

Effect of Different Sources and Time of Application of Organic Manures on Microbial Population, Root Volume, Root Dry Weight and Soil Nutrient Status of Aerobic Rice (*Oryza sativa* L.)

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Abstract

A field experiment was conducted during *kharif* of 2009. The initial status of available N, P₂O₅ and K₂O of the experimental site was 248.5, 26.8 and 202.8 kg ha, respectively. The variety used was Thanu (KMP-101). The results of the field experiment showed that application of vermicompost equivalent to 10 tonnes of FYM + 100% N equivalent through jeevamrutha recorded significantly higher microbial population (24.23 × 10⁶ CFU/g, 3.07 × 10⁵ CFU/g, 6.12 × 10⁵ CFU/g, 8.00 × 10⁶ CFU/g and 5.90 × 10⁶ CFU/g, of total bacteria, fungi, actinomycetes, nitrogen fixers and P solubilizers, respectively), which was on par with poultry manure equivalent to 10 t FYM + jeevamrutha at 100% N equivalent basis (21.50 × 10⁶ CFU/g, 5.43 × 10⁵ CFU/g, 7.53 × 10⁶ CFU/g and 5.73 × 10⁶ CFU/g, of total bacteria, actinomycetes, nitrogen fixers and P solubilizers, respectively). Application of recommended dose of fertilizers (100 : 50 : 50 kg N : P : K/ha) along with 10 tonnes of FYM/ha recorded significantly higher root volume (65.3 and 59.3 cc at 90 DAS and at harvest, respectively). Application of recommended dose of fertilizers (100 : 50 : 50 kg N : P : K/ha) along with 10 tonnes of FYM/ha recorded significantly higher root dry weight (6.51 and 6.03 g at 90 DAS and at harvest, respectively).

Key words : Microbial population, Root volume, Root dry weight, Biodigester liquid, Jeevamrutha.

Rice production is the most water consuming system and utilizes about 60% of total available irrigation water. More than half of the water used for irrigation in India is shared by rice. Although rice is water loving, increasing the area under rice faces the twin problems of water scarcity and soil salinization. Thus, there is a need to find out alternate means of rice cultivation which require less water. Aerobic rice assumes greater importance in the light of the water scarcity and increasing demand for rice. Although the use of fertilizers promises increase in productivity, the indiscriminate and imbalanced use of fertilizers affects the yield, soil health and environment. Now the focus of agriculture is to evolve ecologically sound nutrient management practices. Organic farming is one such approach. The farmers use several organic sources with various levels of nutrients. Hence, it is necessary to evaluate the different sources of organic manures for standardizing the recommendation to farmers. With this view, the present study was made for achieving maximum production.

Methods

A field experiment was conducted at Zonal Agricultural Research Station, Visweshwaraiah Canal Farm, Mandya, University of Agricultural Sciences, Bengaluru during *kharif* of 2009. The soil of the experimental site was red sandy loam with neutral pH (6.53) and low in organic carbon (0.45%). The initial status of available N, P₂O₅ and K₂O of the experimental site was 248.5, 26.8 and 202.8 kg/ha, respectively. The experiment was laid out in a randomized complete block design with 11 treatments replicated thrice.

Detail of treatments and the corresponding symbols used during the study are as follows. T₁ : Recommended package of practice (100 : 50 : 50 NPK/ha + 10 tonnes of FYM), T₂ : 10 tonnes of FYM/ha as a basal dose + 100% N equivalent through cattle urine, T₃ : 10 tonnes of FYM/ha as a basal dose + 100% N equivalent through biodigester liquid, T₄ : 10 tonnes of FYM/ha as a basal dose + 100% N equivalent

Table 1. Microbial population initial and after harvest of the aerobic rice as influenced by various organic sources.

Treatments	Total bacteria no. × 10 ⁶ CFU/g	Fungi no. × 10 ⁵ CFU/g	Acti- nomycetes no. × 10 ⁵ CFU/g	Nitrogen fixers no. × 10 ⁶ CFU/g	P so- lubilizers no. × 10 ⁶ CFU/g
T ₁ Recommended package of practice	18.00	1.92	4.93	10.17	9.07
T ₂ FYM 10 t/ha as a basal dose + cattle urine	17.72	2.39	3.57	8.03	9.50
T ₃ FYM 10 t/ha as a basal dose + biodigester liquid	17.53	2.32	3.83	7.37	10.20
T ₄ FYM 10 t/ha as a basal dose + jeevamrutha	19.33	2.92	4.57	16.47	15.00
T ₅ Vermicompost equivalent to 10 t of FYM + cattle urine	18.80	2.75	4.62	17.03	15.80
T ₆ Vermicompost equivalent to 10 t of FYM + biodigester liquid	19.60	2.96	4.50	17.23	16.20
T ₇ Vermicompost equivalent to 10 t of FYM + jeevamrutha	24.23	3.07	6.12	18.50	19.50
T ₈ Poultry manure equivalent to 10 t of FYM + cattle urine	16.90	2.50	3.81	9.53	6.50
T ₉ Poultry manure equivalent to 10 t of FYM + biodigester liquid	17.47	2.20	3.30	4.50	7.13
T ₁₀ Poultry manure equivalent to 10 t of FYM + jeevamrutha	21.50	2.03	5.43	18.13	18.90
Initial population	4.0	0.5	1.5	2	1.5
SE ±	1.08	0.15	0.42	0.45	1.14
CD at 5%	3.23	0.45	1.25	1.36	3.42

though jeevamrutha, T₅ : Vermicompost equivalent to 10 tonnes of FYM + 100% N equivalent through cattle urine, T₆ : Vermicompost equivalent to 10 tonnes of tonnes of FYM + 100% N equivalent through biodigester liquid, T₇ : Vermicompost equivalent to 10 tonnes of FYM + 100% N equivalent through jeevamrutha, T₈ : Poultry manure equivalent to 10 tonnes of FYM + 100% N equivalent through cattle urine, T₉ : Poultry manure equivalent to 10 tonnes of FYM + 100% N equivalent through biodigester liquid, and T₁₀ : Poultry manure equivalent to 10 tonnes of FYM + 100% N equivalent through jeevamrutha. Application of liquid manures was made at two splits at 40 DAS and DAS as a top dress.

The land of the experimental site was prepared by ploughing twice mechanically with mould board plough and leveled with harrow. The variety used for sowing was Thanu (KMP-101). The required quantities of different organic manures based on the nitrogen content were applied as per the treatment to different plots, 15 days before sowing and the treatments were imposed. Liquid manures like jeevamrutha

and biodigested liquid were prepared and applied as a top dress; where as cattle urine was collected one day before application and used as a top dress. Different organic manures were applied based on the nitrogen content; FYM (0.51), vermicompost (1.35), poultry manure (1.96), cattle urine (0.26), biodigested liquid (0.43) and jeevamrutha (0.28).

Media used to analyze the microbial population are bacteria-soil extract agar media, fungi-sperbers media, actinomycetes, N fixers, N free extract media and P solubilizers.

Results and Discussion

Microbial Population

Application of vermicompost equivalent to 10 t of FYM +jeevamrutha at 100% N equivalent basis recorded significantly higher microbial population (24.23×10^6 CFU/g, 3.07×10^5 CFU/g, 6.12×10^5 CFU/g, 8.00×10^6 CFU/g and 5.90×10^6 CFU/g, of total bacteria, fungi, actinomycetes, nitrogen fixers and P solubilizers, respectively), which was at par with poul-

Table 2. Root volume and root dry weight as influenced by various organic sources in aerobic rice.

Treatments	Root volume (cc)		Root dry weight (g)	
	90 DAS	At harvest	90 DAS	At harvest
T ₁ Recommended package of practice	65.34	59.32	6.51	6.03
T ₂ FYM 10 t /ha as a basal dose + cattle urine	47.77	45.57	4.43	4.37
T ₃ FYM 10 t/ha as a basal dose + biodigester liquid	49.88	46.50	5.05	5.11
T ₄ FYM 10 t/ha as a basal dose + jeevamrutha	48.24	46.07	4.97	4.86
T ₅ Vermicompost equivalent to 10 t of FYM + cattle urine	51.55	47.55	5.14	5.10
T ₆ Vermicompost equivalent to 10 t of FYM + biodigester liquid	58.94	54.80	5.63	5.52
T ₇ Vermicompost equivalent to 10 t of FYM + jeevamrutha	53.52	52.31	5.11	5.35
T ₈ Poultry manure equivalent to 10 t of FYM + cattle urine	51.95	50.81	5.27	5.14
T ₉ Poultry manure equivalent to 10 t of FYM + biodigester liquid	62.29	56.07	6.24	5.89
T ₁₀ Poultry manure equivalent to 10 t of FYM + jeevamrutha	55.85	53.34	5.43	5.37
SE ±	4.12	2.35	0.41	0.25
CD at 5%	12.35	7.05	1.23	0.74

try manure equivalent to 10 t of FYM + jeevamrutha at 100% N equivalent basis (21.50×10^6 CFU/g, 5.43×10^5 CFU/g, 7.53×10^6 CFU/g and 5.73×10^6 CFU/g, of total bacteria, actinomycetes, nitrogen fixers and P solubilizers, respectively). This might be due to jeevamrutha which might helped to improve the soil chemical and biological properties leading to overall improvement in soil health in long run. Similar views were expressed by Mondal et al (1). The reason ascribed for improved nutrient status with increased level of jaggery and pulse flour and decreasing in the level of incubation period could be difference in the microbial activity (2). Similar observation on positive role of sugar on microbial activity was documented by Buenaventurada and Tokiwa (3). Majumdar et al. (4) inferred that application of urine to the soil resulted in increased microflora of soil. Jeevamrutha was able to improve the microbial when supplied on N basis. Use of Jeevamrutha with vermicompost was also helpful in improving the microbial population. These observations indicate that repeated use of jeevamrutha would help in enhanced bacterial activity and ultimately improves soil fertility. Further continuous use of jeevamrutha preferably with vermicompost can improve microbial activity in soil and these improving the fertility in short run and have not indicated yield advantage (2). The increased microbial biomass was mainly attributed to high microbial activity (5).

Root Volume and Root Dry Weight

Application of recommended dose of fertilizers

(100 : 50 : 50 kg N : P : K/ha) along with 10 tonnes of FYM/ha recorded higher root volume (65.34 and 59.32 cc at 90 DAS and at harvest, respectively) and root weight (6.51 and 6.03 g at 90 DAS and at harvest, respectively). However, it was on par with poultry manure equivalent to 10 t of FYM + biodigester liquid at 100% N equivalent basis, vermicompost equivalent to 10 t of FYM + biodigester liquid at 100 % N equivalent basis, poultry manure equivalent to 10 t of FYM + jeevamrutha at 100% N equivalent basis and vermicompost equivalent to 10 t of FYM + jeevamrutha at 100% N equivalent basis treatments. Massive root system in contact with larger surface area of the soil might have absorbed more amount of moisture and nutrients supplied by the different organic manures (FYM, vermicompost and poultry manure, liquid organic manures viz. cattle urine, biodigester liquid and jeevamrutha) and also with chemical fertilizers. Similar findings were given by Kasbe et al. (2).

Soil Nutrient Status

Different organic sources did not significantly influence the organic carbon content, pH and EC of soil after harvest of aerobic rice. Significantly higher amount of nitrogen (272.66 kg/ha), phosphorus (37.23 kg/ha) and potassium (211.55 kg/ha) found in soil after harvest of the crop was observed with FYM 10 t/ha as a basal dose + cattle urine at 100% N equivalent basis. Significantly lower amount of nitrogen (255.22

Table 3. Total nutrient uptake (kg/ha) as influenced by different sources of organic manures in aerobic rice at harvest.

Treatments	pH	EC (ds/m)	OC (%)	Nitrogen (kg/ha)	P ₂ O ₅ (kg/ha)	K ₂ O (kg/ha)
Initial status of soil	6.53	0.29	0.45	248.50	26.8	202.8
T ₁ Recommended package of practice	6.54	0.30	0.45	255.22	29.76	206.30
T ₂ FYM 10 t/ha as a basal dose + cattle urine	6.52	0.28	0.46	272.66	37.23	211.55
T ₃ FYM 10 t/ha as a basal dose + biodigester liquid	6.53	0.28	0.46	267.34	34.50	207.66
T ₄ FYM 10 t ha as a basal dose + jeevamrutha	6.53	0.27	0.48	271.19	35.47	209.34
T ₅ Vermicompost + cattle urine	6.53	0.28	0.47	269.23	33.80	206.33
T ₆ Vermicompost + biodigester liquid	6.52	0.28	0.47	259.53	29.83	209.39
T ₇ Vermicompost + jeevamrutha	6.52	0.28	0.47	262.77	31.60	205.13
T ₈ Poultry manure + cattle urine	6.51	0.28	0.46	265.44	32.87	206.44
T ₉ Poultry manure + biodigester liquid	6.53	0.27	0.48	262.40	30.06	207.15
T ₁₀ Poultry manure + jeevamrutha	6.51	0.28	0.48	261.32	31.40	206.33
SE ±	0.33	0.02	0.03	2.98	1.06	0.95
CD at 5%	NS	NS	NS	8.93	3.9	2.86

kg/ha) and phosphorus (29.76 kg/ha) in soil after harvest of the crop was observed with recommended dose of fertilizers (100 : 50 : 50 kg N : P : K/ha) along with 10 tonnes of FYM/ha. This might be due to higher grain and straw yields of crop, which might have resulted in extraction of most of the soil nutrients. The poultry manure integration with biodigester liquid might have helped to improve the soil physical, chemical and biological properties leading to overall improvement in soil health in the long run. Similar views are expressed by Mondal et al. (1). In general application of organic manures like poultry manure at higher dose than the recommendation improved the NPK status of soil. It was mainly due to mineralization of nitrogen from organic manures through increased activity of soil organisms (6). The results are in conformity with the findings of Subramanian and Kumarswamy (7). Poultry manure appeared to contain higher concentration of macro and micronutrients that contributed for higher solubility and nutrient uptake. Similar views were expressed by Keelara (8), and Suresh and Ramasubba Reddy (9).

Conclusion

Application of vermicompost equivalent to 10 t of FYM + jeevamrutha at 100% N equivalent basis recorded significantly higher microbial population and helps in improving the fertility of soil. To achieve the

sustainability in terms of yield ecosystem there is a need to apply organic manures like FYM, vermicompost and poultry manure along with liquid organic manures like cattle urine, biodigester liquid and jeevamrutha. Continuous application of liquid organic manures along with bulky manures is essential for achieving the sustainability.

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