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Original Research Article

Impact of INM on Yield of Jasmine, Physic-Chemical Properties and Fertility Status of Soil after Harvest of Flowers

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A B S T R A C T

An investigation entitled, "Impact of INM on yield of jasmine grown on Inceptisol" was carried out at Satpuda Botanic Garden, College of Agriculture, Nagpur from first week of January, 2016 to first week of August, 2016. The treatments were comprised of the ten combinations of organic manures and inorganic fertilizers i.e. T_1 – Recommended dose of fertilizer (RDF), T_2 – RDF + *Azotobacter* + PSB, T_3 – 75 % RDF + *Azotobacter* + PSB, T_4 – 50 % RDF + Azatobacter + PSB, T_5 – 100 % N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, T_6 – 100 % N (Cow Dung Slurry) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, T_7 – 100 % N (Farm Yard Manure) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, T_8 – 50 % N (Vermicompost) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB, T_9 – 50 % N (Cow Dung Slurry) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB and T_{10} – 50 % N (Farm yard manure) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB. The experiment was laid out in randomized block design with three replications. The results obtained in the present investigation indicated that, significantly the maximum (611.33) flower buds plant^{-1}, maximum weight of 100 flower buds (51.15 g) and flower yield (23.15 q ha^{-1}) were noted with the treatment RDF + *Azotobacter* + PSB. The soil properties after harvest of jasmine flowers were significantly improved in treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB. The maximum water holding capacity- 51.60 %, pH- 7.20, Organic carbon- 5.97 g kg^{-1}, available N, P, K, S Cu, Fe, Mn and Zn - 354.51, 18.89, 321, 13.21 kg ha^{-1}, 1.20, 16.86, 11.76 and 0.99 mg kg^{-1} respectively were found to be significant. In case of bulk density, EC and calcium carbonate the data was statistically non-significant.

Keywords

Integrated nutrient management, Physico-chemical properties and fertility status

Introduction

Jasmine (*Jasminum sambac* L.*)* is a tropical or subtropical plant which belongs to the family oleaceae. Its native habitat is in South East Asia. The plant is most likely originated in India, where it is one of the most popular ornamental plant grown. Jasmine is also known as "Arabian Jasmine" in English and "Mogra" in Marathi. It is an extremely fragrant and evergreen shrub which can grow up to 1 metre in ideal tropical conditions.

The flowers of jasmine contain antioxidant benefits as a result of many active constituents. It also contains anti-inflammatory components. These components are responsible for the lovely fragrance which is used in many perfumes.

The leaves are antiseptic and are useful for wounds or acne when used as a poultice.

The total area under Jasmine crops in India during the year 2013 - 2014 was estimated to be 23.00 thousand hectare with the production of 122.7 thousand metric tonne of loose flowers and 44.00 lakh number of cut flowers. In Maharashtra, Jasmine is cultivated throughout the state over an area about 2.00 thousand hectare with the production of 3.50 thousand tone loose flowers.

The organic manures and bio-fertilizers are very important for plant growth and yield. It enhances the microbial activity of soil and it supplies micro and macro nutrients. It improves the physico-chemical and biological properties of soil. It will help to maintain the soil health. Fertilizers play vital role in production and productivity of any crop but continuous and imbalanced use of high analysis chemical fertilizers badly influences production potential and soil health. Use of chemical fertilizer in combination with organic manure is essentially required to improve the soil health (Bajpai *et al.*, 2006).

Increase in fertilizer use efficiency must be ensured to achieve sustainable production (Laxminarayana 2006; Tolanur and Badanur 2003). Considering the important role of bio-fertilizers and organic manures in increasing the yield of better quality flowers of jasmine, in the present investigation is proposed on "Effect of integrated nutrient management on growth, yield and quality of Jasmine grown on inceptisol".

Materials and Methods

An investigation entitled, "Effect of Integrated Nutrient Management on growth, yield and quality of jasmine grown on Inceptisol" was carried out at Satpuda Botanic Garden, College of Agriculture, Nagpur from first week of January, 2016 to first week of August, 2016. The treatments were comprised of the ten combinations of organic manures and inorganic fertilizers. The experiment was laid out in randomized block design with three replications. The recommended dose of fertilizer was 120:240:120 kg of N, P_2O_5 and K_2O respectively.

After season of flower, treatment wise soil samples (30 plots) were collected for determining the physico-chemical properties and fertility status of soil. Air dried kept in an oven at 105^0C for 48 hrs for drying, pass through 2 mm sieve, soils were analysis by using standard procedures as described for bulk density by clod coating method (Black 1965), maximum water holding capacity by KR box method (Piper 1966), pH by glass electrode pH meter (Jackson 1967), EC by conductivity meter (Jackson 1967), organic carbon by wet oxidation method (Walkley and Black 1934), Calcium carbonate by rapid titration method (Piper 1966), available Nitrogen by alkaline permanganate method (Subbiah and Asija 1956), Phosphors by Olsen's method (Jackson 1967), Potassium by neutral normal ammonium acetate method (Jackson 1967) and Sulphur by turbidimertric method (Chesnin and Yien 1951) and micronutrients Copper, Iron, Manganese and Zinc by Atomic Absorption Spectrophotometer (Lindsay and Norvell 1978).

Results and Discussion

Yield Parameters

Weight of 100 flower buds (g)

The data in the respect of weight of 100 flower buds (g) in jasmine as influenced by

integrated nutrient management is presented in table 1. The data presented in table 1 showed that, weight of 100 flower buds (g) in jasmine was influenced significantly by different treatment of biofertilizer application.

Significantly the maximum weight of 100 flower buds (51.15 g) was noted with the treatment (T_2) RDF + *Azotobacter* + PSB which was statistically at par with the treatment (T_1) recommended dose of fertilizer (RDF) (50.76 days) and treatment (T_5) 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB (50.67 days) whereas, the treatment (T_4) 50% RDF + Azatobacter + PSB recorded minimum weight of 100 flower buds (48.15 g) in jasmine.

Flower buds plant^{-1}

The data in the respect of number of flower buds plant^{-1} in jasmine as influenced by integrated nutrient management is presented in table 1.

The data presented in table 1 showed that, number of flower buds produced plant^{-1} in jasmine was significantly influenced by different treatments of biofertilizer application.

Though the treatment differences were significant, the treatment (T_2) RDF + *Azotobacter* + PSB recorded maximum (611.33) flower buds plant^{-1}, which was at par by the treatment (T_1) recommended dose of fertilizer (RDF) (608.67), treatment (T_5) 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB (593.33), treatment (T_6) 100% N (Cow Dung Slurry) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB (589.33), treatment (T_7) 100% N (Farm Yard Manure) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB (574.00), treatment (T_8) 50% N (vermicompost) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB (569.67) whereas, the treatment (T_4) 50% RDF + Azatobacter + PSB noted minimum flower buds plant^{-1} (519.00).

Flower yield (q ha^{-1})

The data in the respect of flower yield (q ha^{-1}) in jasmine as influenced by integrated nutrient management is presented in table 1.

The data presented in table 1 showed that, flower yield (q ha^{-1}) in jasmine as influenced by different treatments of biofertilizer was significantly influenced.

The treatment (T_2) RDF + *Azotobacter* + PSB recorded significantly maximum flower yield (23.15 q ha^{-1}) which was statistically at par with the treatment (T_1) recommended dose of fertilizer (RDF) (23.04 q ha^{-1}), treatment (T_5) 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB (22.40 q ha^{-1}), treatment (T_6) 100% N (Cow Dung Slurry) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB (21.98 q ha^{-1}) whereas, the treatment (T_4) 50% RDF + Azatobacter + PSB noted minimum flower yield (18.60 q ha^{-}1) in jasmine.

Due to different treatments, there was increased in yield (0.47%) in treatment (T_2) RDF + *Azotobacter* + PSB over control i.e. treatment (T_1) recommended dose of fertilizer (RDF).

Whereas decreased in yield in all other treatments, but in case of vermicompost and FYM decreased percentage was very low i.e. 2.77 and 4.60 respectively.

Table.1 Effect of integrated nutrient management on weight of 100 flower buds, flower buds plant^{-1} and Flower yield (q ha^{-1})

Treatments	Weight of 100 flower buds (g)	Flower buds plant^{-1}	Flower yield (q ha^{-1})	Yield % increase/ decrease
T_1-Recommended dose of fertilizer (RDF	50.76	608.67	23.04	-
T_2-RDF + *Azotobacter* + PSB	51.15	611.33	23.15	+ 0.47
T_3 – 75 % RDF + *Azotobacter* + PSB	48.18	547.67	19.70	- 14.49
T_4 – 50 % RDF + Azatobacter + PSB	48.15	519.00	18.60	- 19.27
T_5 -100 % N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB	50.67	593.33	22.40	- 2.77
T_6 – 100 % N (Cow Dung Slurry) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB	50.33	589.33	21.98	- 4.60
T_7 – 100 % N (Farm Yard Manure) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB	50.16	574.00	20.79	- 9.76
T_8 – 50 % N (Vermicompost) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB	48.67	569.67	20.67	- 10.28
T_9 – 50 % N (Cow Dung Slurry) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB	48.37	557.00	20.51	- 10.98
T_{10} – 50 % N (Farm yard manure) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB	48.33	550.00	20.49	- 11.06
S.E.(m) ±	0.51	15.22	0.62	-
C.D. at 5 %	1.51	45.23	1.84	-

Table.2 Effect of integrated nutrient management on physic-chemical properties of soil

Treatments	BD (Mg m^{-3})	MWHC (%)	pH	E.C (dSm^{-1})	O.C (g kg^{-1})	$CaCO_3$ (%)
T_1-Recommended dose of fertilizer (RDF	1.47	43.84	7.61	0.20	5.23	3.33
T_2-RDF + *Azotobacter* + PSB	1.46	44.86	7.56	0.17	5.30	3.32
T_3 – 75 % RDF + *Azotobacter* + PSB	1.44	45.21	7.56	0.18	5.35	3.30
T_4 – 50 % RDF + Azatobacter + PSB	1.47	44.21	7.57	0.19	5.40	3.28
T_5 -100 % N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB	1.40	51.60	7.20	0.15	5.97	3.16
T_6 – 100 % N (Cow Dung Slurry) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB	1.41	51.08	7.32	0.15	5.83	3.18
T_7 – 100 % N (Farm Yard Manure) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB	1.41	50.92	7.38	0.15	5.80	3.22
T_8 – 50 % N (Vermicompost) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB	1.41	48.88	7.40	0.15	5.53	3.23
T_9 – 50 % N (Cow Dung Slurry) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB	1.42	47.77	7.45	0.16	5.45	3.24
T_{10} – 50 % N (Farm yard manure) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB	1.43	46.99	7.47	0.17	5.43	3.26
S.E.(m) ±	0.02	1.56	0.08	0.03	0.08	0.05
C.D. at 5 %	-	4.62	0.23	-	0.25	-

Table.3 Effect of integrated nutrient management on fertility status of soil

Treatments	N	P	K	S	Cu	Fe	Mn	Zn
	(kg ha^{-1})				(mg kg^{-1})			
T_1-Recommended dose of fertilizer (RDF	307.32	16.44	296.98	11.14	0.87	15.81	10.43	0.78
T_2-RDF + *Azotobacter* + PSB	313.60	17.47	300.58	11.46	0.93	16.13	10.88	0.81
T_3 – 75 % RDF + *Azotobacter* + PSB	317.78	17.60	304.20	11.99	0.90	15.95	10.68	0.80
T_4 – 50 % RDF + Azatobacter + PSB	310.46	17.32	298.11	11.71	0.85	15.60	10.31	0.76
T_5 -100 % N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB	354.51	18.89	321.00	13.21	1.20	16.86	11.74	0.99
T_6 – 100 % N (Cow Dung Slurry) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB	348.24	18.46	319.20	13.09	1.15	16.74	11.65	0.96
T_7 – 100 % N (Farm Yard Manure) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB	341.82	18.32	316.45	12.85	1.07	16.65	11.49	0.92
T_8 – 50 % N (Vermicompost) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB	334.50	18.15	311.73	12.47	0.99	16.46	11.35	0.88
T_9 – 50 % N (Cow Dung Slurry) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB	332.41	17.97	307.52	12.38	0.97	16.39	11.24	0.85
T_{10} – 50 % N (Farm yard manure) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB	327.18	17.81	305.45	12.16	0.95	16.32	11.08	0.83
S.E.(m) ±	2.11	0.43	4.33	0.12	0.06	0.13	0.07	0.05
C.D. at 5 %	6.26	1.29	12.77	0.37	0.18	0.39	0.20	0.15

The jasmine flowers from the plants treated with T_5 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB (22.40 q ha^{-1}) was at par with treatment application of (T_2) RDF + *Azotobacter* + PSB (23.15 q ha^{-1}), it showed that, application of vermicompost or other organic manures like FYM, cow dung slurry etc. can gives better or comparable yield as compare to only application of inorganic fertilizers. Also organic manures help to sustain the soil health and improve the fertility status of soil. Therefore integrated nutrient management is best option for getting productivity and sustainability of soil health. However, Palagani *et al.*, (2013) reported that, application of biofertilizer increased highest yield per plant and highest yield per ha.

Physico-chemical properties of soil (after harvest of jasmine flower)

The results given in table2, indicate some important physic-chemical properties of soil. Combination of organic and inorganic fertilizer i.e. integrated nutrient management improves physical properties though the data was statistically non-significant. The bulk density range differs from 1.40 to 1.47 Mg m^{-3}. The lowest bulk density was found treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, while the highest bulk density was found in treatment recommended dose of fertilizer (RDF) and treatment 50% RDF + Azatobacter + PSB. The effect of different treatments on maximum water holding of capacity was found to be statistically significant. The Highest maximum water holding capacity was found treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, while the lowest maximum water holding of capacity was found in treatment recommended dose of fertilizer (RDF).

The effect of different treatments on pH and OC were found significant where effect of different treatments on EC and $CaCO_3$ were found non- significant. The pH range varies

from 7.20 to 7.61. The lowest pH was found in treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, while the highest found in treatment recommended dose of fertilizer (RDF).

The EC ranges from 0.15 dS m^{-1} to 0.20 dS m^{-1}. The lowest one was found in treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, treatment 100% N (Cow Dung Slurry) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, treatment 100% N (Farm Yard Manure) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB and treatment 50% N (Vermicompost) + remaining dose of NPK through chemical fertilizers + *Azotobacter* + PSB, while highest EC after harvest of jasmine was recorded by application of treatment recommended dose of fertilizer (RDF). Similar findings were recorded by Gupta *et al.,* (2013).

The OC ranges from 5.23 g kg^{-1} to 5.97 g kg^{-1}. From the results, it was observed that, highest organic carbon content was recorded in treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, while lowest organic carbon content was recorded in treatment recommended dose of fertilizer (RDF). Hence from the data, it can be revealed that, increase in levels of organic manure increased organic carbon content in soil after harvest of jasmine. This may be because of application of manures which results in increase in biomass of plant as increased ancillary characters of plant. Same results were supported with findings of Shirsat *et al.,* (2015). They reported that, the highest organic carbon content was recorded in treatment 50% N through vermicompost + 50% N through urea + P and K (RDF).

The calcium carbonate varies from 3.16 to 3.33 %. The lowest one was found in treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, while highest calcium carbonate after harvest of jasmine was recorded by application of treatment recommended dose of fertilizer (RDF).

Fertility status of soil (after harvest of jasmine flower)

The results in given table 3, indicate some important fertility status properties of soil after harvest of jasmine. The effect of different treatments on available N, P, K and S, micronutrients Cu, Fe, Mn and Zn were found significant. The available nitrogen (kg ha^{-1}), phosphorus (kg ha^{-1}), potassium (kg ha^{-1}) and sulphur (kg ha^{-1}) and micronutrients copper (mg kg^{-1}), iron (mg kg^{-1}), manganese (mg kg^{-1}) and zinc (mg kg^{-1}) were recorded 354.51, 18.89, 321.00, 13.21, 1.20, 16.86, 11.74 and 0.99 respectively in the treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB that was significantly higher as compared to other treatments combination.

Available Nitrogen

It ranges from 307.32 to 354.51 kg ha^{-1}. Highest range for available nitrogen was found with application of treatment 100 % N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, while lowest range for available nitrogen was found with application of treatment recommended dose of fertilizer (RDF). Similar findings were recorded by Airadevi (2012). The highest available nitrogen (206.89 kg ha^{-1}) was recorded in treatment *Azospirillium* + PSB + 50% VC equivalent to RD'N' + 50% RDF.

Due to application of vermicompost, FYM and cow dung slurry microbial population in soil i.e. biological properties of soil improved. Therefore, there is increase in available nitrogen content in soil, which ultimately increases the fertility and productivity of soil as compare with application of inorganic fertilizers alone.

Available Phosphorus

Available phosphorus ranged from 16.44 to 18.89 kg ha^{-1}. Highest range for available phosphorus was found with application of treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, while lowest range for available phosphorus was found with application of treatment recommended dose of fertilizer (RDF). Similar findings were recorded by Shirsat *et al.,* (2013).

They reported that, the available phosphorus after harvest of tuberose was recorded maximum in treatment 50% N through vermicompost + 50% N through urea + P and K (RDF).

Available Potassium

Available potassium ranged from 296.98 to 321 kg ha^{-1}. Highest range for available potassium was found with application of treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, while lowest range for available potassium was found with application of treatment recommended dose of fertilizer (RDF). Similar findings were recorded by Gupta *et al.,* (2013) in glorisa superb. They reported that, the available potassium (168.10 kg/ha) in soil after harvest of crop are observed in treatment vermicompost at 4 t/ha along with ⅓ of recommended dose of NPK.

Available Sulphur

Available sulphur ranged from 11.14 to 13.21 kg ha^{-1}. Highest range for available sulphur was found with application of treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB, while lowest range for available sulphur was found with application of treatment recommended dose of fertilizer (RDF).

Micronutrients

The copper, iron, manganese and zinc concentration in soil was significantly influenced due to different treatment. The value of copper concentration ranged from 0.87 to 1.20 mg kg^{-1}, iron concentration from 15.81 to 16.86 mg kg^{-1}, manganese concentration from 10.43 to 11.74 mg kg^{-1} and zinc concentration from 0.78 to 0.99 mg kg^{-1}. The micronutrients copper, iron, manganese and zinc were recorded 1.20, 16.86, 11.74 and 0.99 mg kg^{-1} respectively in the treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB that was significantly higher as compared to other treatments combination.

Though the treatment 100% N (Vermicompost) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB was more but it was at par with treatment 100% N (Cow Dung Slurry) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB and treatment 100% N (Farm Yard Manure) + remaining dose of P and K through chemical fertilizers + *Azotobacter* + PSB for nearly all the parameters.

From overall results, it was seen that, application of inorganic fertilizers alone can increase the yield attributing parameters and

yield, but did not showed sustainability therefore for getting sustainability, good productivity and maintain soil health in regards to productivity and fertility of soil application of vermicmpost or FYM or cow dung slurry or any other organic manure which is available is essential. Therefore integrated nutrient management is best option for getting productivity and maintains soil health

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