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Available nutrient status as influenced by integrated nutrient management in alfisol

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Abstract
A field experiment conducted during *Summer* 2016 to study the "Effect of Integrated Nutrient Management (INM) on available macro and micro nutrient status of lateritic soils of Konkan region (M.S.) after harvest of Brinjal" at Dapoli. The experiment was laid out in Randomized Block Design (RBD) comprising eleven treatment combinations, replicated thrice and observations were recorded at 30, 60, 90 days after transplanting (DAT) and after harvest. The effect of different inorganic fertilizers and organic manures *viz.*, FYM and vermicompost either alone or in combinations on available macro and micronutrient was studied and it showed significant improvement as a consequence of various treatment combinations. In general available macro and micro nutrient status of experimental plot represented a typical lateritic soil of konkan (M. S.). The application of 25 % RDF through inorganic fertilizers and 75 % RDN through vermicompost had shown significant influence on available macro and micro nutrient status of the soil indicating integration of organics and inorganics is a future need for sustaining soil fertility.

Keywords: Available nutrient status, integrated nutrient management and brinjal

Introduction
Brinjal (*Solanum melongena* Linn.) belongs to the family Solanaceae. Plant is herbaceous, annual, erect or semi-spreading in habit. The varieties of *Solanum melongena* Linn. shows a wide range of fruit shapes and colors, ranging from oval or egg-shaped to long club shaped; and from white, yellow green through degrees of purple pigmentation to almost black. The brinjal also known as 'eggplant' or 'guinea squash'. It is one of the most popular and commercial crop grown in India and other parts of the world and rightly called as vegetable of masses. Brinjal fruits have medicinal properties. Some medicinal use of brinjal tissues and extract include treatment of diabetes, asthama, cholera, bronchitis and diarrhoea.

For achieving high level of production, it should be supplied with adequate quantities of manures and fertilizers. Now-a-days chemical fertilizers are quite expensive input and their usage over a long period may deplete the soil fertility it is also considered that their indiscriminate usage may also cause environmental pollution, soil sickness, reduce the microbial activities and availability of essential nutrients and deteriorate the product quality. Organic manures are basic source of essential plant nutrients and applied in large quantities. From nutrition point of view the role of organic manures is very meager; however, its value lies more in its action as a soil ameliorate, corrective for physical conditions and a parameter of biological activity to enhance soil productivity. It is obvious that the use of organic manures is the urgent need of time. However, because of lower levels of nutrients in various organic manures and their paucity it is impossible to grow the crops with the use of organic manures alone.

Only one source of nutrients like chemical fertilizers, organic manures and biofertilizers cannot improve the production or maintain the production sustainability and soil health. In recent times the concept of Integrated Nutrient Management system has been receiving increasing attention worldwide obviously for reasons of economization of fertilizer usage, safeguarding and ensuring scientific management of soil health for optimum growth, yield and quality of crops in an integrated manner in a specific agro-ecological situation, through balanced use of organic and inorganic plant nutrients; so that one can harvest good yield without deteriorating soil health. Now-a-days demand for brinjal as a fruit vegetable is increasing rapidly among the vegetable consumers in view of its better fruit colour, size and taste. Average productivity of brinjal crop is quite low and there exists a good scope to improve its average productivity in India to fulfil both domestic and national needs.

Keeping the above facts in view, a present investigation was conducted with the objective to study the effect of organic and inorganic fertilizers on fertility status of the soil and yield of brinjal crop in lateritic soil of konkan region.

Material and methods

Soil and weather condition

The present investigation was conducted at Department of Agronomy, College of Agriculture, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri during the month of February to June, 2016. The analytical work was done in the research laboratory of the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dapoli. The experimental site was located at 17.45º N latitude, 73.10º E longitude and 250 m above mean sea level. The climate is hot, humid with well-expressed three seasons *viz.* summer (February to May), rainy (June to September) and winter (October to January). The mean annual rainfall at Dapoli is 3500 mm, which is generally received from June to October with about 95 to 100 rainy days. The field experiment was conducted on typical lateritic soils in the heavy rainfall zone of the Konkan region of the Ratnagiri district. In order to know the initial soil fertility status, a representative surface soil sample (0-22.5 cm depth) was collected, processed and analyzed for different physico-chemical properties (Table 1). Data revealed that the experimental soil was sandy loam in texture, moderately acidic in reaction and having low electrical conductivity, moderately high in organic carbon, medium in available nitrogen and available phosphorus and very high in available potassium. In general, soil properties of experimental site showed a typical lateritic soil of the Konkan region.

Experimental details

The field experiment was laid out in Randomized Block Design (RBD) comprising of eleven treatment combinations replicated thrice during *Summer* season of 2016 at Research Farm of Agronomy Department, College of Agriculture, Dapoli. Brinjal (Local cultivar Bandhtivare) was taken as a test crop during *summer* season 2016. Bandhtivare, the local cultivar of brinjal is grown successfully in all three seasons i.e. *Kharif*, *Rabi* and *Summer* season under Konkan conditions with a spacing of 60cm X 60cm.

Table 1: Initial physico-chemical properties of the experimental field

S. No.	Parameters	Content
A	**Physical properties**	
	Mechanical Analysis	
	a) Sand (%)	68.55
	b) Silt (%)	16.25
	c) Clay (%)	15.20
	d) Texture class	Sandy loam
	1. Particle density (Mg m^{-3})	2.65
	2. Bulk density (Mg m^{-3})	1.31
B	**Chemical properties**	
	1. pH (1:2.5)	5.66
	2. Electrical conductivity (dSm^{-1})	0.098
	Organic carbon (g kg^{-1})	11.6
	3. Available N (kg ha^{-1})	295.13
	Available P_2O_5 (kg ha^{-1})	12.57
	4. Available K_2O (kg ha^{-1})	215.84

Treatment Details

The treatments details are given below.

T_1	:	Control (No NPK)
T_2	:	100% RDN through Farm Yard Manure (FYM)
T_3	:	100% RDN through Vermicompost (VC)
T_4	:	100% RDF through inorganic fertilizers
T_5	:	80% RDF through inorganic fertilizers
T_6	:	25%RDF + 75% RDN through FYM
T_7	:	50% RDF + 50% RDN through FYM
T_8	:	75% RDF + 25% RDN through FYM
T_9	:	25% RDF+ 75% RDN through VC
T_{10}	:	50% RDF + 50% RDN through VC
T_{11}	:	75% RDF + 25% RDN through VC

Note:- FYM – Farm Yard Manure VC- Vermicompost

Manure and Fertilizer Application

Farm Yard Manure (FYM) and Vermicompost (VC) were applied 15 days before transplanting of the crop in single dose based on their nutrient content and crop requirement in the respective treatment on the basis of N, P and K content. The quantity of various fertilizers required to be applied per plot as per the treatment was calculated and applied to the crop. In the respective treatments the amount of Nitrogen was applied in three splits doses *viz.*, first dose of 50 per cent N at the time of transplanting, second dose of 30 per cent N after 30 days of transplanting and remaining 20 per cent dose of N after 60 days of transplanting. However, the quantity of Phosphorus and Potassium were applied in the respective treatments as a single basal dose at the time of transplanting of the crop. The nutrient content in the various manures and fertilizers were determined and considered for calculating dose of respective fertilizers and manures per hectare basis and were applied in the respective treatments.

The various pre and post cultural operations were carried out as per the recommended package of practices. In order to study the effect of various treatments on fertility status of the soil, necessary observations were recorded as per crop schedule from time to time. Physico-chemical properties of initial soil sample and soil collected at an interval of 30, 60, 90DAT and after harvest of crop analyzed by using standard analytical methods.

Statistical analysis

The data have been subjected to appropriate method of statistical analysis as described by Panse and Sukhatme (1967) [13]. Interpretation of result was based on 'F' test. The comparison among means was made by calculating critical difference (CD) at 5 per cent level of significance.

Result and discussion

Effect of organic manures and inorganic fertilizers on fertility status of the soil

Available Nitrogen (N) content of the soil (kg ha^{-1})

The available nitrogen content of soil showed variation from 385.73 to 464.13 kg ha^{-1}, 360.64 to 413.95 kg ha^{-1}, 329.28 to 385.73 kg ha^{-1} and 282.24 to 354.37 kg ha^{-1} with a mean values of 436.85 kg ha^{-1}, 396.85 kg ha^{-1}, 365.77 kg ha^{-1} and 329.57 kg ha^{-1} at 30, 60, 90 DAT and after harvest of brinjal crop, respectively (Table 2). The treatment receiving application of 25 % RDF + 75 % RDN through vermicompost (T_9) showed maximum available nitrogen content of the soil at every growth period of observations of brinjal crop and it was closely followed by the treatment receiving integration of 50% RDF + 50% RDN through vermicompost (T_{10}). In general, available nitrogen status during the growth period of brinjal was found to be medium at 60, 90 DAT and after harvest. However, it was moderately high at 30 DAT.

This may be attributed to the addition of nitrogen through inorganics as well as organic sources which might have helped to build up nitrogen status of soil. When data examined critically further indicated that average nitrogen status was the highest at 30 DAT then showed definite decrease in it's content at 60, 90 DAT and after harvest of the brinjal crop. Whereas, the lowest average available nitrogen content was observed after harvest of the crop. Decrease in available nitrogen status with advancement in the growth period of brinjal crop might be due to utilization of nitrogen by brinjal crop. In addition to this it might have lost through leaching. Since lateritic soils are percolative due to their coarse texture. Further, the vermicompost, FYM and chemical fertilizers alone or in combination were showed it's superiority in increasing available nitrogen over control (Sharma *et al.*, 2009) [16]. The increase may be attributed to higher microbial activity in the integrated nutrient management treatments which favored the conversion of the organically bound nitrogen into inorganic form (Panwar, 2008) [14]. In treatments receiving inorganic fertilizers showed comparatively less available nitrogen could be attributed to rapid release of nitrogen by inorganic fertilizers which have been subjected to various transformation losses like leaching, volatilization, immobilization and fixation of inorganic portion of nitrogen (Nanthakumar and Veeragavathatham, 2002) [13].

Available Phosphorus (P_2O_5)

The available phosphorus content of the soil showed(Table 3) variation from 14.43 to 20.90, 11.94 to 19.16, 10.70 to 17.66 and 8.21 to 15.18 kg ha^{-1} with an average values of 18.25, 16.33, 14.36 and 12.21 kg ha^{-1} at 30, 60, 90 DAT and after harvest of the brinjal crop, respectively. In general at all growth stages of brinjal crop available phosphorus content was observed to be the highest as a result of application of 25 % RDF and 75 % RDN through vermicompost (T_9) and it was closely followed by the integration of 50 % RDF and 50 % RDN through vermicompost (T_{10}). While, average available phosphorus status (P_2O_5) varied from 12.21 to 18.25 kg ha^{-1} was found to be low after harvest of brinjal. However, it was categorized as adequate (medium) at 30, 60 and 90 DAT of brinjal crop.

A critical look on data on available phosphorus status during various growth stages further revealed that in general available phosphorus content was found to be decreased with advancement in growth period of brinjal. Application of vermicompost and FYM in conjunction with chemical fertilizers showed significant variation in available phosphorus content of soil as compared to the control treatment (T_1). These results are in conformity with Sharma *et al.* (2009) [16]. In general, the lateritic soils are poor in available phosphorus content (Dongale 1993; Dongale and Kadrekar 1993) [4]. It may be due to the most of the phosphorus has been fixed. Phosphorus fixation capacity of the lateritic soils has been reported to be 91 to 99 % (Anonymous 1990) [1]. In general at all growth stages of brinjal crop available phosphorus content was observed to be the highest as a result of application of 25 % RDF and 75 % RDN through vermicompost (T_9) and it was closely followed by the integration of 50 % RDF and 50 % RDN through vermicompost (T_{10}). This might be attributed to the fact that application of organic matter leads to the formation of a coating on the sesquioxides; because of this the phosphate fixing capacity of soil was reduced in organic manure-treated plots. Similar results were also reported by Bhardwaj and Omanwar (1994) [3]. In addition to this the increase in available phosphorus content in soil might be due to higher phosphorus content of vermicompost. The release of organic acids during the decomposition process of vermicompost could be another reason for increase in phosphorus content in the soil. The increase in available phosphorus may be due to chelating effect of organic matter and organic matter lowered the Al-P and Fe-P in soil.

Available Potassium (K_2O)

A data on available K_2O at 30, 60, 90 DAT and after harvest showed (Table 3) variation in it's status from 310.46 to 383.04, 294.34 to 358.85, 263.42 to 322.56 and 232.51 to 288.96 kg ha^{-1} with an average values of 349.68, 326.63, 296.17 and 265.75 kg ha^{-1}. Available K_2O status was observed to be decreased with advancements of growth stages of brinjal. The integration of 25 % RDF along with 75 % RDN through vermicompost (T_9) registered the highest content of available potassium at all growth stages of the brinjal. It was closely followed by the application of 25 % RDF along with 75 % RDN through FYM (T_6) and combined application of 50 % RDF along with 50% RDN through vermicompost (T_{10}). In general, average available potassium status was found to be categorized as high at 90 DAT and after harvest. While, it was found to be very high at 30 and 60 DAT.

Available K_2O status was observed to be decreased with advancements of growth stages of brinjal. However, it was maximum in the treatments (T_6), (T_9) and (T_{10}) as compared to rest of the treatments. There was a buildup in available K_2O status as compared to its initial status (215.84 kg ha^{-1}). A close scrutiny of the data indicated that in general available K_2O content in all organic manure treated plots was found to be higher indicating typical lateritic soil of experimental plot. Similar findings were also reported by Ghuge *et al.* (2007). They opined that the combined application of 50 % RDF along with 50 % vermicompost @ 2.5 t ha^{-1} was responsible for more availability of K_2O (369.67 kg ha^{-1}) as compared to rest of the treatments. A close scrutiny of the data on available potassium content of the soil further indicated that the integration of 25 % RDF along with 75 % RDN through vermicompost (T_9) registered the highest content of available potassium at all growth stages of observations during growth period of brinjal. It was closely and statistically followed by the application of 25 % RDF along with 75 % RDN through FYM (T_6) and combined application of 50 % RDF along with 50% RDN through vermicompost (T_{10}). The higher availability of K in soil may be due to beneficial effect of organic manures on the reduction of potassium fixation; added organic matter interacted with K clay to release K from non-exchangeable fraction to the available pool. The reason attributed could be the organic and inorganic acids produced during decomposition of vermicompost which might have helped in the release of mineral bound insoluble potassium and also reduced the potassium fixation (Mohankumar and Gowda, 2010) [11]. Further, when acid soils are limed, exchangeable Al^{3+} is converted to insoluble Al $(OH)_3$. The reduction in exchangeable Al^{3+} reduces competition with K^+, enabling K^+ to compete with Ca^{2+} for vacant exchange sites. As a consequence, greater amount of K^+ can be adsorbed to CEC and leaching losses of K will also likely to be reduced (Tisdale *et al*., 1993) [17].

DTPA extractable micronutrient status

Available Iron (Fe)

Available Fe content was observed to be the lowest (32.73, 40.73, 44.73 and 49.73 mg kg^{-1}) and highest (46.20, 54.20, 60.20 and 65.53 mg kg^{-1}) in the treatments T_1 and T_9 at 30, 60, 90 DAT and after harvest of brinjal crop, respectively (Table 4). Further, there was slight but definite increase in the Fe status with advancement in growth period of brinjal. In general, average available Fe status at all growth period of observations showed variation from 37.71 to 56.56 mg kg^{-1} indicating higher Fe status than the sufficiency level.

In general, data on available Fe status at 30, 60, 90 DAT and after harvest indicated that the soil of experimental plot was typical lateritic soil. Further, there was slightly increase in the Fe status with advancement in growth period of brinjal. It might be due to slow release of Fe after mineralization of organic manures. Maximum available Fe content was observed during all growth stages in the treatment receiving 25% RDF+ 75% RDN through vermicompost (T_9). It was closely followed by the application of 25% RDF+ 75% RDN through FYM (T_6). The available Fe content in lateritic soils ranged from 9.0 to 58.37 mg kg^{-1} with an average value of 25.3 mg kg^{-1} (Anonymous 1990) [1]. Regarding high availability of Fe in lateritic soils, reported that the high content of available Fe may be due to accumulation of sesquioxides and also higher organic matter content, which keeps iron in complexes and available form. In general average Fe status at all growth stages of observations showed variation from 37.71 to 56.56 mg kg^{-1} indicating higher status than the sufficiency level of Fe. (Gajbhiye, 1985) [7]

Available Manganese (Mn)

At 30, 60, 90 DAT and after harvest available Mn showed variation from 25.61 to 49.13, 29.51 to 54.03, 34.24 to 56.76 and 37.61 to 62.13 mg kg^{-1} with an mean values of 38.43, 42.75, 46.21and 51.40 mg kg^{-1}, respectively (Table 4). Available Mn status was found to be maximum in the treatment (T_9) receiving 75 % RDN through vermicompost and 25 % RDF through chemical fertilizers during all growth stages of brinjal crop. It was closely followed by the combined application of 25 % RDF and 75% RDN through FYM (T_6). Further, there was a slight but definite build up in available Mn status with an advancement of growth period of brinjal. In general Mn content of soil during all growth periods of observations were found to be very high above the sufficiency level indicating a typical lateritic soil of the experimental plot. (Gajbhiye. 1985) [7]

In general, available Mn status during all the stages of growth of brinjal crop represented a typical lateritic soil of experimental plot. Available Mn status was found to be maximum in the treatment (T_9) receiving 75 % RDN through vermicompost and 25 % RDF through chemical fertilizers during all growth stages of brinjal crop indicating higher content of available Mn in vermicompost as compared to other organic sources. It was closely followed by the combined application of 25 % RDN through FYM (T_6). Further, there was a slight but definite buildup in available Mn status with an advancement of growth period of brinjal. Similar results were also reported by Babu *et al*. (2007) [2] and Gaidhani (2008) [6]. Regarding high availability of Mn in acid lateritic soils, Mehta and Patel (1967) [10] reported that the high concentration of available Mn might be due to decomposition and mineralization of organic matter due to warm and humid climate of the region.

Available Zn

The available Zn content at 30, 60, 90 DAT and after harvest showed variation from 1.39 to 2.39, 1.73 to 2.73, 2.01 to 3.01 and 2.46 to 3.46 mg kg^{-1} respectively (Table5). The highest content of available Zn at all the growth stages of brinjal crop was seen as a result of application of 25% RDF along with 75 % RDN through vermicompost (T_9) which was very closely followed by the application of 25% RDF along with 75 % RDN through FYM (T_6). The Zn content increased gradually from 30 DAT to harvest of the crop irrespective of the various treatment combinations. The average Zn content was 1.99, 2.33, 2.61 and 3.06 mg kg^{-1} at 30, 60, 90 DAT and after harvest of the crop, respectively indicating adequate supply of Zn in the lateritic soil of experimental plot. (Gajbhiye, 1985) [7].

In general, available Zn status was found to be improved with the advancement of growth period of brinjal crop at all growth stages of observations during brinjal crop. Further, treatment (T_9) receiving application of 75% RDN through vermicompost and 25% RDF through chemical fertilizers had shown the highest available Zn content at all growth stages indicating vermicompost as a rich source of Zn as compared to FYM and chemical fertilizers used in other treatment combinations. The highest content of available Zn content at all the growth stages of brinjal crop was seen as a result of application of 25% RDF along with 75 % RDN through vermicompost (T_9) which was very closely followed by the application of 25% RDF along with 75 % RDN through FYM (T_6). In the present study, it could be seen that the Zn content increased gradually from 30 DAT to harvest of the crop irrespective of the treatments. Tisdale *et al*. (1993) [17] reported that increasing soil temperature increases the availability of Zn to crops by increasing solubility and diffusion of Zn^{2+}. The available Zn content in lateritic soils ranged from 0.16 to 3.70 mg kg^{-1} with an average value of 0.98 mg kg^{-1} (Anonymous 1990) [1]. The results of the present investigation were in the close conformity with Gaidhani (2008) [6], Rewale (2014) [15] and Ghayal, (2016) [8].

Available Copper (Cu)

The highest available copper status (6.38, 7.21, 7.92 and 8.62 mg kg^{-1}) was found in the treatment (T_9) receiving application of 25% RDF through chemical fertilizers in conjunction with 75% RDN through vermicompost, while the lowest (5.09, 5.92, 6.63 and 7.33 mg kg^{-1}) was seen in the control treatment (T_1) at 30, 60, 90 DAT and after harvest of brinjal crop, respectively (Table5). The Cu content of soil shown a slight but gradual increase in it's status with increment in the growth period of brinjal crop. In general, average DTPA extractable Cu status at all growth stages of brinjal crop found to be above than the sufficiency level (Gajbhiye, 1985) [7].

The trends in available Cu content observed in the present investigation can further be substantiated by the fact that organic compounds in the soil solution are capable of chelating solution Cu^{2+}, which increases the solution Cu^{2+} concentration above that predicted by Cu mineral solubility (Tisdale *et al.,* 1993) [17]. Regarding high availability of Cu in acid lateritic soils, Mehta and Patel (1967) [10] reported that the high concentration of available Cu might be due to decomposition and mineralization of organic matter due to warm and humid climate of the region. While the available Cu content in lateritic soils ranges from 0.10 to 7.92 mg kg^{-1} with an average value of 4.17 mg kg^{-1} (Anonymous 1990) [1]. Rewale (2014) [15] and Ghayal (2016) [8] also observed an increase in the available Cu content with integration of vermicompost and chemical fertilizers on lateritic soils of Konkan.

Table 2: Effect of organic manures and inorganic fertilizers on Available nitrogen status (kg ha^{-1}) of soil

Tr. No.	Treatment	Available Nitrogen			
		Days After Transplanting			After harvest
		30	60	90	
T_1	Control (No NPK)	385.73	360.64	329.28	282.24
T_2	100% RDN through FYM	418.13	388.86	363.78	326.14
T_3	100% RDN through VC	425.45	395.14	373.18	335.55
T_4	100% RDF through inorganic fertilizers	435.90	398.27	354.37	316.74
T_5	80% RDF through inorganic fertilizers	430.68	392.00	351.23	304.19
T_6	25%RDF + 75% RDN through FYM	449.49	407.68	376.32	338.69
T_7	50% RDF + 50% RDN through FYM	451.58	404.54	373.18	348.10
T_8	75% RDF + 25% RDN through FYM	439.04	395.14	370.05	335.55
T_9	25% RDF+ 75% RDN through VC	464.13	413.95	385.73	354.37
T_{10}	50% RDF + 50% RDN through VC	456.81	407.68	376.32	344.96
T_{11}	75% RDF + 25% RDN through VC	448.45	401.41	370.05	338.69
Mean		436.85	396.85	365.77	329.57
S.E. (±)		4.105	3.782	3.679	4.188
CD (P=0.05)		12.11	11.16	10.85	12.35
Initial		295.13			

Table 3: Effect of organic manures and inorganic fertilizers on Available phosphorus and Available potassium status (kg ha^{-1}) of soil

T. No.	Treatment	Available Phosphorus				Available Potassium			
		Days After Transplanting			After harvest	Days After Transplanting			After harvest
		30	60	90		30	60	90	
T_1	Control (No NPK)	14.43	11.94	10.70	8.21	310.46	294.34	263.42	232.51
T_2	100% RDN through FYM	17.91	15.92	13.43	11.69	337.34	314.50	284.93	251.33
T_3	100% RDN through VC	18.16	16.42	14.68	12.94	348.10	324.80	295.68	266.11
T_4	100% RDF through inorganic fertilizers	17.42	14.93	13.19	10.20	356.16	334.21	301.06	274.18
T_5	80% RDF through inorganic fertilizers	16.67	14.18	12.19	9.95	350.78	322.56	288.96	260.74
T_6	25%RDF + 75% RDN through FYM	20.15	18.91	16.17	14.18	370.94	349.44	315.84	286.27
T_7	50% RDF + 50% RDN through FYM	19.41	17.66	15.92	13.19	353.47	327.94	291.65	263.42
T_8	75% RDF + 25% RDN through FYM	17.17	15.18	13.93	11.20	336.00	306.43	287.62	255.36
T_9	25% RDF+ 75% RDN through VC	20.90	19.16	17.66	15.18	383.04	358.85	322.56	288.96
T_{10}	50% RDF + 50% RDN through VC	19.90	18.41	16.42	14.68	362.88	342.72	319.87	286.27
T_{11}	75% RDF + 25% RDN through VC	18.66	16.92	14.68	12.94	337.34	317.18	286.27	258.05
Mean		18.25	16.33	14.36	12.21	349.68	326.63	296.17	265.75
S.E. (±)		0.717	0.600	0.567	0.514	6.484	6.944	6.401	6.103
CD (P=0.05)		2.11	1.77	1.67	1.52	19.13	20.48	18.88	18.00
Initial		12.57				215.84			

Table 4: Effect of organic manures and inorganic fertilizers on available DTPA extractable Fe and Mn status of soil (mg kg^{-1})

T. No.	Treatment	Fe				Mn			
		Days After Transplanting			After harvest	Days After Transplanting			After harvest
		30	60	90		30	60	90	
T_1	Control (No NPK)	32.73	40.73	44.73	49.73	25.61	29.51	34.24	37.61
T_2	100% RDN through FYM	36.93	43.93	49.93	55.93	35.45	40.35	43.08	48.45
T_3	100% RDN through VC	37.14	46.14	52.14	56.14	42.25	45.15	49.88	55.25
T_4	100% RDF through inorganic fertilizers	36.56	44.56	50.56	53.56	37.05	39.95	44.68	50.05
T_5	80% RDF through inorganic fertilizers	34.16	42.16	48.16	50.16	32.81	36.71	40.44	45.81
T_6	25%RDF + 75% RDN through FYM	43.15	51.15	57.15	62.15	45.74	48.31	54.04	59.41
T_7	50% RDF + 50% RDN through FYM	36.44	47.44	53.44	58.44	37.21	45.11	44.84	50.21
T_8	75% RDF + 25% RDN through FYM	34.91	44.91	50.91	54.91	38.17	42.07	45.80	51.17
T_9	25% RDF+ 75% RDN through VC	46.20	54.20	60.20	65.53	49.13	54.03	56.76	62.13
T_{10}	50% RDF + 50% RDN through VC	40.33	49.33	55.33	60.33	40.41	46.31	48.04	53.41
T_{11}	75% RDF + 25% RDN through VC	36.25	44.25	50.25	55.25	38.89	42.79	46.52	51.89
Mean		37.71	46.25	52.07	56.56	38.43	42.75	46.21	51.40
S.E. (±)		1.112	1.565	1.386	1.289	1.946	2.174	2.399	2.074
CD (P=0.05)		3.28	4.62	4.09	3.80	5.74	6.41	7.08	6.12

Table 5: Effect of organic manures and inorganic fertilizers on available DTPA extractable Zn and Cu status of soil (mg kg^{-1})

T. No.	Treatment	Zn				Cu			
		Days After Transplanting			After harvest	Days After Transplanting			After harvest
		30	60	90		30	60	90	
T_1	Control (No NPK)	1.39	1.73	2.01	2.46	5.09	5.92	6.63	7.33
T_2	100% RDN through FYM	1.85	2.19	2.47	2.92	5.56	6.39	7.10	7.80
T_3	100% RDN through VC	1.98	2.32	2.60	3.05	5.69	6.52	7.23	7.94
T_4	100% RDF through inorganic fertilizers	1.75	2.09	2.37	2.82	5.43	6.26	6.97	7.68
T_5	80% RDF through inorganic fertilizers	1.66	2.00	2.28	2.73	5.19	6.02	6.73	7.44
T_6	25%RDF + 75% RDN through FYM	2.30	2.64	2.92	3.37	6.29	7.12	7.83	8.53
T_7	50% RDF + 50% RDN through FYM	2.19	2.53	2.81	3.26	6.11	6.94	7.65	8.36
T_8	75% RDF + 25% RDN through FYM	2.05	2.39	2.67	3.12	5.86	6.69	7.40	8.10
T_9	25% RDF+ 75% RDN through VC	2.39	2.73	3.01	3.46	6.38	7.21	7.92	8.62
T_{10}	50% RDF + 50% RDN through VC	2.26	2.60	2.88	3.33	6.16	6.99	7.70	8.41
T_{11}	75% RDF + 25% RDN through VC	2.11	2.45	2.73	3.18	6.03	6.86	7.57	8.28
Mean		1.99	2.33	2.61	3.06	5.80	6.63	7.34	8.04
S.E. (±)		0.164	0.035	0.174	0.112	0.177	0.222	0.261	0.162
CD (P=0.05)		0.48	0.10	0.51	0.33	0.52	0.66	0.77	0.48

Conclusion

The results of the present investigation revealed that the application of 25 % RDF through inorganic fertilizers and 75 % RDN through vermicompost had shown it's influence on chemical properties of the soil indicating integration of organics and inorganics is a future need for sustaining soil fertility.

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