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Availability of major nutrients in soil as influenced by integrated nutrient management in tomato-onion cropping system

R. Uma Reddy* and M. Suryanarayan Reddy**
Department of Soil Science and Agricultural Chemistry,
Regional Agricultural Research Station, Polasa, Jagtial 505 327, Andhra Pradesh

ABSTRACT

Integrated use of organic manures and inorganic fertilizers was studied for crop response in an experiment based on tomato-onion cropping system. Application of organic manures with inorganic fertilizers significantly improved the availability of N, P, and K in soil. The availability of major nutrients in soil increased with increase in level of organic manures application and with no fertilizer registered maximum but on par with 50 and 75 per cent manure levels while the 25 per cent level of organic manure recorded minimum. Based on the results of this study it could be concluded that the combined use of organic manures and inorganic fertilizers is suitable for sustaining yield and maintaining soil health.

Key words: Vemicompost, poultry manure, neem cake, farm yard manure.

INTRODUCTION

In recent years, chemical fertilizers have played significant role in providing soil nutrients for intensive crop production. But dependence only on chemical fertilizers has created problem of multiple nutrient deficiencies, diminishing soil fertility and unsustainable crop yields. This necessiated a review of various approaches for ensuring effective use of available renewable sources of plant nutrients for supplementing commercial fertilizers.

The soil fertility gets depleted by growing same crop year after year. Moreover, growing same crop on the same land invites specific insect pest and disease problems. All these problems can be avoided by growing the crops in a scientific manner and following appropriate crop rotation. During recent years, the interest in vegetable production has assumed greater importance as a result of increased appreciation of food value of vegetables and regarding their place in the nation's food requirements. Hence, keeping in view the significance of organic manures in maintaining the soil health, an attempt has been made to critically examine the use of different nutrient sources to obtain better yield and to maintain good soil health in tomato-onion cropping system under integrated nutrient management programme.

MATERIALS AND METHODS

The experiment was conducted at Agricultural Research Institute, Rajendranagar, Hyderabad. The soil is red sandy loam, classified under Alfisols. Soil samples were collected prior to layout of the experiment and were analysed for available nutrients following standard procedures. The soil having organic carbon 0.45%, available nitrogen 195.9 kg ha^{-1}, available phosphorus 17.9 P_2O_5 kg ha^{-1} and available potassium 287.60 K_2O kg ha^{-1}. The treatments consisted of four levels (25, 50, 75 and 100 per cent) each of vermicompost (VC), poultry manure (PM), neem cake (NC) and farm yard manure (FYM), along with one treatment of recommended dose of fertilizers (RDF) and control (without any fertilizers and manures). In total, there were 18 treatments that were laid out in a randomized block design, each replicated thrice. For tomato the entire dose of phosphorus and potassium @ 60 kg/ha were applied as basal dose. Nitrogen was supplied according to the treatments one week before sowing through different organic manures. For onion entire dose of phosphorus and potassium @ 40 kg/ha were applied as basal dose and nitrogen was applied @ 80 kg/ha in three equal splits, *i.e.,* at the time of 40, 60 DAT and at flowering stage. Manures were not applied alone.

The experimental data were analysed by the method of analysis of variance. All the characters were analysed to test the variance of different treatments at 5 per cent level of significance

RESULTS AND DISCUSSION

The available N, P and K in soil were significantly influenced by the type and levels of manure application in conjunction with fertilizers (Tables 1,2 & 3). In all types of manures, the treatment with 100 per cent level of manure which was on par with 75 and 50 per cent level of manures showed highest available N, P & K

*Corresponding author's present address: Coordinator, DAATTC, Warangal, E-mail: ravula_umareddy@rediffmail.com
**College of Agriculture, Rajendranagar, Hyderabad 500030

Table 1. Available nitrogen (kg ha^{-1}) in soil as influenced by INM in tomato-onion cropping system.

Treatment		Tomato	Onion	Tomato	Onion
		Kharif	*Rabi*	*Kharif*	*Rabi*
T1	Control	181.1	169.3	165.6	156.8
T2	RDF	219.9	198.0	221.2	209.0
T3	75 N + 25 FYM	226.4	201.1	231.1	210.9
T4	50 N + 50 FYM	227.6	201.8	231.8	215.6
T5	25 N + 75 FYM	228.3	201.9	232.9	215.8
T6	100 FYM	228.6	203.2	233.8	216.6
T7	75 N + 25 VC	234.7	204.2	240.8	221.6
T8	50 N + 50 VC	239.3	205.8	244.2	221.9
T9	25 N + 75 VC	241.6	207.1	246.5	222.6
T10	100 VC	242.6	209.6	246.8	223.5
T11	75 N + 25 PM	235.1	202.1	239.2	220.9
T12	50 N + 50 PM	234.6	204.1	239.8	221.8
T13	25 N + 75 PM	237.3	205.1	240.1	222.1
T14	100 PM	239.9	205.2	240.8	222.6
T15	75 N + 25 NC	234.3	201.8	236.8	219.1
T16	50 N + 50 NC	234.9	203.9	238.6	219.8
T17	25 N + 75 NC	236.1	204.1	239.1	220.1
T18	100 NC	236.8	204.2	239.8	220.8
$CD_{0.05}$		4.9	2.3	5.1	2.2
Manurial comparison (Mean values)					
FYM		227.7	202.0	232.4	214.7
VC		239.5	206.6	244.5	222.4
PM		236.7	204.1	239.9	221.8
NC		235.5	203.5	238.5	219.9
RDF		219.9	198.0	221.2	209.0
Control		181.1	169.3	165.6	156.8

VC = Vermicompost, PM = Poultry manure, NC = Neem cake

in soil at the time of harvest of crops in this sequence. This may be attributed to the direct addition and slow release of N, P and K through manures added to soil (Bharadwaj and Omanwar, 1). The 100 per cent level of VC showed highest available N, P and K while control plots recorded the lowest. The lower values of available N, P and K in RDF treatment at the time of harvest of all crops may be attributed to the maximum utilisation of applied nutrients by the crop, which are in the most available form.

The available N, in soil was higher at the time of harvest of tomato crop as compared to maturity of onion crop. This may be ascribed to the slow release of N from manures applied to tomato crop, which was made available to succeeding onion crop where no manures were applied. The increase in available N over initial content due to application of VC, PM, NC, FYM and RDF was by +14.35, +13.83, +11.92, +6.70 and +0.95 kg ha^{-1}, whereas in control there was depletion to the extent of -51.25 kg ha^{-1}. The build up of available phosphorus might be due to the organic acids, which were released during microbial decomposition of organic matter helped in the solubility of native phosphates, thus, increasing available phosphorus content in soil (Khan *et al.*, 5). Besides this, appreciable quantities of carbon dioxide released during decomposition of organic matter might have formed carbonic acid, which enhances the solubility of phosphates resulting in higher phosphate availability in plots treated with organic manures. Similar results were observed by Bharadwaj and Omanwar (1) with FYM, Madhavi and Suryanarayan Reddy (7) with poultry manure, when applied in combination with fertilizers. Applied organic matter leads to the formation

Table 2. Available phosphorus (kg $P_2O_5ha^{-1}$) in soil as influenced by INM in tomato-onion cropping system.

Treatment		Tomato	Onion	Tomato	Onion
		Kharif	*Rabi*	*Kharif*	*Rabi*
T1	Control	16.6	15.9	13.6	13.4
T2	RDF	24.2	27.2	29.8	31.4
T3	75 N + 25 FYM	25.9	28.7	31.0	33.8
T4	50 N + 50 FYM	26.4	30.3	31.2	34.6
T5	25 N + 75 FYM	27.1	31.6	32.4	34.9
T6	100 FYM	27.3	31.8	33.6	35.1
T7	75 N + 25 VC	25.8	30.9	35.9	38.9
T8	50 N + 50 VC	28.9	32.9	36.4	39.4
T9	25 N + 75 VC	30.4	33.1	37.1	39.8
T10	100 VC	30.4	33.8	37.9	40.1
T11	75 N + 25 PM	24.1	31.8	36.1	38.9
T12	50 N + 50 PM	28.3	32.1	36.3	39.1
T13	25 N + 75 PM	29.1	32.4	36.6	39.3
T14	100 PM	29.9	33.1	36.9	39.6
T15	75 N + 25 NC	25.0	30.1	34.1	37.2
T16	50 N + 50 NC	27.1	31.1	34.8	37.5
T17	25 N + 75 NC	27.6	32.1	35.1	38.1
T18	100 NC	27.9	32.8	35.3	38.6
$CD_{0.05}$		0.67	0.6	0.7	0.74
Manurial comparison (Mean values)					
FYM		26.7	30.6	32.0	34.6
VC		28.9	32.7	36.8	39.5
PM		27.8	32.3	36.2	38.9
NC		26.9	31.5	34.8	37.8
RDF		24.2	27.2	29.8	31.4
Control		16.6	15.9	13.6	13.4

VC = Vermicompost, PM = Poultry manure, NC = Neem cake

of a coating on the sesquioxides, because of this the phosphate fixing capacity of soil is reduced in manure treated plots. There was increase in available phosphorus content due to the application of VC, PM, NC, FYM and RDF by +20.52, +20.18, +18.80, +15.58 and +12.36 kg ha^{-1} respectively, while a depletion by -5.61 kg ha^{-1} was observed in control plots. Kumar *et al.*, (6) also observed increase in available P under the influence of combined use of organic manures with in organics than with organics alone against their respective initial values.

The build up of available K in soil was due to beneficial effect of organic manures on the reduction of potassium fixation, releasing K due to the interaction of organic matter with clay, and direct addition of K to the available pool of soil. Similar beneficial effects of organics on available K was reported earlier in case of poultry manure (Madhavi and Suryanarayana Reddy, 7), FYM (Bharadwaj and Omanwar, 1) and vermicompost (Jambhekar, 4), VC, PM and FYM (Gopal Reddy and Suryanarayan Reddy, 3). The data (Table 3) also clearly indicated that there was higher content of available potassium at the time of harvest of tomato crop while it was decreased at the end of onion. This indicates that there was considerable built up in available K content because of application of both the organic and inorganic sources containing K to the tomato crop. The decrease at the harvest of onion crop was due to the fact that available K might have been utilized by onion plants in considerable amounts during crop growth period. Similar decrease in available potassium as a result of cropping was reported by Geeta (2). There was continuous decrease in available K content in control treatment showing

Table 3. Available potassium (kg K_2O ha^{-1}) in soil as influenced by INM in tomato-onion cropping system.

Treatment		Tomato	Onion	Tomato	Onion
		Kharif	*Rabi*	*Kharif*	*Rabi*
T1	Control	256.9	228.23	221.67	226.1
T2	RDF	333.0	301.86	337.12	304.4
T3	75 N + 25 FYM	335.9	312.11	340.93	319.2
T4	50 N + 50 FYM	337.1	313.32	342.15	320.3
T5	25 N + 75 FYM	337.3	313.52	342.41	320.5
T6	100 FYM	337.4	313.73	342.56	320.6
T7	75 N + 25 VC	339.5	315.10	344.01	322.0
T8	50 N + 50 VC	340.6	316.27	345.23	322.8
T9	25 N + 75 VC	341.5	316.47	345.53	323.2
T10	100 VC	341.6	316.92	345.69	323.4
T11	75 N + 25 PM	337.2	314.24	343.05	320.9
T12	50 N + 50 PM	338.4	315.45	344.27	322.3
T13	25 N + 75 PM	339.1	315.73	344.47	322.4
T14	100 PM	339.4	315.80	344.62	322.4
T15	75 N + 25 NC	336.4	313.09	341.78	320.1
T16	50 N + 50 NC	336.6	314.31	343.15	321.2
T17	25 N + 75 NC	338.0	314.46	343.35	321.4
T18	100 NC	338.2	314.77	343.61	321.5
$CD_{0.05}$		1.0	1.1	1.1	1.0
Manurial comparison (Mean values)					
FYM		336.9	313.1	342.0	320.1
VC		340.8	316.1	345.1	322.8
PM		338.5	315.0	342.9	322.0
NC		337.3	314.1	342.9	321.0
RDF		333.0	301.8	337.1	304.4
Control		256.9	228.2	221.6	226.1

VC = Vermicompost, PM = Poultry manure, NC = Neem cake

depletion against replenishment of K to available K pool in soil in rest of the treatments. At the termination of experiment, it was found that, there was +17.50, +16.62, +15.68 and +14.78 kg ha^{-1} increase in available potassium contents over initial value due to application of VC, PM, NC and FYM respectively while there was decrease available potassium content by -79.20 kg ha^{-1} in control plots.

The content of available N, P and K in soil due to application of different manures followed the order : VC > PM > NC > FYM. The differences in soil available N, P and K contents in plots treated with different manures might be attributed to the variation in their inherent capacity to supply these nutrients. The available N, P and K in soil was significantly increased by manure application in conjunction with fertilizer (Reddy and Suryanarayan Reddy, 3).

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