



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2020; 8(1): 937-940

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Received: 24-11-2019

Accepted: 28-12-2019

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## Effect of organic, inorganic and integrated nutrient management on yield attributes, production of onion and soil properties, under vertisol of Maharashtra

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i11.8370>

### Abstract

Field experiment was conducted in rabbi season of 2016-17 at Research Farm of at AICRP on Integrated farming System. Vasantnao Naik Marathwada Krishi Vidyapeeth, Parbhani entitled "Effect of Organic, Inorganic and Integrated Nutrient Management on Soil Properties, Production and Economics of Onion Under Vertisol". The experiment was laid out on Vertisols with eight treatment combination, replicated three times in randomized block design. Application 50% recommended NPK + 50% N through FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test the highest onion bulb yield (139.57 qt ha<sup>-1</sup>) and leaf strew yield (2.02 qt ha<sup>-1</sup>) was recorded by INM treatments. The growth parameters of onion plant height, number of leaves per plant significantly differed over inorganic and absolute control during crop growth period. Similarly, nutrient availability of N (183.56 kg ha<sup>-1</sup>), P (14.23 kg ha<sup>-1</sup>) and K (369.56 kg ha<sup>-1</sup>) was recorded of application of treatment 50% recommended NPK + 50% N through FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test than rest of the treatments. The bulk density was improved by application of organic and INM than inorganic and control treatments during the crop growth period. The results in respect of pH, EC and organic carbon showed significant variations among the treatments due to application of organic, inorganic and INM treatment.

**Keywords:** organic, inorganic and integrated, attributes, Maharashtra

### Introduction

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crop cultivated extensively in India and it belongs to family *Alliaceae*. Onion is liked for its flavour and pungency which is due to presence of a volatile oil "Allyl propyl disulphide" an organic compound rich in sulphur. Onion bulb is rich source of mineral like phosphorus, calcium and carbohydrates and Vit C. Onion is an important vegetable crop in all continents commercially cultivated over hundred countries of the world.

In the world, area under onion is 4.30 million hectare with 83.35 million metric tons production in respect to 19.4 MT/ha productivity in India, onion is grown on 1.05 million hectare accounting for 16.81 million metric tons of bulb production with 16.00 MT/ha productivity. Contribution of India in onion production in the world is around 20.2 per cent and Maharashtra is leading state in onion production in India, accounting 0.26 million hectare area and 4.66 million metric tons of total onion production and productivity of 17.9 MT/ha. (Anonymous, 2013)<sup>[1]</sup>. The contribution of Maharashtra in onion production in India is 28 per cent, and specific pocket area of onion production are Nasik (Lasalgaon), Nagar (Karjat), Pune, Solapur, Satara, Dhule and Jalgaon districts on commercial scale. Nasik is the leading district for production of onion in the country. The export of onion from India by the year 2012-13 was 1.66 million MT in the valued 0.20 million. (Anonymous, 2013)<sup>[1]</sup>.

Hence, the use of high yielding varieties, precise and timely application of organic and inorganic fertilizer, herbicide, pesticide etc are the means to enhance the yield and quality of crop. The judicious use of organic and inorganic fertilizer is indispensable to achieve the targeted yield and to maintain good soil health. Organic material such as FYM and Vermicompost improves soil physical and chemical properties which are important for plant

growth (Snyman *et al.*, 1998) [9]. The superior yield and quality of onion was under application of vermicompost, FYM, biofertilizers may be due to better vegetative growth of treated plants which produced more photosynthesis and metabolites resulting higher yield and quality (Maji and Das, 2008) [5]. However, vermicompost, FYM, biofertilizers integrated with chemical fertilizers gives better result in terms of yield, physico-chemical and biological properties of soil.

The present study was undertaken to evaluate and compare the organic, inorganic sources of nutrients in alone and in combination with chemical fertilizers and their effects on plant growth, yield, physico-chemical and biological properties of soil and available nutrients at harvesting.

### Material and Methods

Field experiment was conducted in *rabbi* season of the year 2016-17 to study the "Effect of organic, inorganic and integrated Nutrient Management on Soil Properties, Production and economics of onion under vertisol" by using different sources of organic, inorganic and INM at research farm of AICRP on Integrated farming System. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. To achieve the objectives of the study. The experiment was laid out on Vertisols with eight treatment combination, replicated three times in randomized block design the treatment consist of T<sub>1</sub>. (50 % recommended NPK + 50 % N through FYM + Inorganic sources of micronutrient as per soil test), T<sub>2</sub>. (Different organic sources each equivalent to 1/3 recommended N (FYM + Vermi-compost + non edible oil cake), T<sub>3</sub>. (T<sub>2</sub> + Intercropping of trap crop), T<sub>4</sub>. (T<sub>2</sub> + Agronomic practices for weed and pest control (No chemical, pesticide and herbicide), T<sub>5</sub>. (50 % N as FYM + Bio-fertilizer for N + Rock phosphate to substitute the P requirement of crops + Phosphate solubilizing bacterial culture), T<sub>6</sub>. (T<sub>2</sub> + bio-fertilizer containing N and P carriers), T<sub>7</sub>. (100 % NPK + Secondary and micronutrient based on soil test (ZnSO<sub>4</sub> 10 kg + S 25 kg), T<sub>8</sub>. (Absolute control). long term fertility experiments have also clearly demonstrated that chemical fertilizers above cannot sustain the productivity at correct level under intensive cropping systems. So to overcome the burden of chemical fertilizers and for achieving the higher productivity, vermicompost, FYM, biofertilizers offers a potential opportunity in reducing doses of chemical fertilizers, especially N, P and K for onion production in eco-friendly manners. Ploughing of field was done after growing of weed

up to 10 to 15 cm height and thereafter sowing of onion was carried out as per agronomical practice for weed control. Seeds of onion (AFLR) raised on seed bed for two months and transplanted to main field. Two subsequent irrigation were given to make transplantation of onion to cultivate in experiment field. The organic source as FYM and vermicompost was incorporated in soil before sowing of crop and after vermicompost manure were applied to crop through fertilizers like urea, respectively. Irrespective treatments T<sub>5</sub>, T<sub>1</sub>, and T<sub>7</sub>. The seed treatment of *Azotobactor* and PSB were carried out prior to sowing. Biometric observations were carried out at 60 DAS and harvesting for Plant height and no. of leaves respectively. The plant height and no. of leaves of 5 selected plants was measured at harvesting. In order to determine the soil properties of experimental soil before sowing, the surface (15.0-20 cm depth) soil samples were collected from randomly selected spots covering experimental area. A composite soil sample was prepared and analyzed for its various soil properties. The available N. P. K. and micronutrient were analyzed by using standards methods after harvest of onion.

### Results and Discussion

#### pH, EC and organic carbon

The significant variations were observed on soil pH, EC and soil organic carbon (Table -1) due to different organic, inorganic and INM treatments at harvest of onion crop. The results obtained from experimental finding showed that the maximum pH (7.38) was recorded by treatment T<sub>8</sub>. absolute control. However, the minimum soil pH (7.22) was recorded by treatments T<sub>4</sub>. (T<sub>2</sub> + Agronomic practices for weed and pest control (No chemical, pesticide and herbicide). Similarly, results were reported by Vennila and Muthuvel (1999) [12]. The maximum EC was recorded by treatment T<sub>8</sub>. absolute control (0.45 dS m<sup>-1</sup>) where as minimum soil EC (0.27 dS m<sup>-1</sup>) was recorded by treatment T<sub>6</sub>. (T<sub>2</sub> + bio-fertilizer containing N and P carriers) Similar, results were reported by, Maheswarappa *et al.* (1999) [6]. The soil organic carbon was differed due to different organic, inorganic and INM treatments at harvest of onion crop and showed the the maximum organic carbon content in soil was 0.64 per cent in treatment T<sub>6</sub>. (T<sub>2</sub> + bio-fertilizer containing N and P carriers) and significantly superior over all treatments. The minimum soil organic carbon was recorded by absolute control 0.40 per cent Similar, results were reported by Acharya *et al.* (1988).

**Table 1:** Effect of organic, inorganic sources and INM on plant height of onion

Tr. No.	Treatments Details	Plant height (cm)		Number of leaves per plant		pH	EC (dS m <sup>-1</sup> )	O C (g/kg)
		60 DAS	At Harvest	60 DAS	Harvest			
T <sub>1</sub>	50 % recommended NPK + 50 % N trough FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test	58.83	62.10	9.40	13.46	7.31	0.40	0.586
T <sub>2</sub>	Different organic sources each equivalent to 1/3 recommended N (FYM + Vermi-compost + non edible oil cake)	49.80	51.10	7.06	11.60	7.24	0.28	0.560
T <sub>3</sub>	T <sub>2</sub> + Intercropping of trap crop.	51.06	53.73	8.20	11.93	7.24	0.32	0.550
T <sub>4</sub>	T <sub>2</sub> + Agronomic practices for weed and pest control (No chemical, pesticide and herbicide).	53.40	56.00	4.86	12.06	7.22	0.34	0.573
T <sub>5</sub>	50 % N as FYM + Bio-fertilizer for N + Rock phosphate to substitute the P requirement of crops + Phosphate solubilizing bacterial culture	52.13	58.4	7.03	12.16	7.24	0.30	0.530
T <sub>6</sub>	T <sub>2</sub> + bio-fertilizer containing N and P carriers.	55.13	59.48	8.86	12.20	7.30	0.27	0.640
T <sub>7</sub>	100 % NPK + Secondary and micronutrient based on soil test (ZnSO <sub>4</sub> 10 kg + S 25 kg).	56.86	60.66	9.33	12.46	7.32	0.43	0.570
T <sub>8</sub>	Absolute control.	48.13	50.33	4.33	10.46	7.38	0.45	0.400
	S Em±	2.15	2.34	0.73	0.37	0.04	0.03	0.012
	C.D.@ 5%	6.60	7.17	2.24	1.16	NS	0.09	0.038

### Fertility status

Different biofertilizer treatments significantly increased the available N, P and K in soil at harvesting (Table-2). The Treatment T<sub>1</sub> (50 % recommended NPK + 50 % N through FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test) showed highest availability nitrogen (183.5 kg ha<sup>-1</sup>), phosphorus (14.23 kg ha<sup>-1</sup>) and potassium (369.56 kg ha<sup>-1</sup>) respectively, after harvest of onion. However, the PSB + *Azotobacter* were applied in treatments T<sub>5</sub> and T<sub>6</sub> were recorded higher nitrogen, phosphorus and potassium among different biofertilizer treatments. This could be due to integrated nutrient management in onion during crop growth period. Similarly, the application of organic manure along with biofertilizers improved the soil health status with respect of soil organic carbon and available N, P and K, this might be due to higher microbial activity in organic treatments which favour the conversion of organic bound nitrogen to inorganic form. These results were in close agreement with Vidyavathi *et al.* (2011) available nitrogen was significantly high under integrated nutrient management practices compared to inorganic nutrient management practices. Similarly, Jayathilake, *et al.* (2006). These results are in close agreement with Narkhede and Khandare (2016) [7]. The highest soil available N, P and K was recorded by application of soil N, P, and K along with organic manures which contributes to the availability of nutrients by chelating process.

The significant variations were observed on available sulphur and micronutrients (table-2) in soil due to different organic, inorganic and INM treatments at harvest of onion crop. The

results obtained from experimental finding showed that, the available sulphur were ranged from 7.43 to 13.38 kg ha<sup>-1</sup> at harvest of onion crop and the maximum sulphur (13.38 kg ha<sup>-1</sup>) recorded by treatment T<sub>1</sub> (50 % recommended NPK + 50 % N through FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test) followed by treatment T<sub>7</sub> (100 % NPK + Secondary and micronutrient based on soil test (ZnSO<sub>4</sub> 10 kg + S 25 kg) and T<sub>6</sub> (T<sub>2</sub> + bio-fertilizer containing N and P carriers) sulphur (12.64 and 11.34 kg ha<sup>-1</sup>) at harvest. The minimum sulphur content (7.43 kg ha<sup>-1</sup>) was recorded by treatments T<sub>8</sub> (control) at harvest. Similar, results were reported by the positive response of onion towards N and sulphur in terms of yield and quality of bulbs was reported by Vachhani and Patel (1993) [11].

DTPA extractable iron, copper manganese and zinc in soil differed significantly among the different biofertilizer, chemical and integrated nutrient management treatments due to application of different nutrient sources after harvest of onion in (table-2). The DTPA extractable iron, copper manganese and zinc build up was maximum in soil recorded by INM treatments 50% recommended NPK + 50 % N through FYM + Inorganic sources of micronutrient as per soil test than the other treatments after harvest of onion. The maximum availability DTPA extractable iron, copper, manganese and zinc may be attributed due to the chelating action of organic compounds released during decomposition of FYM, green manure and wheat crop straw which increased availability of micronutrients by preventing fixation. Walia *et al.*, (2010) [13].

**Table 2:** Effect of organic, inorganic sources and INM on nutrient availability, DTPA extractable micronutrient in soil

Tr. No.	Treatments Details	N (kg ha <sup>-1</sup> )	P (kg ha <sup>-1</sup> )	K (kg ha <sup>-1</sup> )	S (kg ha <sup>-1</sup> )	Copper (mg kg <sup>-1</sup> )	Iron (mg kg <sup>-1</sup> )	Manganese (mg kg <sup>-1</sup> )	Zinc (mg kg <sup>-1</sup> )
T <sub>1</sub>	50 % recommended NPK + 50 % N through FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test	183.56	14.23	369.56	13.38	2.70	3.87	6.53	0.89
T <sub>2</sub>	Different organic sources each equivalent to 1/3 recommended N (FYM + Vermi-compost + non edible oil cake)	152.83	13.43	358.90	11.90	2.38	1.17	3.32	0.48
T <sub>3</sub>	T <sub>2</sub> + Intercropping of trap crop.	167.50	13.40	355.13	8.83	2.47	2.71	3.89	0.49
T <sub>4</sub>	T <sub>2</sub> + Agronomic practices for weed and pest control (No chemical, pesticide and herbicide).	159.70	13.13	354.56	8.40	2.28	2.31	3.56	0.53
T <sub>5</sub>	50 % N as FYM + Bio-fertilizer for N + Rock phosphate to substitute the P requirement of crops + Phosphate solubilizing bacterial culture	171.23	13.46	351.33	10.53	2.29	1.13	4.07	0.36
T <sub>6</sub>	T <sub>2</sub> + bio-fertilizer containing N and P carriers.	171.33	13.80	362.06	11.34	2.59	2.92	4.63	0.63
T <sub>7</sub>	100 % NPK + Secondary and micronutrient based on soil test (ZnSO <sub>4</sub> 10 kg + S 25 kg).	179.67	13.96	366.00	12.64	2.68	3.57	6.43	0.83
T <sub>8</sub>	Absolute control.	149.96	12.82	345.63	7.43	2.12	1.03	2.86	0.31
	S E ±	2.175	0.233	3.803	0.85	0.10	0.54	0.81	0.11
	C.D.@ 5%	6.661	0.713	11.647	2.62	0.32	1.65	2.50	0.34

### Yield and yield attributes

The maximum onion bulb yield (139.57 qt ha<sup>-1</sup>) and leaf straw yield (2.02 qt ha<sup>-1</sup>) at harvest. recorded by treatment T<sub>1</sub> (50 % recommended NPK + 50 % N through FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test) followed by treatment T<sub>7</sub> (100 % NPK + Secondary and micronutrient based on soil test (ZnSO<sub>4</sub> 10 kg + S 25 kg) and T<sub>6</sub> (T<sub>2</sub> + bio-fertilizer containing N and P carriers) onion bulb yield (134.28, 129.50 qt ha<sup>-1</sup>) and leaf straw yield (1.95, 1.87 qt ha<sup>-1</sup>) at harvest, respectively. Jayathilake *et al.* (2003) [4] reported that, the total bulb yield of onion and its components significantly increased with the application of biofertilizers in combination with organic nitrogen fertilizers. The maximum plant height

of onion per plant at 60 DAS (58.83 cm) and at harvest (62.10 cm) was recorded by treatment T<sub>1</sub> (50 % recommended NPK + 50 % N through FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test, Reddy and Reddy (2005) [8]. showed that application of vermicompost and compost significantly increased plant height that might be due to chelating effects of application of manures leads to more availability of nutrients. The maximum number of leaves per plant at 60 DAS (9.40) and at harvest (13.46) recorded by treatment T<sub>1</sub> (50 % recommended NPK + 50 % N through FYM/crop residues/compost/other organic source + inorganic sources of micronutrient as per soil test. Varu *et al.* (1997) [10] recorded higher number of leaves per plant with the application of *Azotobacter*, PSB in combination

with chemical fertilizers which had the better effect on vegetative growth by releasing different organic acids from various plant parts.

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