5 i.e. 100 % N (CDS) + *Azo*tobacter + PSB (6.52 cm and 45.88, respectively), T_4 i.e.100% N (VC) + *Azo*tobacter + PSB (6.30 cm and 44.24, respectively), T_6 i.e. 100% N (FYM) + *Azo*tobacter + PSB (6.27 cm and 44.07, respectively), T_3 i.e.75 % N (Urea) + *Azo*tobacter + PSB (6.14 cm and 43.67, respectively) and T_7 i.e. 50% N (VC) + 50% N (CDS) + *Azo*tobacter + PSB (5.94 cm and 40.93, respectively) in respect of diameter of primary shoot and leaves primary $shoot^{-1}$, however, in respect of leaf area it was statistically at par with T_4 (25.60 cm^2), T_5 (26.59 cm^2) and T_6 (25.63 cm^2). Similarly, the superior treatment was found to be at par with the treatment T_4 (26.59) in respect of productive shoots $plant^{-1}$. An increase in vegetative growth in jasmine with the treatments of integrated nutrient management might be attributed to macronutrients supplied through optimum dose of inorganic fertilizers and the stimulative activity of microflora in the rhizosphere leading to increased nutrient availability and increased photosynthesis rate and carbohydrate accumulation as a result of multiferous role of organic sources and bio fertilizers. Yathindra *et al.* (2016) [5] also suggested that combined application of inorganic fertilizers, biofertilizers and vermicompost was superior over their individual application for better plant growth and development in Bird of Paradise (*Strelitzia reginae* L).

Flowering

Significantly the earliest 50 per cent flowering (92.67 days) was noticed with the treatment T_4 i.e. 100% N (VC) + *Azotobacter* + PSB and it was found to be at par with the treatments T_5 (93.67 days), T_{10} (94.00 days), T_7 (94.33 days) and T_8 (94.67 days), whereas, the treatment T_1 i.e. 100% N (Urea) took maximum days for 50 per cent flowering (104.67 days) in jasmine. Application of biofertilizers and organic manures enhanced the microflora and enzymatic activity which might have stimulated an early flowering. These results are in concurrence with the findings of Pandey *et al.* (2010) [2] who reported advancement in flowering due to integrated nutrient management in chrysanthemum.

Flower yield

The treatment T_2 i.e. 100 % N (Urea) + *Azotobacter*+ PSB recorded significantly maximum flower yield ha^{-1} (17.03 q) which was statistically at par with the treatments T_4 i.e. 100 % N (VC) + *Azotobacter* + PSB (16.91 q), T_5 i.e. 100 % N (CDS) + *Azotobacter* + PSB (16.78 q), T_6 i.e. 100 % N (FYM) + *Azotobacter* + PSB (16.63 q) and T_3 i.e. 75% N (Urea) + *Azotobacter* + PSB (15.52 q), whereas, minimum flower yield (14.56 q) ha^{-1} was noted with the treatment T_1 (control). This increase in the yield of jasmine flowers ha^{-1} might be due to the fact that, the plants treated with biofertilizers along with 100 % N (Urea) enhanced vegetative growth in terms of diameter of primary shoot, leaves primary shoot^{-1}, leaf area and productive shoots plant^{-1}. This might have resulted into the production and accumulation of more photosynthates which would have diverted to the sink resulting into more flower yield ha^{-1} in jasmine.These results are similar with the findings of Shirsath *et al.* (2015) [4] who recorded that, yield of tuberose flowers was found maximum with the application of 50 % N through vermicompost + 50% N through urea + P and K (RDF).

Flower quality

The jasmine plants treated with the treatment T_4 i.e. 100 % N (VC) + *Azotobacter* + PSB and T_2 i.e. 100 % N (Urea) + *Azotobacter* + PSB recorded significantly maximum diameter of flower bud (9.77 mm each) and mean corolla tube length (1.06 cm each) which were statistically at par with the treatments T_5 (9.59 mm and 1.05 cm, respectively), T_6 (9.55 mm and 1.04 cm, respectively), T_3(9.51 mm and 1.03 cm, respectively) and T_7 (9.40 mm and 1.03 cm, respectively). Similarly, the treatment T_4 noted significantly maximum longevity of intact flower in jasmine (2.62 days) and it was statistically at par with the treatments T_5 (2.54 days) and T_2 (2.48 days), whereas, the treatment T_1 (control) noted minimum diameter of flower bud (8.19 mm), mean corolla tube length (0.87 cm) and longevity of intact flower (1.80 days). The flower buds harvested from the jasmine plants treated with bio fertilizers along with the organic and inorganic sources of nitrogen were better in quality and remained fresh for longer time as compared to inorganic fertilizer alone. This might be due to the fact that, bio fertilizers and organic manures enhanced vegetative growth of plants causing more utilization of photosynthetic products that would have produced better quality flowers and increased their turgidity which helped them to last longer after harvesting. Lambat and Pal (2012) [1] also concluded that, the quality of rose flowers can be improved by application of organic manure along with PSB and *Azotobacter*.

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