RESEARCH PAPER International Journal of Agricultural Sciences, Vol. 7 Issue 1 (January, 2011) : 193-196

Effect of different sources and time of application of organic manures on yield attributes, yield and economics of aerobic rice (*Oryza sativa* L.)

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ABSTRACT

A field experiment was conducted during *Kharif* 2009 at Zonal Agricultural Research Station, V.C. Farm, Mandya, University of Agricultural Sciences, Bengaluru. The initial status of available N, P_2O_5 and K_2O of the experimental site was 248.5, 26.8 and 202.8 kg ha^{-1}, respectively. The variety used was Thanu (KMP-101). The results of the field experiment indicated that significantly higher number of productive tillers per hill (28.02), number of filled grains per panicle (140.2) and thousand grain weight (22.78 g) recorded with recommended dose of fertilizer (100:50:50 kg N:P:K ha^{-1}) + 10 tonnes of FYM ha^{-1}. Application of recommended dose of fertilizer (100:50:50 kg N:P:K ha^{-1}) + 10 tonnes of FYM ha^{-1} recorded significantly higher grain yield (40.49 q ha^{-1}) and straw yield (46.35 q ha^{-1}). However, it was at 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. Significantly higher net return (Rs.28267) as well as higher benefit cost ratio (3.68) was recorded with poultry manure equivalent to 10 t of FYM + biodigester liquid at 100 % N equivalent basis.

Rajanna, G.A., Murali, K., Nayak, Pradeep, Lakshmipathy, R.N., Gopakalli, Pradeep and Paramesh, V. (2011). Effect of different sources and time of application of organic manures on yield attributes, yield and economics of aerobic rice (*Oryza sativa* L.). *Internat. J. agric. Sci.*, **7**(1): 193-196.

Key words : Aerobic rice, Organic manures, Yield, Economics

INTRODUCTION

Rice (*Oryza sativa* L.) occupies a pride place among the food crops cultivated in the world. The world rice production in 2008-09 was 610 m. t. cultivated over an area of 147 m ha with the productivity of 3.75 t ha^{-1}. India has the largest area among rice growing countries and stands second in production. India produces 97.0 m t of rice in an area of 43.18 m ha with the productivity of 2101 kg ha^{-1}. In Karnataka, rice is grown in an area of 1.42 m ha with an annual production of 3.60 m t and productivity is 2.53 t ha^{-1} (Anonymous, 2010). Rice production is the most water consuming system and utilizes about 60 per cent of total available irrigation water. To meet the water crisis head on, valuable gains can be achieved by growing rice with less water. Therefore, there is a need to develop an alternate system that requires less water. Aerobic method is a new concept of growing rice. It is a production system, which concentrates on direct seeding and irrigating intermittently, in contrast to the practices such as rising of nursery, puddling, transplanting and submergence. The concept of organic farming has been gaining momentum with the use of different manures and crop residues in order to increase the productivity of crop as well as the soil fertility status. So, the present investigation on response of irrigated aerobic rice to various levels of nitrogen through organic sources on yield attributes, yield and economics of irrigated aerobic rice for achieving maximum production has been carried out.

MATERIALS AND METHODS

A field experiment was conducted at Zonal Agricultural Research Station, Visweshwaraiah Canal Farm, Mandya, University of Agricultural Sciences, Bengaluru during *Kharif* 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, P_2O_5 and K_2O of the experimental site was 248.5, 26.8 and 202.8 kg ha^{-1}, respectively. The experiment was laid out in a Randomized Complete Block Design with eleven treatments replicated thrice.

Detail of treatments and the corresponding symbols

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used during the study are as follows : T_1**:** Recommended package of practice (100:50:50 NPK ha^{-1} +10 tonnes of FYM), T_2:10 tonnes of FYM ha^{-1} as a basal dose + 100 % N equivalent through cattle urine, T_3: 10 tonnes of FYM ha^{-1} as a basal dose + 100 % N equivalent through biodigester liquid, T_4:10 tonnes of FYM ha^{-1} as a basal dose + 100 % N equivalent through jeevamrutha, T_5: Vermicompost equivalent to 10 tonnes of FYM + 100 % N equivalent through cattle urine, T_6: Vermicompost equivalent to 10 tonnes of FYM + 100 % N equivalent through biodigester liquid, T_7: Vermicompost equivalent to 10 tonnes of FYM + 100 % N equivalent through jeevamrutha, T_8: Poultry manure equivalent to 10 tonnes of FYM + 100 % N equivalent through cattle urine, T_9: Poultry manure equivalent to 10 tonnes of FYM + 100 % N equivalent through biodigester liquid, T_{10}: Poultry manure equivalent to 10 tonnes of FYM + 100 % N equivalent through Jeevamrutha

(Note: Application of liquid manures at two splits at 40 DAS and 75 DAS as atop dress)

The land of the experimental site was prepared by ploughing twice mechanically with mould board plough and then, 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).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been presented under following heads :

Yield attributes:

Yield attributes of aerobic rice were significantly influenced by different sources of organic manures (Table 1). Application of recommended dose of fertilizer (100:50:50 kg N:P:K ha^{-1}) along with 10 tonnes of FYM ha^{-1} recorded higher number of productive tillers $hill^{-1}$ (28.02), panicle length (18.57 cm), panicle weight (3.29 g), filled grains $panicle^{-1}$ (140.2) and 1000 grain weight (22.8 g). However, it was at 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. The higher yield parameters might be due use of higher dose of nitrogen, phosphorus and potassium through organic sources might have helped in inducing good vegetative growth. These results are in conformity with the findings of Siddaram (2009). This produced higher number of panicles leading to higher yield. This increased panicle length and panicle weight may be attributed to steady supply of nutrients which enhanced the dry matter production due to more availability of photosynthates. Increase in filled grain and thousand-grain weight under different organic sources might be due to N induced enhancement in photosynthetic activity and these resulted in the translocation of photosynthates and amino acids from the leaves and culms to the grain. The present

Table 1: Yield parameters as influenced by different organic sources in aerobic rice

Treatments	Number of productive tillers $hill^{-1}$	Panicle length (cm)	Panicle weight (g)	1000 grain weight (g)	Filled grains $panicle^{-1}$	Chaffy Grains $Panicle^{-1}$
T_1	28.02	18.57	3.29	22.8	140.2	8.2
T_2	19.50	15.44	2.32	17.8	118.5	12.2
T_3	22.90	16.31	2.74	19.7	126.5	10.8
T_4	22.68	16.11	2.58	19.0	123.9	11.3
T_5	23.14	16.54	2.79	20.1	129.4	10.0
T_6	26.83	17.67	3.09	21.7	136.5	8.7
T_7	25.55	17.16	2.83	20.6	133.5	9.6
T_8	23.80	16.78	2.79	20.1	131.4	10.0
T_9	27.25	18.37	3.21	22.1	136.6	8.4
T_{10}	25.73	17.25	2.89	21.2	134.8	9.5
S.E. ±	0.89	0.54	0.16	0.73	2.40	0.55
C.D. (P=0.05)	2.68	1.61	0.49	2.17	7.21	1.64

findings are in accordance with the findings of Belder *et al.* (2005)

Grain and straw yields:

Grain and straw yields of aerobic rice was significantly influenced by different sources of organic manures (Table 2). Significantly higher grain and straw yields (40.49 and 46.35 q ha^{-1}) were recorded with recommended dose of fertilizer (100:50:50 kg N:P:K ha^{-1}) along with 10 tonnes of FYM ha^{-1}. However, it was at par with poultry manure equivalent to 10 t of FYM + biodigester liquid at 100 % N equivalent basis (39.21 and 45.13 q ha^{-1}), vermicompost equivalent to 10 t of FYM + biodigester liquid at 100 % N equivalent basis (37.58 and 42.83 q ha^{-1}), poultry manure equivalent to 10 t of FYM + jeevamrutha at 100 % N equivalent basis (35.74 and 40.98 q ha^{-1}) and vermicompost equivalent to 10 t of FYM + jeevamrutha at 100 % N equivalent basis (34.57 and 39.08 q ha^{-1}). This significant increase in grain yield and straw yield might be due to the higher yield attributing parameters like productive tillers, number of filled grains per panicle, 1000 grain weight and significant reduction chaffy grains per panicle. These results are in accordance with the findings of Dhurandher and Tripathi (1999) who reported that higher leaf area and leaf area duration which are responsible for higher photosynthetic activity and promoted dry matter production resulting in higher grain and straw yield. The higher yield in the organic manure treatments may be due cementing action of polysaccharides and other organic compounds released during the decomposition of organic matters, thus leading to taller plants, increased number of leaves, tillers and intern the final yield. The differential action of FYM, when compared to vermicompost and poultry manures, may be because of the fact that the poultry manure and vermicompost has high and slow release of nitrogen due to slow mineralization when compared to FYM, which helps in the availability of nutrients to plants throughout the growth of the plants and thus resulting in higher yields. (Channabasanagowda *et al*., 2008). Application of FYM 10 t ha^{-1} as a basal dose + cattle urine at 100 % N equivalent basis recorded significantly lower grain and straw yields. This might be due to slow release of nutrients which may lead to non availability of nutrients at early stage of the crop growth. Marcinkowski and Pietrzak (2006) noticed the high N losses from soil when cattle urine was applied on soil surface.

Table 2 : Grain yield, straw yield and harvest index (HI) as influenced by different organic sources in aerobic rice

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index
T_1	40.49	46.35	0.467
T_2	28.47	32.49	0.467
T_3	31.22	35.20	0.470
T_4	30.71	34.77	0.469
T_5	33.26	37.15	0.472
T_6	37.58	42.83	0.468
T_7	34.57	39.08	0.468
T_8	34.04	38.34	0.470
T_9	39.21	45.13	0.469
T_{10}	35.74	40.98	0.465
S.E. ±	2.10	2.62	0.02
C.D. (P=0.05)	6.30	7.86	NS

NS=Non-significant

Economics:

Higher gross return of Rs. 43267 per ha was worked out with recommended dose of fertilizer (100:50:50 kg N:P:K ha^{-1}) along with 10 tonnes of FYM ha^{-1}. The higher gross return was mainly due to higher grain and straw yields. Similar findings were also observed by Rajini Rani and Srivastava (2001). Maximum net return of Rs. 28517 per ha was found with poultry manure equivalent to 10 t of FYM + biodigester liquid at 100 % N equivalent basis. This is due to lower cost of cultivation. The lowest net returns of Rs. 11692 per ha was recorded with FYM 10 t ha^{-1} as a basal dose + 100 % N equivalent through jeeramritha. This is due to higher cost of cultivation. Similar results were observed by Kumar and Prasad (2002). Among different treatments, poultry manure equivalent to 10 t of FYM + biodigester liquid at 100 % N equivalent basis gave significantly higher benefit cost ratio

Table 3: Economics of aerobic rice cultivation as influenced by different sources of organic manures in aerobic rice

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross Returns (Rs. ha^{-1})	Net Returns (Rs. ha^{-1})	B : C Ratio
T_1	16766	43267	25501	2.93
T_2	17096	30419	13323	2.02
T_3	15576	33335	17759	2.46
T_4	21107	32799	11692	1.72
T_5	20656	35486	14830	1.85
T_6	19136	40153	21017	2.28
T_7	25167	36918	11751	1.59
T_8	14921	36344	21423	2.81
T_9	13401	41918	28517	3.68
T_{10}	18932	38195	19263	2.26
S.E. ±	-	2157	2157	0.14
C.D. (P=0.05)	-	6466	6466	0.43

(3.68) (Table 3). This might be due to lower cost of cultivation and higher net returns. Similar views were expressed by Mondal *et al*. (2003). However, lower benefit cost ratio (1.59) was observed with vermicompost equivalent to 10 t of FYM + jeevamrutha at 100 % N equivalent basis due to high cost of cultivation. This is in conformity with Godhawale *et al*. (2007) who reported that lower benefit cost ratio (1.05) obtained with application of vermicompost at 5 tonnes ha^{-1}.

Conclusion:

Use of poultrymanure along with biodigester liquid at 100% N equivalent basis is one of the cheap and efficient sources of nitrogen in organic farming which can be an efficient substitute for chemical fertilizers for higher crop yield and profitability of aerobic rice.

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Received : September, 2010; Accepted : December, 2010