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SOIL SUSTAINABILITY AND NUTRITIONAL QUALITY OF ORGANICALLY GROWN RICE UNDER FARMERS FIELDS OF NAGPUR DISTRICT

N.N.Ghube[1], R.M.Ghodpage[2], W.P.Badole[3], S.S.Balpande[4] and V.G.Nagdeote[5]

ABSTRACT

A research work was carried out on organic rice grown in farmer's field of Nagpur district during the year 2016-17 with the objective to evaluate the soil properties, nutritional quality and yield of organically grown rice in farmer's field. Organic carbon was recorded between 6.2 to 11.1 g kg^{-1} under the study which an increased by 4.35 to 44.14 per cent at different locations. Soil available N was highest (295.5 kg ha^{-1}) with the application of FYM @ 7 t ha^{-1} + Ghanjivamrut @ 500 kg ha^{-1}, which an increased by 30.64 per cent at Gangner location, whereas, maximum available P was recorded 20.36 kg ha^{-1} with the application of FYM @ 7 t ha^{-1} + Ghanjivamrut @ 500 kg ha^{-1} to rice over inorganic fertilizer. The value of soil available K varied from 224 to 324.81.7 kg ha^{-1} with the application of inorganic and continuous use of different organic inputs among different locations which comes under medium to high category. The concentration of nutritional quality parameters like protein, starch, lysine, carotene and tryptophan of rice grain varied from 7.00-8.35 per cent, 51-54 per cent, 3.38-5.02 g 16 g^{-1} N, 0.16-0.38 µg g^{-1} and Tryptophan 0.51-0.62 g16 g^{-1}, respectively were influenced by the application of various types of organic and inorganic inputs. The highest grain yield of rice was obtained 6.5 t $ha^{-1}$with the application of balanced amount of inorganic fertilizer at Umri location. However, grain yield of rice reduced by 13.46 to 26.90 with the use of different doses of organic resources over inorganic fertilizer. Soil properties of EC, organic carbon and available N were positively correlated with yield of rice crop.
(Key words: Nutritional quality, organic rice, crop yield)

INTRODUCTION

Management and use of nutrient enriched inputs has become an important component of sustainable agriculture and received much interest in the recent years as a means of increasing soil organic carbon and serves as the potential source of nutrients to play great role for promoting growth and providing immunity in plant growth system. Awareness of soil health and environmental issues in agriculture promotes production of organic food which is emerging as an attractive source of rural income generation. In India, about 5.28 lakh ha area is under organic farming includes certified and area under organic conversion, the productivity of crops in organic farming is lower by 9.2 per cent as compared to conventional farming (Ramesh *et al*., 2010). According to the estimates 201MT of crop residues, 287 MT of dung, 184 MT of rural compost and 12.2 MT of city compost are produced in India $year^{-1}$ which can provide 9 MT of nutrients the quantity equivalent to about 40% of nutrients supplied by fertilizers at present (Bhumbla, 2010). Organic farming has been considered as one of the best options for protecting sustaining soil health and productivity and is gaining lot of importance in present-day agriculture. Various workers have tried different types of organic inputs to find out their effectiveness, efficiency and cost benefits impacts as compared to the inorganic fertilizers. Very little work has been reported on impact of various liquid and solid organic inputs and its quantity on soil health, nutritional quality and yield of rice. Considering the above facts, the present study was done to understand the evaluation of various liquid and solid organic resources on soil sustainability, nutritional quality and rice crop grown on farmer's field.

MATERIALS AND METHODS

The four locations viz.,Umri, Gumthala, Chacher and Gangner, villages of Nagpur district were selected for assessment of soil fertility and grain quality of rice of organic growing farmer's field (organic farms) of Nagpur district. The quantity of organic manure (t ha^{-1}) and organic liquids (l ha^{-1}) used by the farmers is presented in

1. P.G. Student, SSAC Section, College of Agriculture, Nagpur
2. Professor (CAS), SSAC Section, College of Agriculture, Nagpur
3. Assoc. Professor, SSAC Section, College of Agriculture, Nagpur
4. Asstt. Professor, SSAC Section, College of Agriculture, Nagpur
5. Assoc. Professor, Agronomy Section, College of Agriculture, Nagpur

table 1. These organic sources in nutrient management practices were applied from 5- 15 years continuously.Soil samples from the top 0-20 cm depth were collected after harvest of rice crop from each certified farms and from nearby conventional farms (adjacent to organic farms) having similar soils. The soil samples were analyzed by adopting standard methods for various soil properties in order to assess the fertility status of soil. Organic carbon was assessed by wet oxidation method (Walkley and Black, 1934). Available nitrogen was analysed by using Kjeldahl's method (Subbiah and Asija, 1956), phosphorus was estimated by using vanado molybdate yellow colour method (Jackson,1973) and potassium was estimated from diacid extract by using flamephotometer (Jackson,1973). Protein% was calculated by the total N % in grain multiplied by the factor 6.25. The protein yield (kg ha^{-1}) was calculated by the formula given below

Protein yield (kg ha^{-1})= protein % x yield (q ha^{-1}).Nutritional quality of rice grain were estimated by the calorimetric method given by Hodge and Hofreiter (1962) and Tasai (1972).The doses of organic manure or liquid fertilizers were not applied similar at the studied locations. The organic manure was applied in soil before sowing whereas organic liquid fertilizers were applied in the soil before and after sowing (3-4 times) for rice. Fertilizers applied between 7 to 10 t ha^{-1} through FYM, Biola, Bioguru and Bhusampada 250 g $acre^{-1}$, Ghanjivamrut @ 500 kg ha^{-1}, Jivamrut was applied @ 500 lit. ha^{-1} and paddy straw 5 t ha^{-1}. Dose of inorganic fertilizers i.e. nitrogen, phosphorus and potassium were applied by farmers through DAP, Urea, 20:20:10,18:18:10 and MOP.They were not applied the recommended dose of nutrients.Nutrients doses of inorganic were different at studied locations.

Preparation of Amrutpani: It was prepared in proportion of 10 kg cow dung +10 litre cow urine.+ 1 kg Jaggary . Mixtures were prepared in earthen pots, stirred daily for 10 minutes upto 7 days. Mixtures were diluted 10 times with water and applied ha^{-1} basis.

Preparation of Jivamrut: It was prepared with cow dung 10 kg + cow urine 10 litre+ Jaggary 2 kg + gram flour 2 kg and half kg soil from bunds(organic rich soil) with 100 litre water. Above mixture were poured in the plastic drums and mixing all materials continue until they are thoroughly mixed. It was stirred properly 2-3 times with wooden stick in a day for increasing aeration and enhancing microbial activity and keep it for one week. It was diluted in 100 litre water with 10 litre jivamrut and applied @ 500 litre ha^{-1}.The whole process was made and left in shade for increase the activity of microorganism.(prepared by farmers).

Preparation of Ghanaajimrut: Make a pit size of 10:5:2.5 feet dimension. Take 500 kg fresh FYM and 50 litre jivamrut in the pit. Cover the mixture properly with any straw material available, wait for one week for decomposition of material. After one week mix the mixture of FYM and jivamrut properly. Follow the similar process for 3-4 times at an interval of one week. If procedure followed properly, 40-45 days is required to complete the material of ghanajivamrut.

RESULTS AND DISCUSSION

Fertility status of soil after harvest of rice

The data of available nitrogen of soil after harvest of organic rice are presented in table 2. Soil available nitrogen, phosphorus and potassium were observed between 204.9 to 323.9, 12.52 to 20.36 and 224 to 324.8 kg ha^{-1} with the application of organic and inorganic inputs. The increase in available N content of soil might be attribute to the more N fixation in soil on account of higher microbial population, leaving to better mineralization of organic N with other nutrient application. Ganapathi *et al.*(2014) resulted an improvement in available N,P,K and OC with 100 % N through FYM + green manuring in situ incorporation for paddy.

With the use of different organic inputs viz., FYM @ 10 t ha^{-1}, FYM@ 7 t ha^{-1} + Ghanjivamrut 500 kg ha^{-1} there was an maximum in available P content in soil to the tune of 18.74, 26.43, 41.20 and 24.70 per cent over the application of chemical fertilizers alone at location of Umri, Gumthala, Chacher and Gangner, respectively which indicates the solubalizing action of organic acids and its availability. Build up of available P with the application of inorganic fertilizer and crop residue was ascribed to the release of organic acid, during decomposition which in turn helped in releasing native P through solubalizing action of the acids and thus reduces the P fixing capacity of soil which ultimately helps in release of sufficient quantity of plant available P (Sharma and Subehia, 2014). Srilata and Sharma (2015) reported that continuous use of organic manure coupled with fertilization had build-up of available phosphorus in the treatment where it was applied and slightly depletion those, where it was not applied. Available K in soil was observed between 224 to 324.8 kg ha^{-1} with continuous use of organic inputs among different locations which comes under medium to high category.

In the present study, the soil organic carbon ranged from 6.2 to 11.1 g kg^{-1} in the rice crop treated with various doses of organic inputs and chemical fertilizers alone. When the continuous use of FYM (7 t ha^{-1}) + Ghanjivamrut 500 kg ha^{-1} to rice crop from 12 years at Gumthala location recorded the highest organic carbon content in soil (11.1 g kg^{-1}) which may be attributed to highest contribution of organic carbon to the soil in the form of solid source and also its rapid mineralization under temperate conditions. The application of FYM 10 t ha^{-1}+Biola and Bioguru 250 g $acre^{-1}$ from 7 years, FYM (7 t ha^{-1}) + Ghanjivamrut 500 kg ha^{-1} from12-13 years resulted an increase in the organic content of soil to the tune of 14.63 to 35.78,19.48 to 44.14, and 14.49 to 39.80 per cent at Umri, Gumthala and Gangner, respectively over the use of inorganic fertilizer alone to rice, whereas Chacher location not much difference was found in organic carbon.

Nutritional quality of rice

Results pertaining to nutritional quality of rice grain due to application of different organic and inorganic sources are presented in table 2.From the data, protein per

cent of rice grain varied from the lowest value of 7.00 per cent under organic rice (FYM 10 t ha^{-1}, Biola and Bioguru 250 g $acre^{-1}$each) to highest level of 8.35 with the application of FYM 10 tha^{-1} + Jivamrut 500 l ha^{-1} since 7- 8 years at Umri and Gangner location. Tiwari *et al.* (2001) found that application of FYM @ 10 t ha^{-1} produced higher protein content of rice grain. The highest protein yield was obtained (492.7 kg ha^{-1}) with the application of inorganic fertilizer at Umri location. Protein yield was observed from 256.0 to 492.7 kg ha^{-1} in the present study. Starch per cent in rice grain varied from 51 to 54 per cent under organic rice treated with different resources.

The concentration of Lysine varied from the lowest value of 3.38 g16 g^{-1} N under organic rice (FYM 10 t ha^{-1} + Jivamrut 500 l ha^{-1}) at Gangner location to highest level of 5.02 g16 g^{-1} N with the application of FYM @10 t ha^{-1} at Umri location. The data revealed that, the continuous application of organic source *viz.,* FYM (10 t ha^{-1}), Biola and Bioguru (250 g $acre^{-1}$), Bhusampada (250 g $acre^{-1}$) + FYM (10 t ha^{-1}), FYM (10 t ha^{-1}), FYM (7 t ha^{-1}) + Ghanjivamrut 500 kg ha^{-1}, FYM 10 t ha^{-1} + Jivamrut 500 l ha^{-1} and Paddy Straw (5 t ha^{-1}) for years 5 to 15, respectively led to a slightly increase in lysine content in some locations over the application of inorganic fertilizer alone (adjacent area of organic field). The value of lysine varied from 3.50 to 4.41 g16 g^{-1} N with average mean of four locations 3.92 g16 g^{-1} N was recorded under different doses of inorganic fertilizer applied to rice cultivation at different locations.

The concentration of carotene in rice grain varied from the lowest value of 0.16µg g^{-1} under organic rice (FYM 7 t ha^{-1} + Ghanjivamrut 500 kg ha^{-1}) and inorganic fertilizers at Umri to highest level of 0.38 µg g^{-1} with the application of FYM 10 tha^{-1} + Jivamrut 500 lit. ha^{-1} at Chacher location. Nghia *et al.* (2006) stated that the amounts of total carotenoid in golden rice grains were ranging from 0.81 - 1.37 ìg g^{-1} of milled grains, it was observed that the amount of carotenoid content in grains seemed to be more stable when stored at 40^0C than being stored at room temperature condition. The content of tryptophan in rice grain ranged between the value of 0.51 g16 g^{-1} N to highest level of 0.62 g16 g^{-1} N with the application of various organic and inorganic inputs. The value of tryptophan varied from 0.52 to 0.56 g16 g^{-1} N was recorded under different doses of inorganic fertilizer applied to rice crop at different locations. Banerjee *et al.* (2011) reported that the tryptophan levels varied from 0.36-0.88 g16 g^{-1} N, the mean being 0.642 g l6 g^{-1} N. Among the land races containing high levels of lysine, the tryptophan content ranged from 0.256 to 0.86 g 16 g^{-1} N, the average being 0.514.

Yield of rice (t ha^{-1})

The grain yield of rice was recorded between 4.7 to 5.5, 4.2 to 5.2, 4.0 to 5.0, and 3.2 to 5.2 with the mean of 5.2, 4.7, 4.5 and 4.3 t ha^{-1} in location of Umri, Gumthala, Chacher and Gangner, respectively with the application of various organic sources in terms of solid/ liquid inputs i.e. FYM (10 t ha^{-1}), Biola and Bioguru (250 g $acre^{-1}$), Bhusampada (250 g $acre^{-1}$) + FYM (10 t ha^{-1}), FYM (10 t ha^{-1}), FYM (7 t ha^{-1}) + Ghanjivamrut 500 kg ha^{-1}, FYM 10 t ha^{-1} + Jivamrut 500 lit.ha^{-1}, Paddy Straw (5 t ha^{-1}), respectively.

With the application of inorganic fertilizer, the highest grain yield of rice was recorded 6.5 t ha^{-1} at Umri location (Table 3). It is clear from the data that, the decreased of grain yield of rice under the use of organic inputs by 19.78, 16.72, 13.46, and 26.90 per cent with Umri, Gumthala, Chacher and Gangner, respectively over the application of inorganic fertilizer. Nishan *et al.* (2016) reported that loss ofthe grain yield of the rice to the tune of 15.25 per cent in organically grown rice (100% RDN through FYM + VC + NC) over integrated nutrient management treatment (90:45:45) NPK kg ha^{-1} + FYM 5 t ha^{-1}). Balpande *et al.* (2013) reported that application of manurial liquids significantly influenced the yield of wheat. Basha and Basavarajappa (2016)reported that the application of 100:50:50 kg NPK ha^{-1} increased the grain yield of rice by 10.58 per cent over the application of jivamrut @ 500 litre ha^{-1} at 30, 60 and 90 DAS.

From the data of correlation, soil properties of electrical conductivity, organic carbon and available nitrogen were positively correlated with the yield of rice crop (Table 4). The nitrogen was positively correlated with electrical conductivity and organic carbon in the present study. Das *et al.* (2014) reported that integrated nutrient management approach brought about a positive influenced on organic carbon, soil available nutrient status, yield and uptake of nutrients by autumn rice.

Table 1. Effect on fertility status of soil after harvest of rice as influenced by various organic inputs

	Locations	Available N (kg ha^{-1})	+ /- over inorganic %	OC (g kg^{-1})	+ /- over inorganic %	Available P (kg ha^{-1})	+ /- over inorganic %	Available K (kg ha^{-1})	+ /- over inorganic %
	crop								
Umari	Rice-1[a]	319.5	+20.22	10.9	+35.78	15.60	+4.68	246.4	-2.99
	Rice-2[b]	290.3	+12.19	8.2	+14.63	17.20	+13.54	280.0	+9.37
	Rice -3[c]	323.9	+21.30	10.8	+35.19	16.80	+11.49	274.4	+7.52
	Rice -4[c]	287.6	+11.37	8.5	+17.65	18.30	+18.74	263.2	+3.58
	Rice -5[d]	279.7	+8.87	8.2	+14.63	17.32	+14.15	252.0	-0.70
	Rice -6[c]	292.2	+12.77	9.6	+27.08	15.54	+4.31	263.2	+3.58
	Rice -7[c]	306.5	+16.84	9.6	+27.08	15.82	+6.01	259.4	+2.17
	Mean	299.9		9.4	--	16.65		262.6	
	Inorganic	254.9		7.0	--	14.87		253.7	
Gumthala	Rice -1[d]	315.9	+17.86	11.1	+44.14	15.40	+18.70	263.2	+7.50
	Rice -2[e]	281.2	+7.73	8.6	+27.91	14.70	+14.82	313.6	+22.36
	Rice -3[d]	274.4	+5.44	7.7	+19.48	13.90	+9.92	302.4	+19.49
	Rice -4[c]	287.3	+9.69	8.7	+28.74	15.60	+19.74	291.2	+16.39
	Rice -5[c]	277.2	+6.40	8.3	+25.30	14.56	+14.01	324..8	+25.04
	Rice -6[c]	287.2	+9.66	7.9	+21.52	15.83	+26.43	299.0	+18.58
	Rice -7[e]	287.17	+9.65	7.8	+20.51	11.44	-9.44	301.0	+19.11
	Mean	287.20		8.5	--	14.49		299.3	
	Inorganic	259.4		6.2	--	12.52		243.4	
Chacher	Rice -1[e]	287.1	+13.01	9.2	+4.35	13.44	+10.94	224.0	-21.29
	Rice -2[d]	300.1	+16.77	9.3	+5.38	20.36	+41.20	313.6	+13.37
	Rice -3[e]	291.2	+14.23	8.6	-2.33	15.68	+23.66	308.0	+11.79
	Rice -4[d]	287.3	+13.07	8.5	-3.53	15.68	+23.66	313.8	+13.42
	Rice -5[f]	288.3	+13.37	7.7	-14.29	16.80	+28.75	324.8	+16.35
	Rice -6[e]	280.4	+10.93	7.8	-12.82	14.78	+19.01	296.8	+8.48
	Rice -7[d]	309.2	+19.22	9.2	+4.35	12.88	+7.07	268.8	-1.07
	Mean	291.9		8.6	--	15.66		292.8	
	Inorganic	249.7		8.8	--	11.97		271.6	
Gangner	Rice -1[d]	295.5	+30.64	9.8	+39.80	16.40	+8.17	319.2	+17.03
	Rice -2[e]	287.5	+28.71	8.3	+28.92	17.30	+12.94	319.2	+17.03
	Rice -3[d]	295.5	+30.64	8.8	+32.95	20.00	+24.70	302.4	+12.42
	Rice -4[e]	276.3	+25.82	7.7	+23.38	15.60	+3.46	296.8	+10.76
	Rice -5[f]	257.3	+20.34	6.9	+14.49	16.93	+11.04	291.2	+9.05
	Rice -6[e]	264.4	+22.50	7.5	+21.33	16.82	+10.46	305.7	+13.38
	Rice -7[d]	260.9	+21.44	7.5	+21.33	13.96	-7.88	308.0	+14.01
	Mean	276.7		8.0	--	16.71		306.0	
	Inorganic	204.9		5.9	--	15.06		264.8	

a = FYM (10 t ha^{-1})+Biola and Bioguru (250 g acre^{-1} each),

b = Bhusampada (250 g acre-^{1}+FYM 10 t ha^{-1}), c= FYM (10 t ha^{-1}),

d = FYM (7 t ha^{-1}) +Ghanjivamrut 500 kg ha^{-1},e = FYM 10 t ha^{-1} + Jivamrut 500 lit. ha^{-1},

f = Paddy Straw (5 t ha^{-1})

Table 2. Influence of different organic nutrients inputs on nutritional quality of rice

Locations		Protein (%)	Protein yield, (kg ha^{-1})	Starch (%)	Lysine (g16g^{-1} N)	Carotene (µgg^{-1})	Tryptophan (g16 g^{-1} N)
	Crop						
Umri	Rice-1[a]	7.00	385.0	52.00	4.72	0.25	0.52
	Rice-2[b]	7.21	338.9	52.00	3.98	0.22	0.54
	Rice -3[c]	8.00	440.0	51.20	4.12	0.37	0.56
	Rice -4[c]	7.44	386.9	51.19	5.02	0.35	0.55
	Rice -5[d]	7.38	369.0	52.42	3.88	0.19	0.59
	Rice -6[c]	7.40	384.8	51.76	4.94	0.30	0.55
	Rice -7[c]	7.72	416.9	51.19	4.07	0.29	0.56
	Mean	7.45	387.4	51.68	4.39	0.28	0.55
	Inorganic	7.58	492.7	51.50	3 .50	0.16	0.54
Gumthala	Rice -1[d]	7.29	379.1	52.15	4.77	0.29	0.51
	Rice -2[e]	7.52	376.0	52.00	4.40	0.18	0.55
	Rice -3[d]	8.01	376.5	51.23	3.58	0.32	0.51
	Rice -4[c]	7.71	362.4	51.61	4.05	0.21	0.55
	Rice -5[e]	7.60	319.2	51.42	3.92	0.19	0.60
	Rice -6[c]	7.62	365.8	51.68	3.74	0.36	0.54
	Rice -7[e]	7.6	334.4	51.00	4.50	0.25	0.52
	Mean	7.62	358.1	51.58	4.14	0.25	0.54
	Inorganic	7.82	430.1	51.67	4.41	0.34	0.52
Chacher	Rice -1[e]	8.19	385.0	53.00	4.72	0.38	0.61
	Rice -2[d]	8.12	341.0	52.00	4.39	0.24	0.57
	Rice -3[e]	8.11	397.0	51.23	3.89	0.23	0.60
	Rice -4[d]	7.85	353.3	52.00	3.71	0.18	0.55
	Rice -5[f]	8.00	336.0	51.44	4.05	0.34	0.61
	Rice -6[e]	8.05	322.0	51.93	3.75	0.17	0.58
	Rice -7[d]	8.11	406.0	52.00	4.99	0.16	0.57
	Mean	8.06	362.7	51.94	4.21	0.24	0.58
	Inorganic	7.51	390.5	52.11	3.95	0.32	0.54
Gangner	Rice -1[d]	7.92	411.8	54.00	3.96	0.23	0.55
	Rice -2[e]	8.12	381.6	54.00	4.78	0.33	0.62
	Rice -3[d]	8.11	340.6	52.23	4.82	0.28	0.60
	Rice -4[e]	8.35	375.8	53.00	3.38	0.30	0.57
	Rice -5[f]	8.00	416.0	52.44	3.49	0.18	0.60
	Rice -6[e]	8.10	299.7	53.13	3.66	0.26	0.58
	Rice -7[d]	8.00	256.0	54.00	3.99	0.27	0.56
	Mean	8.09	347.9	53.26	4.01	0.26	0.58
	Inorganic	8.18	491.0	52.93	3.85	0.35	0.56

a = FYM (10 t ha^{-1})+Biola and Bioguru (250 g acre^{-1} each)
b = Bhusampada (250 g acre^{-1}) + FYM(10 t ha^{-1}), c = FYM (10 t ha^{-1})
d = FYM (7 t ha^{-1}) + Ghanjivamrut 500 kg ha^{-1} e = FYM 10 t ha^{-1} + Jivamrut 500 lit. ha^{-1}
,f = Paddy Straw (5 t ha^{-1})

Table 3. Effect of various organic and inorganic inputs on yield (t ha^{-1}) of rice

Locations		Organic sources applied since	Yield (t ha^{-1})	% yield Increased / decreased over inorganic fertilizer
	Crop			
Umri	Rice-1[a]	7 Years	5.5	-15.38
	Rice-2[b]	8 Years	4.7	-27.69
	Rice -3[c]	5 Years	5.5	-15.38
	Rice -4[c]	14 Years	5.2	-20.00
	Rice -5[d]	12 Years	5.0	-23.08
	Rice -6[c]	11 Years	5.2	-20.00
	Rice -7[c]	10 Years	5.4	-16.92
	Mean	-	5.2	-19.78
	Inorganic	14 Years	6.5	-
	Rice -1[d]	13 Years	5.2	-6.38
Gumthala	Rice -2[e]	10 Years	5.0	-10.64
	Rice -3[d]	5 Years	4.7	-17.02
	Rice -4[c]	7 Years	4.7	-17.02
	Rice -5[e]	15 Years	4.2	-27.66
	Rice -6[c]	12 Years	4.8	-14.89
	Rice -7[e]	9 Years	4.4	-23.40
	Mean	-	4.7	-16.72
	Inorganic	15 Years	5.5	-
	Rice -1[e]	12 Years	4.7	-9.61
Chacher	Rice -2[d]	11 Years	4.2	-19.23
	Rice -3[e]	7 Years	4.9	-5.76
	Rice -4[d]	6 Years	4.5	-13.46
	Rice -5[f]	9 Years	4.2	-19.23
	Rice -6[e]	8 Years	4.0	-23.07
	Rice -7[d]	14 Years	5.0	-3.84
	Mean	-	4.5	-13.46
	Inorganic	12 Years	5.2	-
	Rice -1[d]	12 Years	5.2	-13.33
Gangner	Rice -2[e]	11 Years	4.7	-21.67
	Rice -3[d]	7 Years	4.2	-30.00
	Rice -4[e]	8 Years	4.5	-25.00
	Rice -5[f]	15 Years	5.2	-13.33
	Rice -6[e]	12 Years	3.7	-38.33
	Rice -7[d]	14 Years	3.2	-46.67
	Mean	-	4.3	-26.90
	Inorganic	11 Years	6.0	-

Table 4. Correlation between the chemical properties of soils and yield of rice

	Yield (t ha^{-1})	pH	EC (dSm^{-1})	OC (gkg^{-1})	Ava. N (kg ha^{-1})	Ava. P (kg ha^{-1})	Ava. K (kg ha^{-1})
Yield (t ha^{-1})	1						
pH	0.354	1					
EC (dSm^{-1})	0.420*	0.218	1				
Organic Carbon (g kg^{-1})	0.602**	0.295	0.370	1			
Available. N (kg ha^{-1})	0.587**	0.254	0.399*	0.897**	1		
Available. P (kg ha^{-1})	-0.057	-0.291	-0.022	0.117	0.202	1	
Available. K (kg ha^{-1})	-0.531	-0.391	-0.341	-0.477	0.397	0.205	1

** Significant at 1% level * Significant at 5% level

REFERENCES

Balpande, S. S., R. M. Ghodpage, M. M. Raut and P.H.Kausadikar, 2013. Effect of manurial Liquids on soil microbiota, productivity and economics of wheat. J. Soils and crops, **23** (1):226-230.

Banerjee, S., G. Chandel, N. Mandal, B.M. Meea and T. Saluja, 2011. Assessment of nutritive value in milled rice grain of some Indian rice landraces and their molecular characterization. Bangladesh J. Agril. Res. **36** (3)

Basha, S. Jaffar and R. Basavarajappa, 2016. Studies on organic and inorganic nutrient management practices for sustainable production of aerobic rice. J. Soils and crops, **26** (1):14-20.

Bhumbla, D. R. 2010. Role of Fertilizers in food grain production. J. Indian Soc. Soil Sci. **58**: 89-97.

Das, A., R. Lal, D.P. Patel, P.G, Idapuganti, Jayanta Layek, S.V. Nagchand, P.K. Ghosh, Jurisandhya Bordolai and Manoj Kumar, 2014. Effect of tillage and biomass on soil quality and productivity of low land rice cultivation by small scale farmers in North Eastern India. Soil and tillage research,**143**: 50-58.

Ganapathi, K. S., Niranjana, Y. Vishwanathshetty and H. M. Chindanandappa, 2014. Effect of organic farming on productivity of rice and soil fertility under alfisol of southern transition zone of Karnataka, Green farming, **5** (5): 833-835.

Hodge, J. E. and D. T. Hofreiter, 1962 Method in carbohydrate chemistry, Academic press, New York.

Jackson, M. L. 1973. Soil Chemical Analysis, Prentice Hall of India, pvt. Limited, New Delhi.

Nghia, Pham Trung, Dong Thanh Liem, Tran Vu Hai and Tran Thi Cuc Hoa, 2006. Effect of storage conditions on total carotenoid content in golden rice grains. Omon rice, (**14**): 18-27.

Nishan, M. A., L. Girijadevi and V. L. Geethakumari, 2016. Yield and economics of organic nutrition in direct seeded rices. Green farming, **7** (3): 659-662.

Sharma, V. and S. K. Subehia, 2014. Effect of long term INM on rice- wheat production and soil properties in North-Western Himalaya. J. Indian Soc. Soil Sci., **62** (3): 248-254.

Srilata, M. and S. H. Kumar Sharma, 2015. Influence of long term use of fertilizer and manure on available nutrient status of organic phosphorous in soil under continuous rice-rice cropping system. Indian J. Advance Res. **3** (6): 960-964.

Subbiah, B. V. and G. L. Asija, 1956. A rapid procedure for the estimation of available nitrogen in the soil. Current Sci. **25**:259-260.

Ramesh P., N. R. Panwar, A. B. Singh, S. Ramana, Sushil Kumar Yadav, Rahul Shrivastava and A. Subba Rao, 2010. Status of organic farming in India. Current Sci. **98**(9):1190.

Tasai, M. A., 1972. Use of p-nitrophenyl phosphate for assay of soil phosphtase activity. Soil Bio. Biochem. **1**: 301-307.

Tiwari, V. N., Hari Singh, Hari and R. M Upadhyay, 2001. Effect of biocides, organic manure and blue green algae on yield and yield attributing characteristics of rice and soil productivity under sodic soil condition, J. Indian Soc. Soil Sci. **49** (2): 332-336.

Walkley, N.M. and A. I. Black, 1934. Estimation of organic carbon by chromic acid titration method. Soil Sci. **25**. 259-263.

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