The Andhra Agric. J 59(2):242-248, 2012

Integrated Nutrient Management with Vermicompost on Yield, Quality and Uptake of Nutrients by Crops in Onion – Radish Cropping System

T Prabhakar Reddy, G Padmaja and P Chandrasekhar Rao
Department of Soil Science & Agricultural Chemistry, College of Agriculture, Rajendranagar, ANGRAU, Hyderabad- 500 030, Andhra Pradesh

ABSTRACT

A field experiment was conducted on a sandy loam soil during *kharif* (onion) and *rabi* (radish) seasons of 2007-08 with a view to study the effect of integrated use of nitrogen (0, 60, 90 and 120 kg N ha^{-1}) and vermicompost (0, 5 and 10 t ha^{-1}) on performance of crops in terms of yield, quality and nutrient uptake. Among the different combinations, application of 10 t vermicompost ha^{-1} + 120 kg N ha^{-1} recorded significantly highest fresh bulb yields and total uptake of N, P, K and S by onion at harvest. The radish crop grown during *rabi* responded favorably to the residual and cumulative treatments. The highest root yield and total nutrient uptakes of N, P, K and S by radish at harvest was recorded in residual and cumulative treatments receiving 10 t vermicompost ha^{-1} + 120 kg N ha^{-1}. With regard to quality parameters of onion and radish the effect of levels of nitrogen, vermicompost and their interactions showed significant effect.

Key words : Nitrogen, Onion, Radish, Vermicompost

Onion (*Allium cepa* L.) is one of the major bulbous crops of the world and one of the most important commercial vegetable crops grown in India. But the productivity of onion in India is quite low compare to USA, Spain, Turkey and Iran. Radish (*Raphanus sativum*) is one of the most important root vegetable grown for its edible fleshy roots. Increased use of the fertilizer nitrogen is probably the most important single factor that has enabled the crop production to increase significantly in recent years. The critical role of nitrogen in plant metabolism, its low supply in soils and management of nitrogen through organic and inorganic sources is an extremely important aspect of crop production (Reddy and Reddy, 1998). Vermicompost is a rich source of macro and micronutrients, vitamins, enzymes, growth hormones and microflora. This organic manure plays a significant role in improving the fertility of top soil and enhances the productivity of the crop. Further, there is a need to promote use of organics in addition to inorganic fertilizers for sustained maintenance of soil fertility (Vasanthi and Kumaraswamy 1999). Keeping in view the significance of integrated nutrient management in maintaining the soil health and improvement in the productivity of crops, an experiment was conducted to study the effect of nitrogen and vermicompost on yield, quality and uptake of nutrients by crops grown on an Alfisol.

MATERIALS AND METHODS

A field experiment was conducted on a sandy loam soil (Alfisol) at Student Farm, College of Agriculture, Rajendranagar, Hyderabad during *kharif* (onion) and *rabi* (radish) seasons of 2007-08 with a view to study the effects of integrated use of nitrogen and vermicompost on performance of crops in terms of yield and nutrient uptake by crops. During *kharif* (onion), an experiment was laid out in Randomized Block Design with factorial concept consisting of twelve treatment combinations taking 3 levels of vermicompost (0, 5 and 10 t ha^{-1}) and four levels of nitrogen (0, 60, 90 and 120 kg N ha^{-1}). Nitrogen was applied as per the treatments. The recommended doses of P_2O_5 (80 kg ha^{-1}) and K_2O (100 kg ha^{-1}) were applied uniformly to all the treatments.

In *rabi* (radish) season, all the plots were divided into two equal halves. Fertilizers were not applied to one half to know the residual effect on radish grown during *rabi* after harvest of onion crop. In another half a common dose of 75 per cent of recommended dose of N, P and K fertilizers were applied to radish crop for all the treatments to know the cumulative effect.

The experimental soil is sandy loam in texture, slightly alkaline (pH 7.2) in reaction, non- saline (0.18 dSm^{-1}), low in organic carbon (0.43 percent) and available N (196.5 kg ha^{-1}) and medium in available P_2O_5 (29.21 kg ha^{-1}), K_2O (293.5 kg ha^{-1}) and S (21.95 kg ha^{-1}). Apart from initial soil analysis, the

Table 1. Effect of levels of vermicompost and nitrogen on bulb yield (t ha^{-1}) of onion

Treatments	Onion yield (t ha^{-1})				
	Nitrogen doses				
	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean
0 t ha^{-1} (V_0)	12.26	14.56	16.64	17.61	15.27
5 t ha^{-1} (V_1)	15.23	18.55	20.72	22.51	19.25
10 t ha^{-1} (V_2)	19.70	22.51	23.43	24.45	22.52
Mean	15.73	18.54	20.27	21.52	
	S.Ed±		CD (0.05)		
V	0.41		0.86		
N	0.47		0.98		
V×N	0.81		1.69		

V – Vermicompost N – Nitrogen

Table 2. Cumulative and residual effect of levels of vermicompost and nitrogen on yield (t ha^{-1}) of radish

Treatments	Cumulative effect					Residual effect				
	Nitrogen doses					Nitrogen doses				
	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean
0 t ha^{-1} (V_0)	18.43	20.07	20.21	20.25	19.99	15.22	15.45	15.74	15.97	15.59
5 t ha^{-1} (V_1)	21.13	21.60	21.96	22.27	21.74	16.84	17.13	17.45	17.57	17.25
10 t ha^{-1} (V_2)	22.37	23.03	23.13	23.43	22.99	18.01	18.16	18.37	18.45	18.24
Mean	20.98	21.57	21.77	23.43		16.69	16.91	17.19	17.34	
	S.Ed±		CD (0.05)			S.Ed±		CD (0.05)		
V	0.11		0.22			0.04		0.08		
N	0.12		0.26			0.05		0.10		
V×N	0.21		0.45			0.08		0.17		

V – Vermicompost N – Nitrogen

nutrient composition of vermicompost was also analyzed before applying to field. The contents of nitrogen, phosphorus, potassium and sulphur found to be 1.56, 0.98, 1.61 and 0.76 per cent, respectively.

RESULTS AND DISCUSSION

Yield

The results of the field experiment showed that the performance of onion and radish crops improved significantly with integrated use of vermicompost and nitrogen fertilizers when compared to application of either recommended doses of N as inorganic fertilizer or vermicompost alone (Table 1). Among the different combinations, application of 10 t vermicompost ha^{-1} + 120 kg N ha^{-1} (V_2N_3) recorded significantly highest fresh bulb yields (24.45 t ha^{-1}) at harvest. However, the bulb yield at V_2N_3 was on par with the application of 10 t vermicompost ha^{-1} along with 90 kg N ha^{-1} (23.43 t ha^{-1}). Integrated application of nitrogen along with vermicompost increased the nutrients availability through mineralization and transformation in the soil. This increased availability of nutrients during crop

Table 3. Effect of levels of nitrogen and vermicompost on quality parameters of onion

Treatments	TSS(%)					Total Sugars (%)				
	Nitrogen doses					Nitrogen doses				
	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean
0 t ha^{-1} (V_0)	8.42	9.16	9.21	9.27	9.02	8.34	9.26	9.32	9.35	9.07
5 t ha^{-1} (V_1)	9.97	10.09	10.17	10.24	10.12	9.60	9.64	9.67	9.69	9.65
10 t ha^{-1} (V_2)	11.27	11.33	11.36	11.39	11.34	9.86	9.94	9.97	10.01	9.94
Mean	9.89	10.20	10.25	10.30		9.27	9.61	9.65	9.68	
	S.Ed±		CD (0.05)			S.Ed±		CD (0.05)		
V	0.007		0.015			0.004		0.01		
N	0.008		0.017			0.005		0.01		
V×N	0.014		0.03			0.009		0.02		

Table 4. Cumulative and residual effect of levels of nitrogen and vermicompost on Vitamin C (mg 100 g^{-1}) of radish

Treatments	Cumulative effect					Residual effect				
	Nitrogen doses					Nitrogen doses				
	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean
0 t ha^{-1} (V_0)	13.08	13.12	13.15	13.19	13.13	10.08	10.40	10.48	10.58	10.39
5 t ha^{-1} (V_1)	13.93	13.98	14.07	14.10	14.02	12.20	12.27	12.27	12.33	12.27
10 t ha^{-1} (V_2)	14.35	14.38	14.42	14.43	14.39	13.71	13.87	13.92	13.94	13.86
Mean	13.79	13.83	13.88	13.91		11.20	12.18	12.22	12.28	
	S.Ed±		CD (0.05)			S.Ed±		CD (0.05)		
V	0.004		0.01			0.01		0.02		
N	0.005		0.01			0.01		0.02		
V×N	0.01		0.02			0.02		0.03		

growth period has lead to an increased drymatter production by the crop at different growth stages, resulting in higher bulb yield. Similar increase in the bulb yield of onion due to application of nitrogen and vermicompost was also reported by Yadav *et al*. (2003).

The radish crop grown during *rabi* responded favorably to the residual and cumulative treatments after harvest of onion and the highest yield of radish (23.43 t ha^{-1}) was recorded with application of 10 t vermicompost ha^{-1} + 120 kg N ha^{-1} and it was on par with the treatment receiving vermicompost @ 10 t ha^{-1} along with 90 kg N ha^{-1} (23.13 t ha^{-1}) (Table 2). Hence among all the treatment combinations, application of vermicompost @ 10 t ha^{-1} along with 90 kg N ha^{-1} is ideal which contributed to maximum bulb yield of onion and also supported the radish crop with additional application of only 75 per cent of recommended dose of fertilisers. The results are in line with the findings of Reddy (1998).

Table 5. Effect of levels of nitrogen and vermicompost on total N, P, K and S uptake (kg ha^{-1}) by onion (leaf+bulb) at 30, 60, 90 DAT and at harvest

Treatments	Total N uptake (kg ha^{-1})					Total P uptake (kg ha^{-1})				
	Nitrogen doses					Nitrogen doses				
	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean
0 t ha^{-1} (V_0)	49.24	62.42	71.32	78.65	65.41	5.21	6.80	7.86	9.37	7.31
5 t ha^{-1} (V_1)	73.14	83.70	94.64	105.70	89.30	11.05	14.16	15.78	18.30	14.82
10 t ha^{-1} (V_2)	95.92	101.80	114.00	119.50	107.8	19.01	20.89	23.04	24.45	21.85
Mean	72.76	82.63	93.33	101.30		11.76	13.95	15.56	17.37	
	S.Ed±		CD (0.05)			S.Ed±		CD (0.05)		
V	0.78		1.62			0.17		0.34		
N	0.90		1.87			0.19		0.40		
V×N	1.56		3.24			0.33		0.69		

Treatments	Total K uptake (kg ha^{-1})					Total Suptake (kg ha^{-1})				
	Nitrogen doses					Nitrogen doses				
	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean
0 t ha^{-1} (V_0)	81.98	92.91	105.6	113.8	98.5	27.35	31.75	36.57	39.87	33.89
5 t ha^{-1} (V_1)	106.30	125.20	134.8	148.6	128.7	38.20	45.72	49.66	56.00	47.40
10 t ha^{-1} (V_2)	137.70	144.70	154.5	160.7	149.4	52.42	56.09	60.52	63.65	58.17
Mean	108.60	120.90	131.6	141.1		39.32	44.52	48.92	53.18	
	S.Ed±		CD (0.05)			S.Ed±		CD (0.05)		
V	1.01		2.09			0.43		0.89		
N	1.16		2.41			0.50		1.04		
V×N	2.01		4.18			0.87		1.80		

Quality

With regard to quality parameters of onion, the effect of levels of nitrogen, vermicompost and their interactions showed significant effect (Table 3&4). The values pertaining to TSS (11.39%) and total sugars (10.01 %) in onion bulb at harvest found to be significantly highest with application of 10 t vermicompost ha^{-1} + 120 kg N ha^{-1}. Such increase in quality parameters can be attributed to increase in ascorbic acid content and total sugars resulting in good quality of onions which can store for long period of time (Mamatha *et al*., 2006). The results obtained on vitamin C content in the root of radish at harvest revealed that all the cumulative treatment (75 percent RDF) resulted in higher vitamin C content than their corresponding residual treatments.

Uptake

The uptakes of N, P, K and S by onion at harvest were highest when nitrogen was applied @ 120 kg ha^{-1} along with vermicompost @ 10 t ha^{-1} (Table 5). The per cent increase in total N, P, K and S uptake at N_3 level found to be 8.5, 11.6, 7.1 and 8.7 per cent over N_2, and 39.2, 47.7, 29.8 and 35.2

Table 6. Cumulative and residual effect of levels of nitrogen and vermicompost on total N and P uptake (kg ha^{-1}) by radish at harvest

Total N uptake (kg ha^{-1})

Treatments	Cumulative effect					Residual effect				
	Nitrogen doses					Nitrogen doses				
	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean
0 t ha^{-1} (V_0)	87.11	87.67	88.29	88.82	87.97	40.06	40.63	41.36	41.79	40.96
5 t ha^{-1} (V_1)	91.27	91.45	91.84	91.93	91.62	42.91	43.37	43.69	43.72	43.24
10 t ha^{-1} (V_2)	92.65	92.91	93.29	93.61	93.11	44.35	44.59	44.88	45.14	44.74
Mean	90.34	90.67	91.14	91.46		42.44	42.87	43.31	43.55	
	S.Ed±		CD (0.05)			S.Ed±		CD (0.05)		
V	0.07		0.14			0.07		0.15		
N	0.08		0.16			0.08		0.17		
V×N	0.13		0.28			0.14		0.30		

Total P uptake (kg ha^{-1})

Treatments	Cumulative effect					Residual effect				
	Nitrogen doses					Nitrogen doses				
	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean
0 t ha^{-1} (V_0)	5.35	5.31	5.47	5.35	5.37	2.79	2.75	2.89	2.90	2.83
5 t ha^{-1} (V_1)	5.56	5.60	5.48	5.54	5.55	3.05	3.07	2.96	3.09	3.04
10 t ha^{-1} (V_2)	5.68	5.52	5.62	5.73	5.64	3.09	3.11	3.15	3.12	3.12
Mean	5.53	5.48	5.52	5.54		2.98	2.98	3.00	3.04	
	S.Ed±		CD (0.05)			S.Ed±		CD (0.05)		
V	0.04		0.08			0.03		0.05		
N	0.04		NS			0.03		NS		
V×N	0.07		NS			0.05		NS		

per cent over N_0, respectively. The total N, P, K and S uptake at V_2 level increased to an extent of 47.4, 20.7, 16.1 and 22.7 per cent over V_1 and 65.8, 98.9, 51.6 and 71.6 per cent over V_0, respectively. This indicates the significance of vermicompost and nitrogen in increasing the nutrient availability. Ravindra Babu (1999) observed similar increase nutrient uptake with the combined application of nitrogen along with organic manures.

The total nutrient uptakes (kg ha^{-1}) of N, P, K and S by radish at harvest were found to be significantly highest when nitrogen was applied @ 120 kg ha^{-1} along with vermicompost @ 10 t ha^{-1}. All the cumulative treatments showed higher root yield and nutrient uptake values than their corresponding residual treatments (Table 6&7). These results clearly indicate that vermicompost and nitrogen applied to preceding onion crop could not meet the complete nutrient requirement of radish. Succeeding crop requires a minimum fertilization to sustain the yield levels, which was evident by lower yields under residual treatments. The results are in aggrement with the findings of Patiram and Singh (1993).

Table 7. Cumulative and residual effect of levels of nitrogen and vermicompost on total K and S uptake (kg ha^{-1}) by radish at harvest

Total K uptake (kg ha^{-1})

Treatments	Cumulative effect					Residual effect				
	Nitrogen doses					Nitrogen doses				
	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean
0 t ha^{-1} (V_0)	81.25	81.51	81.03	85.53	81.58	41.40	42.18	42.76	43.11	42.36
5 t ha^{-1} (V_1)	83.80	84.17	84.67	84.36	84.25	44.52	44.72	44.95	45.25	44.86
10 t ha^{-1} (V_2)	85.42	84.67	85.36	85.40	85.21	45.85	46.20	46.27	46.62	46.24
Mean	83.49	83.45	83.68	84.10		43.92	44.37	44.66	45.00	
	S.Ed±		CD (0.05)			S.Ed±		CD (0.05)		
V	0.30		0.62			0.10		0.20		
N	0.30		NS			0.11		0.23		
V×N	0.59		NS			0.19		0.40		

Total S uptake (kg ha^{-1})

Treatments	Cumulative effect					Residual effect				
	Nitrogen doses					Nitrogen doses				
	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean	0 kg ha^{-1} (N_0)	60 kg ha^{-1} (N_1)	90 kg ha^{-1} (N_2)	120 kg ha^{-1} (N_3)	Mean
0 t ha^{-1} (V_0)	13.52	13.51	13.56	13.73	13.58	4.91	5.00	5.05	5.04	5.00
5 t ha^{-1} (V_1)	13.87	14.16	14.27	14.11	14.10	5.23	5.22	5.37	5.41	5.31
10 t ha^{-1} (V_2)	14.21	14.27	14.28	14.31	14.27	5.42	5.41	5.53	5.42	5.45
Mean	13.87	13.98	14.04	14.05		5.19	5.21	5.32	5.29	
	S.Ed±		CD (0.05)			S.Ed±		CD (0.05)		
V	0.04		0.09			0.03		0.07		
N	0.05		0.10			0.04		0.08		
V×N	0.09		0.18			0.07		NS		

To meet the nutrient requirements of onion - radish cropping system, application of 75 per cent RDF to radish apart from application of 90 kg N ha^{-1} along with 10 t vermicompost ha^{-1} to onion is sufficient as this combination has ensured sufficient supply of nutrients and favoured better growth and yield of both onion and radish crops.

LITERATURE CITED

Mamatha H N, Yeledhalli N A, Prakash S S, Alloli T B and Ravi M V 2006. Application of organic and inorganic sources of nitrogen on yield, quality of onion and some soil properties in Alfisol. *Journal of Asian Agriculture* 3(1): 33-37.

Patiram N and Singh K A 1993. Effect of continuous application of manures and nitrogenous fertilizers of some properties of acid Inceptisol. *Journal of the Indian Society of Soil Science* 41: 430-433.

Ravindra Babu M 1999. Studies on integrated nutrient management with vermicompost and inorganic fertilizer in carrot. M Sc (Horti.) Thesis, Acharya N G Ranga Agricultural University, Rajendranagar, Hyderabad, A.P.

Reddy G and Reddy M S 1998. Effect of organic manures and nitrogen levels on soil available nutrients status in maize – soybean cropping system. *Journal of Indian Society of Soil Science* 46: 474-476.

Reddy P K 1998. Integrated nutrient management involving vermicompost in bitter gourd. M Sc (Horti.) Thesis, Acharya N G Ranga Agricultural University, Rajendranagar, Hyderabad, A.P.

Vasanthi D and Kumaraswamy K 1999. Efficiency of vermicompost to improve soil fertility and yield. *Journal of Indian Society of Soil Science* 47: 268-272.

Yadav R L, Sen N L and Yadav B L 2003. Response of onion to nitrogen and potassium fertilization under semi-arid condition of Rajasthan. *Indian Journal of Horticulture* 60(2): 176-178.

(Received on 25.08.2011 and revised on 08.09.2011)