www.ThePharmaJournal.com
The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; 9(9): 557-563
© 2020 TPI
www.thepharmajournal.com
Received: 21-06-2020
Accepted: 19-08-2020

Impact of different manures on soil properties and yield of rice in lateritic soil of Konkan

SR Diwale, NB Gokhale, NH Khobragade, MR Wahane, RV Dhopavkar and AA Joke

SR Diwale
Department of Soil Science and Agril. Chemistry, Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

NB Gokhale
Department of Soil Science and Agril. Chemistry, Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

NH Khobragade
Department of Soil Science and Agril. Chemistry, Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

MR Wahane
Department of Soil Science and Agril. Chemistry, Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

RV Dhopavkar
Department of Soil Science and Agril. Chemistry, Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

AA Joke
Department of Soil Science and Agril. Chemistry, Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

Corresponding Author:
MR Wahane
Department of Soil Science and Agril. Chemistry, Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, India

Abstract

A field experiment was carried out to study the impact of different manures on soil properties and yield of rice in lateritic soil at Department of Agronomy, Dr.B.S. Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (Maharashtra) during *kharif* seasons of 2004, comprising thirteen treatment combinations where four sources of manures i.e. FYM, poultry manure, vermicompost and goat manure and three levels of manures i.e. @ 2.5, 5.0, 7.5 t ha^{-1} were applied, with one absolute control. The data revealed that application of poultry manure was observed to be superior source as compared to FYM, vermicompost and goat manure; whereas in case of levels, application of manures @ 10 t ha^{-1} to rice was found to be more effective than their lower levels and rest of the treatment combinations in view point of yield of rice, physico-chemical properties and nutrient status of soil.

Keywords: Rice, organic manures, yield, nutrient status, soil properties

Introduction

Rice (*Oryza sativa* L.) is widely grown in tropical and subtropical regions (Singh *et al.* 2012) [27], being one of the leading staple crop for half of the world's population. According to IRRI (2009) [13], rice is the staple food of more than three billion people in the world, most of who live in Asia. It is important energy source of more than half of the world and 65% of the Indian population (Liu *et al.* 2008) [20]. The production of rice in the world containing low levels of plant available macro and micro nutrients, reduces not only grain yield, but also nutritional quality. Low fertile soils are brought under cultivation due to high population pressure. To feed ever-rising world population, which is estimated to be 10 billion by the end of this century (Lal, 2009) [18], an increase in rice production per unit area is direly needed (Von Grebmer *et al.* 2008). Although high-yielding input-responsive varieties are available, a large yield gap exists between the farmers' fields and research stations in developing countries. In addition to adequate irrigation water, balanced supply of macro and micronutrients is vital for bridging this yield gap. After nitrogen (N), phosphorus (P) and potassium (K), widespread zinc (Zn) and other micronutrient deficiency has been found responsible for yield reduction in rice (Fageria *et al.* 2002) [11].

The nutrient deficiency is being paid more attention in recent times in areas where intensive agriculture is practiced. Depletion of nutrients in soil has been accelerated by increase of intensive cultivation with increased dependence on inorganic fertilizer and decreasing emphasis on the use of organic manures and in addition with use of high yielding varieties. On an average to produce one tonne of grain of high-yielding varieties of rice, remove about 22 kg N, 7 kg P_2O_5, 32 kg K_2O, 5 kg MgO, 4 kg CaO, 1 kg S and 40g Zn from the soil (Chaudhary *et al.* 2007) [8]. There is a need to ascertain and promote the uses of types of fertilizers required to correct the deficiency of all these nutrients especially the manures *viz.*, FYM, vermicompost, poultry manures, goat manure, etc. which helps in promoting yield and availability of several essential plant nutrients. About 90 % of plant available N and S, 50-60 % K, 30 % P and almost 70% of micronutrients reside in organic matter (Stevenson, 1982). Keeping in view the importance of manures, a field experiment was conducted to study the impact of different manure application on soil properties and rice productivity.

Materials and Methods

In order to evolve suitable nutrient management system for rice with respect to organic manure, a field experiment was conducted at Research Farm, Department of Agronomy, College of Agriculture, Dapoli during *kharif* 2004 in factorial randomized block design (FRBD) replicated thrice with thirteen treatment combinations comprising of manure sources (FYM, poultry manure, vermicompost and goat manure) and three levels of manures (5.0, 7.5 and 10.0 t ha^{-1}). The soil samples (initial and after harvest) were analyzed by following the standard procedure for physical and chemical parameter viz., pH, EC (dSm^{-1}) and OC (g kg^{-1}) by Jackson (1973) [14] available N (kg ha^{-1}) described by Subbiah and Asija (1956), available P (kg ha^{-1}) by Bray and Kurtz (1945) and available K (kg ha^{-1}) (Jackson 1973) [14], exchangeable Ca and Mg by Versenate method (Anonymous 1968) and Cation exchange capacity was determined as per the procedure given by Baruah and Barthakur (1999) [6]. The texture of the soil of experimental plot was clay loam with mean pH value of 6.3, electrical conductivity 0.05 dS m^{-1} in 1:2.5 soils: water solution, organic carbon 13.1 g kg^{-1}, with available nitrogen 340.0 kg ha^{-1}, available phosphorus 6.60 kg ha^{-1}, exchangeable potash 188.0 kg ha^{-1}, exchangeable bases Ca [2.1 cmol (p$^+$) kg^{-1}], Mg [1.4 cmol(p$^+$) kg^{-1}] and Cation exchange capacity of 8.8 [cmol (p$^+$) kg^{-1}].

Results and Discussion

Physico-chemical properties of soil

Application of different organic manures viz., FYM, poultry manure, vermicompost and goat manure with three levels (5.0, 7.5 and 10.0 t ha^{-1}) significantly increased soil pH, electrical conductivity and organic carbon where, application of poultry manure resulted into significant increase in soil pH (6.70), electrical conductivity (0.15 dS m^{-1}) and organic carbon (23.1 g kg^{-1}) over vermicompost, FYM and goat manure (Table 1, 2 and 3). Further, application of manures @ 10.0 t ha^{-1} significantly increased the soil pH by 0.08 and 0.05, EC by 0.046 and 0.013 dS m^{-1} and organic carbon (22.7 g kg^{-1}) in soil which was significantly superior to their lower levels of 5.0 t ha^{-1} and 7.5 t ha^{-1}. The interaction effect among the levels and sources of manures were found to be non significant in case of soil pH and significant soil EC (0.17 dS m^{-1}) and organic carbon (24.9 g kg^{-1}) recorded with the treatment receiving poultry manure @ 10.0 t ha^{-1} which was significantly superior to all other treatment combinations followed by poultry manure @ 7.5 t ha^{-1} and vermicompost @ 10.0 t ha^{-1}.

Table 1: Effect of different levels of organic manures on soil pH (1:2.5) after harvest of rice

Sources (S)	**Levels** (L) **(t ha^{-1})**			
	5.0	**7.5**	**10**	**Mean**
Absolute control (C)	-	-	-	6.30
FYM	6.54	6.56	6.62	6.57
Poultry manure	6.64	6.70	6.76	6.70
Vermicompost	6.60	6.61	6.66	6.62
Goat manure	6.60	6.60	6.65	6.62
Mean	6.60	6.62	6.67	
	Sources (S)	Levels (L)	Interaction (S x L)	C x (S, L & S x L)
SE±	0.007	0.006	0.009	0.01
CD (P=0.05)	0.020	0.017	NS	0.028

Table 2: Effect of different levels of organic manures on electrical conductivity (dS m^{-1}) of soil after harvest of rice

Sources	**Levels (t ha^{-1})**			
	5.0	**7.5**	**10.0**	**Mean**
Absolute control	-	-	-	0.058
FYM	0.087	0.098	0.118	0.101
Poultry manure	0.119	0.164	0.171	0.151
Vermicompost	0.105	0.146	0.159	0.137
Goat manure	0.100	0.135	0.147	0.127
Mean	0.103	0.136	0.149	
	Sources	Levels	Source x Levels	Cont. v/s Others
SE±	0.001	0.001	0.003	0.003
CD (P=0.05)	0.004	0.004	0.007	0.008

Table 3: Effect of different levels of organic manures on organic carbon content (g kg^{-1}) of soil after the harvest of rice

Sources (S)	**Levels** (L) **(t ha^{-1})**			
	5.0	**7.5**	**10**	**Mean**
Absolute control (C)	-	-	-	1.21
FYM	1.71	1.74	1.82	1.76
Poultry manure	2.03	2.41	2.49	2.31
Vermicompost	2.01	2.33	2.39	2.24
Goat manure	1.93	1.98	2.39	2.10
Mean	1.92	2.12	2.27	
	Sources (S)	Levels (L)	Interaction (S x L)	C x (S, L & S x L)
SE±	0.01	0.01	0.02	0.02
CD (P=0.05)	0.029	0.025	0.051	0.053

The rise in soil pH due to organic amendments appears to be related to the total calcium content of the organic manures and may be attributed to the self liming effect caused by the mineralization of C and release of bases (Hue, 1992) [12] and buffering effect of added bicarbonates and organic acids with carboxyl and phenolic hydroxyl groups (Sharpley and Moyer, 2000). The ability of poultry manure to increase soil pH was also attributable to the presence of basic cations in the poultry manure released upon microbial decarboxylation (Natsher and Schwetnmann, 1991) [23]. Laterite and lateritic soils which generally depleted of total soluble salts due to intensive leaching showed slight increase due to the application of organic manure during the period of study, due to the possible built up of the soluble nutrient drawn from manures on mineralization. Natsher and Schwetnmann (1991) [23] attributed increase in EC due to the salts in the poultry manure which are released during microbial decarboxylation.

The improvement in soil organic carbon in organic manures treated plots might be ascribed to direct addition of organic matter through organic manures and also due to addition of considerable amount of leaf litter of crops in the present cropping sequence. Newaj and Yadav (1994) [24] observed increase in content of organic carbon at end of all the cropping systems, being the maximum under pigeon pea-wheat-green gram cropping systems. Appavu and Saravanan (1999) [4] observed significantly increase in organic carbon content of soil by the addition of goat manures followed by poultry manure and farm yard manure under sorghum-soybean cropping sequence.

Availability of nutrients

The available N, P and K content of the post-harvest soil was significantly influenced by graded levels of different organic manures as compared to absolute control and revealed that the application of poultry manure registered maximum value of available N (392.0 kg ha^{-1}), available P_2O_5 (11.29 kg ha^{-1}) and available K_2O (367.0 kg ha^{-1}) followed by FYM, vermicompost, goat manure which was significantly superior over all other treatment combinations (Table 4, 5 and 6). The application of manures @ 10.0 t ha^{-1} to rice crop significantly increased the available N (389.0 kg ha^{-1}), available P (11.38 kg ha^{-1}) and available K (343.0 kg ha^{-1}) over their lower levels of 5.0 and 7.5 t ha^{-1}. Data revealed that interaction effects of manure sources and levels found to be significant, where the application of poultry manure @ 10.0 t ha^{-1} recorded the higher value of available N (408.0 kg ha^{-1}), available P (12.65 kg ha^{-1}) and available K (421.0 kg ha^{-1}) which was significantly superior to all other treatment combinations.

Table 4: Effect of different levels of organic manures on available nitrogen (kg ha^{-1}) of soil after the harvest of rice

Sources (S)	**Levels** (L) **(t ha^{-1})**			
	5.0	**7.5**	**10**	**Mean**
Absolute control (C)	-	-	-	320
FYM	362	367	371	367
Poultry manure	380	389	408	392
Vermicompost	368	380	395	381
Goat manure	365	378	382	375
Mean	369	378	389	
	Sources (S)	Levels (L)	Interaction (S x L)	C x (S, L & S x L)
SE±	0.54	0.49	0.98	1.02
CD (P=0.05)	1.65	1.43	2.85	2.97

Masthana Reddy *et al.* (2005) [22] also observed available N increased with graded levels of poultry manure. The increase in available N over control was also reported by Singh *et al.* (2000) [29] with FYM and poultry manure, Prakash *et al.* (2002) [25] FYM and vermicompost and Kharub and Chander (2008) [17] with graded levels as FYM for different crops. Further, the application of poultry manure, vermicompost, goat manure and FYM for nitrogen might have increased the microbial population leading to mineralization of organically bound N into plant available from.

Table 5: Effect of different levels of organic manures on available P_2O_5 content (kg ha^{-1}) of soil after the harvest of rice

Sources (S)	**Levels** (L) **(t ha^{-1})**			
	5.0	**7.5**	**10**	**Mean**
Absolute control (C)	-	-	-	6.51
FYM	8.21	9.15	10.20	9.19
Poultry manure	9.98	11.25	12.65	11.29
Vermicompost	9.85	10.95	11.36	10.72
Goat manure	9.79	10.47	11.30	10.52
Mean	9.46	10.46	11.38	
	Sources (S)	Levels (L)	Interaction (S x L)	C x (S, L & S x L)
SE±	0.02	0.01	0.03	0.03
CD (P=0.05)	0.05	0.04	0.09	0.09

Among sources of manures, poultry manure showed its superiority over rest of the sources followed by vermicompost. Similarly, graded levels of manures significantly increased the available P_2O_5 status of soil. Khan *et al.* (1984) [16] reported that the highest available phosphorous recorded in manure treated plots might be due to organic acids, which were released during the microbial decomposition of organic matter, which helped in the solubility of native insoluble phosphates, thus increasing the available phosphorous content in soil. Besides this, appreciable quantities of carbon dioxide released during the decomposition of organic matter might be formed into carbonic acid, which might have enhanced the solubility of phosphates. Applied organic matter leads to the formation of a coating on the sesquioxides; because of this the phosphate fixing capacity of soil was reduced in manure-treated plots. Similar results were reported by Bhardwaj and Omanwar (1994) [7].

Table 6: Effect of different levels of organic manures on available K_2O content (kg ha^{-1}) of soil after the harvest of rice

Sources (S)	**Levels** (L) **(t ha^{-1})**			
	5.0	**7.5**	**10**	**Mean**
Absolute control (C)	-	-	-	139
FYM	251	264	273	263
Poultry manure	305	376	421	367
Vermicompost	264	327	340	311
Goat manure	260	327	336	308
Mean	270	324	343	
	Sources (S)	Levels (L)	Interaction (S x L)	C x (S, L & S x L)
SE$\pm$	5.61	4.85	9.71	10.11
CD (P=0.05)	16.36	14.17	28.34	29.49

Abraham and Lal (2003) [1] reported increasing available K_2O status of soil due to application of organic manures along with cow urine foliar spray under black gram-wheat-green gram cropping system. 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. Similar beneficial effects of organics on available K were reported earlier in case of vermicompost by Jambhekar (1990) [15].

Madhavi and Reddy (1994) [21] reported 28.9 per cent increase in available K_2O over control due to application of poultry manure @ 4.5 t ha^{-1}. Awodun *et al.* (2007) [5] also observed increase in available K_2O content of soil with increasing levels of goat manure. This might be assigned to increased release of nutrients in soil from native pool as well as their residual effects. Organic acid and chelates produced during decomposition of organic residues and phosphorus tied up as insoluble Ca, Fe and Al form may be released as soluble form (Dhillion and Dev 1986) [10].

Exchangeable bases

Graded levels of different organic manures significantly influenced the exchangeable Ca and Mg of the post-harvest soil compared to absolute control. It is seen from the data that the application of poultry manure recorded maximum value of exchangeable Ca (2.72 cmol (p+) kg^{-1}) and exchangeable Mg (1.96 cmol (p+) kg^{-1}), which was significantly superior over all other treatment combinations (Table 7 and 8). The application of manures @ 10.0 t ha^{-1} to rice crop significantly increased the exchangeable Ca (2.74 cmol (p+) kg^{-1}) and exchangeable Mg (2.00 cmol (p+) kg^{-1}), over their lower levels of 5.0 and 7.5 t ha^{-1}. The interaction between manure sources and levels found to be significant, where the application of poultry manure @ 10.0 t ha^{-1} recorded the higher value of exchangeable Ca (2.78 cmol (p+) kg^{-1}) and exchangeable Mg (2.13 cmol (p+) kg^{-1}), which was significantly superior to all other treatment combinations.

Table 7: Effect of different levels of organic manures on exchangeable calcium [cmol (p+) kg^{-1}] content in soil after harvest of rice

Sources (S)	**Levels** (L) **(t ha^{-1})**			
	5.0	**7.5**	**10**	**Mean**
Absolute control (C)	-	-	-	2.03
FYM	2.47	2.63	2.72	2.61
Poultry manure	2.62	2.77	2.78	2.72
Vermicompost	2.57	2.68	2.77	2.67
Goat manure	2.53	2.67	2.68	2.63
Mean	2.55	2.69	2.74	
	Sources (S)	Levels (L)	Interaction (S x L)	C x (S, L & S x L)
SE$\pm$	0.01	0.01	0.02	0.02
CD (P=0.05)	0.03	0.02	0.05	0.05

By and large, a gradual increase in exchangeable calcium was noticed with graded levels of different organic manures. Adeleye *et al.* (2010) [2] observed increase in exchangeable calcium and magnesium with poultry manure applied at 10.0 t ha^{-1}. Srikant *et al.* (2000) [31] recorded exchangeable calcium and magnesium varied from 4.00 to 4.85 and 2.22 to 4.10 cmol (p^+) kg^{-1} respectively after harvest of cowpea grown in *Alfiso*l. Awodun *et al.* (2007) [5] also observed linear increased in exchangeable Ca and Mg with graded levels of goat manure. The increase in exchangeable calcium and magnesium due to organic manures may be ascribed to the higher content of these nutrients in these manures; it could be attributed to the effect of organic acids produced during the process of decomposition which enhances the solubility of native Ca and Mg and its retention by the organic colloids. The increased availability is also due to the chelates of higher stability with organic ligands which have lower susceptibility to adsorption fixation and precipitation in the soil.

Table 8: Effect of different levels of organic manures on exchangeable magnesium [cmol(p+) kg^{-1}] content in soil after harvest of rice

Sources (S)	**Levels** (L) **(t ha^{-1})**			
	5.0	**7.5**	**10**	**Mean**
Absolute control (C)	-	-	-	1.23
FYM	1.67	1.82	1.92	1.80
Poultry manure	1.82	1.93	2.13	1.96

Vermicompost	1.77	1.90	2.02	1.90
Goat manure	1.72	1.83	1.93	1.83
Mean	1.75	1.87	2.00	
	Sources (S)	Levels (L)	Interaction (S x L)	C x (S, L & S x L)
SE±	0.01	0.01	0.02	0.02
CD (P=0.05)	0.03	0.02	0.05	0.05

Cation Exchange Capacity

The increasing trend for CEC was noticed with addition of organic manures over absolute control (Table 9). The highest CEC of soil observed with application of poultry manure [16.88 cmol(p$^+$) kg^{-1}] was significantly superior to vermicompost [16.02 cmol(p$^+$) kg^{-1}], goat manure [15.44 cmol(p$^+$) kg^{-1}] and FYM [14.67 cmol(p$^+$) kg^{-1}].

Table 9: Effect of different levels of organic manures on CEC [cmol (p+) kg^{-1}] of soil after harvest of rice

Sources (S)	**Levels** (L) **(t ha^{-1})**			
	5.0	**7.5**	**10**	**Mean**
Absolute control (C)	-	-	-	10.00
FYM	12.83	14.67	16.50	14.67
Poultry manure	15.60	16.17	18.87	16.88
Vermicompost	14.67	15.87	17.53	16.02
Goat manure	13.93	15.37	17.03	15.44
Mean	14.26	15.52	17.48	
	Sources (S)	Levels (L)	Interaction (S x L)	C x (S, L & S x L)
SE±	0.08	0.07	0.14	0.14
CD (P=0.05)	0.23	0.20	0.40	0.42

Data further reveals that the increasing levels of manures significantly increased the soil CEC higher being in the treatment receiving manures @ 10.0 t ha^{-1} [17.48 cmol(p$^+$) kg^{-1}]. The interaction effect among the sources and levels were found to be significant. The highest CEC of soil at harvest recorded with poultry manure @ 10.0 t ha^{-1} [18.87 cmol (p$^+$) kg^{-1}] was significantly superior to the rest of the treatment combinations.

The profound increase in CEC due to organic manure might be due to humic acid content of organic matter. The humic acid was found to contain functional groups, that would from the source of negative charge and they could have contributed towards CEC of the soil. Similar reports were reported earlier by Lax (1991) [19] who observed that the incorporation of soil organic matter induced the exchange capacity due to the various functional groups namely carboxyl, phenolic etc. present in the humic substances of soil organic substances. Poultry manure might be content higher amount of humic acid as compared to other manures. Hence, it recorded higher CEC in present study. The beneficial effect of organic manures in increasing CEC of soil has also been reported by Prakash *et al.* (2002) [25]. Further, Rohtas Kumar (2006) [26] and Adeleye *et al.* (2010) [2] observed increase in CEC due to application of FYM and poultry manure for different soils.

Yield of rice

Perusal of data in Table 10 and 11 revealed that application of organic manures recorded significant increase in grain yield, which was increased from 19.47 to 23.24 q ha^{-1} (i.e. ranged from 108 to 129 %), however, the increase in straw yield due to organic manures varied from 15.85 to 18.77 q ha^{-1} over absolute control. Singh *et al.* (2007) [28] recorded 114.0 to 116.8 per cent higher rice grain yield with organic amendments over control.

Table 10: Effect of different levels of organic manures on grain yield of rice (q ha^{-1})

Sources (S)	**Levels** (L) **(t ha^{-1})**			
	5.0	**7.5**	**10.0**	**Mean**
Absolute control (C)	-	-	-	17.97
FYM	34.22	39.54	40.62	38.13
Poultry manure	37.86	41.18	44.58	41.21
Vermicompost	36.27	40.63	41.30	39.40
Goat manure	33.86	38.32	40.41	37.44
Mean	35.55	39.92	41.66	
	Sources (S)	Levels (L)	Interaction (S x L)	C x (S, L & S x L)
SE±	0.07	0.06	0.13	0.13
CD (P=0.05)	0.22	0.19	0.38	0.39

Application of manures from 5.0 to 10.0 t ha^{-1} resulted into significant and graded increase in grain yield of rice. The grain (35.55 to 41.66 q ha^{-1}) and straw yield (43.91 q ha^{-1}) was found to be increased from with the increasing levels of manures which was significantly superior over all treatment. Interaction effects among various treatments were found to be significant. The data revealed that treatment receiving poultry manure @ 10.0 t ha^{-1} gave the highest grain (44.58 q ha^{-1}) and straw (46.48 q ha^{-1}) yield of rice, which were significantly superior to all other treatment combinations.

From data, it was also revealed that applications of FYM and goat manure gave lower grain yield as compared to poultry manure and vermicompost, which resulted in growth and yield components. The beneficial response of organic manures over absolute control to yield might be attributed to the availability of sufficient amount of plant nutrients throughout the growth period of crops, improvement of soil environment resulting in higher root proliferation leading to better absorption of moisture and nutrient, plant vigor and superior yield attributes and ultimately higher yield (Sinha *et al.* 1981) [30]. The reason for distinct response to poultry manure over rest of the organic materials may be attributed to the high status of available nutrients and optimum C/N ratio in poultry manure (Yadav and Jha 1988) [34], which gave better yield attributes, dry matter production and thus, resulted in higher yield. Further, the poultry manure had both urinary and fecal excretion; hence, the fertilizer value of poultry manure was nearly three times higher than FYM (Devegowda 1997) [9].

Table 11: Effect of different levels of organic manures on straw yield (q ha^{-1}) of rice

Sources (S)	**Levels** (L) (t ha^{-1})			
	5.0	**7.5**	**10.0**	**Mean**
Absolute control (C)	-	-	-	25.86
FYM	40.97	42.86	42.62	42.15
Poultry manure	42.56	44.86	46.48	44.63
Vermicompost	41.08	43.48	44.30	42.95
Goat manure	40.62	42.27	42.25	41.71
Mean	41.31	43.37	43.91	
	Sources (S)	Levels (L)	Interaction (S x L)	C x (S, L & S x L)
SE±	0.13	0.11	0.23	0.24
CD (P=0.05)	0.38	0.33	0.66	0.69

Conclusion

The results obtained from this trial indicated that the application of poultry manure @ 10 t ha^{-1} to rice crop found to be more effective over rest of the treatment combinations under rain fed conditions, resulted to highest grain and straw yield, soil physico-chemical properties and nutrient status of soil in well drained clay loam soil of Konkan.

Reference

1. Abraham T, Lal RB. Strategies for INM Technology in sustainable edaphic-cultivar management for a legume based (black gram- wheat- green gram) cropping system for Inceptisols in the NEPZ. Crop Research. 2003; 26(1):17-25.
2. Adeleye, EO Ayeni, LS, Ojeniyi SO. Effect of paltry manure on soil physico-chemical properties, leaf nutrient contents and yield of yam (*Dioscorea rotundata*) on Alfisol in Southwestern Nigeria Journal of American Science. 2010; 6(10):871-878.
3. Anonymous. Diagnosis and Improvement of Saline and Alkali Soils. Handbook No.60 U.S.D.A. Washington, 1968, 94.
4. Appavu K, Saravanan A. Effect of organic manures and tillage practices on soil physical properties and crop yields under sorghum- soybean cropping sequence. The Madras Agricultural Journal. 1999; 86(10-12):516-565.
5. Awodun MA, Omonijo LI, Ojeniyi SO. Effect of goat dung and NPK fertilizer on soil and leaf nutrient content, growth and yield of pepper. International Journal of Soil Science. 2007; 2(2):142-147.
6. Baruah TC, Barthakur HP. A Textbook of Soil Analysis. Vikas Publishing House, Pvt. Ltd., New Delhi, 1999.
7. Bharadwaj V, Omanawar PK. Long term effect of continuous rotational cropping and fertilization on crop yields and soil properties –II Effects on EC, pH, organic matter and available nutrients of soil. Journal of the Indian Society of Soil Science. 1994; 42(3):387-392.
8. Chaudhary SK, Thakur SK, Pandey AK. Response of wetland rice to nitrogen and zinc. Oryza, 2007; 44(1):31-34.
9. Devegowda G. Poultry manure excreta and other wastes as a source of organic manures. In: Training Course on Organic Farming UAS, GKVK, Bangalore, India. 1997, 7-11.
10. Dhillon NS, Dev G. Effect of applied P, farm yard manure and moisture regimes on transformation of inorganic phosphorus. Journal of the Indian Society of Soil Science, 1986; 34:605-607.
11. Fageria NK, Baligar VC, Clark RB. Micronutrients in crop production. Advances of Agronomy, 2002; 77:185-268.
12. Hue, NV. Correcting soil acidity of a highly weathered Ultisols with chicken manure and sewage sludge. Communications in Soil Science and Plant Analysis, 992; 23:241.
13. IRRI (International Rice Research Institute). Rough rice production by country and geographical region-USDA. Trend in the rice economy In: world rice statistics. Retrieved from: www.irri.org/science/ricestat, 2009.
14. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, 1973, 134-182.
15. Jambhekar HA. Effect of Vermicompost as a bio-fertilizer on grape vines. VIIIth Southern Regional Conference on Microbial Inoculant Pune, 1990.
16. Khan G, Gupta SK, Banerjee SK. Integrated management of organic manure and fertilizer nitrogen for rice. Journal of the Indian Society of Soil Science, 1984; 32(1):123.
17. Kharub AS, Chander S. Effect of organic farming on yield, quality and soil-fertility status under basmati rice (*Oryza sativa*)-wheat (*Triticum aestivum*) cropping system. Indian Journal of Agronomy. 2008; 53(3):172-177.
18. Lal R. Laws of sustainable soil management. Agronomy and Sustainable Development, 2009; 29:7-10.
19. Lax A. Cation exchange capacity induced in calcareous soils in fertilization with manures. Soil Science. 1991; 16:174-178.
20. Liu G, Bernhardt L, Jia H, Wamishe A, Jia Y. Molecular characterization of the recombinant inbred line population derived from a Japonica–Indica rice cross. Euphytica, 2008; 159:73-82. http://dx.doi.org/10.1007/s10681-007-9459-6
21. Madhavi BL, Suryanarayan Reddy M. Effect of poultry manure on soil fertility and maize yield. National Seminar on Development in Soil Science, 1994; 94:285-287.
22. Masthana Reddy BG, Pattar PS, Kuchanur PH. Response of rice to poultry manure and graded levels of NPK under

irrigated conditions. Oryza, 2005; 42(2):109-111.

23. Natsher M, Schwetnmann N. Proton buffering in organichorizons of acid forest soils. Geoderma, 1991; 48:93-106.
24. Newaj R, Yadav DS. Changes in physico- chemical properties of soil under intensive cropping systems. Indian Journal of Agronomy, 1994; 39(3):373-378.
25. Prakash YS, Bhadoria PBS, Rakshit Amitava Comparative efficacy of organic manures on the changes in soil properties and nutrient availability in an Alfisol. Journal of the Indian Society of Soil Science, 2002; 50(2):21-221
26. Rohtas Kumar. Influence of long term farmyard manure and nitrogen application in bajra-wheat cropping system and fractions of P, K, Zn and Cu in soil. Ph. D. Dissertation, Department of soil science, CCS Haryana Agricultaral University, Hissar India, 2006.
27. Singh AK, Chandra N, Bharati RC. Effects genotypes and planting time on phenology and performance of rice (*Oryza sativa* L.). Vegetos, 2012; 25:151-156.
28. Singh AK, Tripathi PN, Singh R. Effect of rhizobium inoculation, nitrogen and phosphorus levels on growth, yield and quality of kharif cowpea [*Vigna, unguiculata* (L.) Walp].Crop Research, 2007; 33(1):71-73.
29. Singh GR, Pandya KS, Chaure NK, Parihar SS, Choudhary KK. Soil fertility, Productivity and profitability of rice under different organic manures. Oryza, 2000; 37(3):208-212.
30. Sinha NP, Prasad B, Ghosh AB. Effect of continuous use of fertilizers on yield and nutrient uptake in wheat-soybean-potato cropping system.Journal of the Indian Society of Soil Science, 1981; 29:537-542.
31. Srikanth K, Srinivasmurthy CA, Siddaramapp R, Ramakrishna Parama VR. Direct and Residual effect of enriched composts, FYM, vermicompost and fertilizers on properties of an Alfisol. Journal of the Indian Society of Soil Science, 2000; 48(3):496-499.
32. Subbiah BV, Asija GI. A rapid procedure for the estimation of available nitrogen in soil. Current Science, 1956; 25(8):259-260.
33. Von Grebmer K, Fritschel H, Nestorova B, Olofinbiyi T, Pandya-Lorch R, Yohannes Y. Global Hunger Index. The Challenge of Hunger Bonn, Washington D.C., Dublin, 2008.
34. Yadav K, Jha KK. Effect of poultry manure and sewage sludge on the humification and functional groups of humic substances. Journal of the Indian Society of Soil Science. 1988; 36:439-444.