RESEARCH PAPER International Journal of Agricultural Sciences, June, 2010, Vol. 6 Issue 2 : 426-429

Effect of nitrogen levels through organic sources on growth, dry matter production and nutrient uptake of irrigated aerobic rice (*Oryza sativa* L.)

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ABSTRACT

A field experA field experiment was conducted to study the effect of various levels of nitrogen through organic sources on growth, dry matter production and nutrient uptake of irrigated aerobic rice during *Kharif* season 2008 at Zonal Agricultural Research Station, V.C. Farm, Mandya, University of Agricultural Sciences, Bengaluru in red sandy loam soil. The variety used was Thanu (KMP-101). The results of the field experiment showed that application of recommended dose of fertilizer (100:50:50 kg N:P:K ha^{-1}) + 10 tonnes of FYM ha^{-1} recorded significantly higher growth parameters like plant height (63.1 cm), number of tillers (36.2 hill^{-1}), leaf area (1602 cm^2 hill^{-1}) and dry matter production at harvest (151.1 g hill^{-1}). However, it was at par with 200 % recommended dose of nitrogen (RDN) equivalent through vermicompost ha^{-1}, 200 % RDN equivalent through FYM ha^{-1}, 150 % RDN equivalent through vermicompost ha^{-1} and 100 % RDN equivalent through poultry manure ha^{-1}. Significantly higher nitrogen, phosphorus and potassium uptake (124.2, 30.6 and 93.9 kg ha^{-1}, respectively) registered with recommended dose of fertilizer (100:50:50 kg N:P:K ha^{-1}) + 10 tonnes of FYM ha^{-1}. However, it was at par with 200 % recommended dose of nitrogen (RDN) equivalent through vermicompost ha^{-1}, 200 % RDN equivalent through FYM ha^{-1}, 150 % RDN equivalent through vermicompost ha^{-1} and 100 % RDN equivalent through poultry manure ha^{-1}.

Key words : Rice, Nitrogen, FYM, Vermicompost, Poultry manure

INTRODUCTION

Rice (*Oryza sativa* L.) is the major crop of India and occupies larger cropped area of 43.77 million hectares with an annual production of 96.43 million tonnes and productivity of 2203 kg ha^{-1}. In Karnataka, it is grown in an area of 1.49 million hectares with an annual production of 5.74 million tonnes with a productivity of 3868 kg ha^{-1} (Anonymous, 2008). Breeders, Physiologists, Agronomists and soil scientists are striving hard to overcome many difficulties in taking rice out of its natural environment by developing an alternate management systems. Among these, success of aerobic rice depends on efficient management of plant nutrients. Further, it is not desirable to apply nutrients only through inorganic sources. Application of organic manures for increasing soil fertility has gained importance in recent years due to high cost and adverse impact of fertilizers. Incorporation of organic manures has given a hope to reduce the cost of cultivation and minimize adverse effects of chemical fertilizers. Use of different organic manures like farm yard manure, vermicompost and poultry manure deserves priority for sustained production and better resource utilization in the cultivation system. Compared to chemical farming this method was self-sufficient and self-dependent as compared to modern chemical farming relying more on organic in order to assess the utility of locally available resources. Nitrogen is pivotal in realization of rice yield. In India about 67 per cent of rice soils are estimated to be deficit in adequate nitrogen and consequently rice crop has become a major consumer of nitrogen fertilizer. The efficiency of applied nitrogen fertilizer is low, ranges from 20-25 per cent in aerobic soil. Aerobic soil has higher rate of percolation than flooded soil because of lack of flooding. In view of this, an experiment was conducted on "Effect of various levels of nitrogen through organic sources on growth, dry matter production and nutrient uptake of irrigated aerobic rice".

MATERIALS AND METHODS

A field experiment was conducted at Zonal Agricultural Research Station, Visweshwaraiah Canal Farm, Mandya, University of Agricultural Sciences, Bengaluru during *Kharif* 2008. The soil of the experimental site was red sandy loam with neutral pH (6.97) and medium in organic carbon (0.56%) content. The initial status of available N, P_2O_5 and K_2O of the experimental site was 292.5 28.2 and 169.3 and kg ha^{-1}, respectively. The experiment was laid out in a Randomized Complete Block Design with eleven treatments replicated thrice. The treatments were recommended dose of fertilizer (100:50:50 kg N: P: K ha^{-1}) (T_1), recommended dose of fertilizer + 10 tonnes of FYM ha^{-1} (T_2), 100 % recommended dose of nitrogen (RDN) equivalent through FYM ha^{-1} (T_3), 100 % RDN equivalent through vermicompost ha^{-1} (T_4), 100 % RDN equivalent through poultry manure ha^{-1} (T_5), 150 % RDN

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equivalent through FYM ha^{-1} (T_6), 150 % RDN equivalent through vermicompost ha^{-1} (T_7), 150 % RDN equivalent through poultry manure ha^{-1} (T_8), 200 % RDN equivalent through FYM ha^{-1} (T_9), 200 % RDN equivalent through vermicompost ha^{-1} (T_{10}) and 200 % RDN equivalent through poultry manure ha^{-1} (T_{11}).

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).

RESULTS AND DISCUSSION

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

Growth parameters:

The different growth parameters like plant height, number of tillers and leaf area of irrigated aerobic rice significantly influenced by various levels of nitrogen through organic sources (Table 1). Higher plant height (63.1 cm), number of tillers (36.2 hill^{-1}) and leaf area (1602 cm^2 hill^{-1}) was 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 200 % RDN equivalent through vermicompost ha^{-1} (62.6 cm, 35.1 hill^{-1} and 1561 cm^2 hill^{-1} of plant height, number of tillers and leaf area, respectively), 200 % RDN equivalent through FYM ha^{-1} (60.5 cm, 34.5 hill^{-1} and 1535 cm^2 hill^{-1} of plant height, number of tillers and leaf area, respectively), 150 % RDN equivalent through vermicompost ha^{-1} (58.7 cm, 33.9 hill^{-1} and 1513 cm^2 hill^{-1} of plant height, number of tillers and leaf area, respectively) and 100 % RDN equivalent through poultry manure ha^{-1} (58.1 cm, 33.6 hill^{-1} and 1500 cm^2 hill^{-1} of plant height, number of tillers and leaf area, respectively). Significant increase in plant height might be due to greater availability and steady release of nutrients from organic sources (FYM, vermicompost and poultry manure), which perhaps enabled the recovery of plant height towards reproductive stage. Devaraju *et al.* (1998) opined that adequate supply of plant nutrients influenced the plant height. Nitrogen increases the chlorophyll content at all growth stages as it is a constituent and might have increased the photosynthesis and resulted in increased plant height (Gill and Singh, 1985). Tiller number increased with nitrogen supply and is in accordance with the findings of Shanmugam (1983). The development of leaf area is an important factor that could affect crop response to added nitrogen. Larger leaf area development aids in more interception of light leading to higher dry matter production (Vijayalakshmi and Nagarajan, 1994).

Dry matter production:

Application of recommended dose of fertilizers (100:50:50 kg N:P:K ha^{-1}) along with 10 tonnes of FYM ha^{-1} recorded significantly higher total dry matter at 30 DAS (2.9 g hill^{-1}), 60 DAS (13.0 g hill^{-1}), 90 DAS (65.0 g hill^{-1}) and at harvest (151.1 g hill^{-1}) (Table 2). However, it was at par with 200 % RDN equivalent through vermicompost ha^{-1} (2.8, 13.1, 64.4 and 147.9 g hill^{-1} at 30,

Table 1 : Growth parameters as influenced by levels of nitrogen through organic sources in irrigated aerobic rice

Treatments	Plant height (cm)	Number of tillers hill^{-1}	Leaf area (cm^2 hill^{-1})
T_1 : Recommended dose of fertilizer (100:50:50 kg N:P:K ha^{-1})	55.2	31.6	1381
T_2 : Recommended dose of fertilizer + 10 tonnes of FYM ha^{-1}	63.1	36.2	1602
T_3 : 100 % RDN equivalent through FYM ha^{-1}	52.9	30.4	1322
T_4 : 100 % RDN equivalent through vermicompost ha^{-1}	54.2	31.1	1335
T_5 : 100 % RDN equivalent through poultry manure ha^{-1}	58.1	33.6	1499
T_6 : 150 % RDN equivalent through FYM ha^{-1}	55.6	31.9	1410
T_7 : 150 % RDN equivalent through vermicompost ha^{-1}	58.7	33.9	1513
T_8 : 150 % RDN equivalent through poultry manure ha^{-1}	52.3	29.6	1307
T_9 : 200 % RDN equivalent through FYM ha^{-1}	60.5	34.5	1535
T_{10} : 200 % RDN equivalent through vermicompost ha^{-1}	62.6	35.1	1561
T_{11} : 200 % RDN equivalent through poultry manure ha^{-1}	51.9	28.6	1278
S.E. ±	2.40	1.37	46.89
C.D. (P=0.05)	7.08	31.63	138.33

FYM - Farm yard manure
RDN - Recommended dose of nitrogen

Table 2 : Total dry matter production (g hill^{-1}) as influenced by various levels of nitrogen through organic sources in irrigated aerobic rice at different growth stages

Treatment s	30 DAS	60 DAS	90 DAS	At harvest
T_1 : Recommended dose of fertilizer (100:50:50 kg N:P:K ha^{-1})	2.6	10.2	53.9	141.7
T_2 : Recommended dose of fertilizer + 10 tonnes of FYM ha^{-1}	2.9	13.0	65.0	151.1
T_3 : 100 % RDN equivalent through FYM ha^{-1}	2.4	9.0	51.3	138.9
T_4 : 100 % RDN equivalent through vermicompost ha^{-1}	2.5	9.4	52.0	139.6
T_5 : 100 % RDN equivalent through poultry manure ha^{-1}	2.6	12.0	59.8	145.8
T_6 : 150 % RDN equivalent through FYM ha^{-1}	2.5	10.8	55.9	142.6
T_7 : 150 % RDN equivalent through vermicompost ha^{-1}	2.7	12.2	61.0	146.3
T_8 : 150 % RDN equivalent through poultry manure ha^{-1}	2.4	8.7	50.0	138.7
T_9 : 200 % RDN equivalent through FYM ha^{-1}	2.7	12.5	62.9	147.1
T_{10} : 200 % RDN equivalent through vermicompost ha^{-1}	2.8	13.1	64.4	147.9
T_{11} : 200 % RDN equivalent through poultry manure ha^{-1}	2.3	8.5	49.1	137.4
S.E. ±	0.08	0.54	1.85	2.59
C.D. (P=0.05)	0.23	1.61	5.50	7.65

FYM - Farm yard manure
RDN - Recommended dose of nitrogen

60, 90 DAS and at harvest, respectively), 200 % RDN equivalent through FYM ha^{-1} (2.7, 12.5, 62.9 and 147.1 g hill^{-1} at 30, 60, 90 DAS and at harvest, respectively), 150 % RDN equivalent through vermicompost ha^{-1} (2.7, 12.2, 61.0 and 146.3 g hill^{-1} at 30, 60, 90 DAS and at harvest, respectively) and 100 % RDN equivalent through poultry manure ha^{-1} (2.6, 12.0, 59.8 and 145.8 g hill^{-1} at 30, 60, 90 DAS and at harvest, respectively). The combined application of inorganic fertilizer and organic manure could have helped in balanced availability of nutrients at all stages. Further, this might have improved the soil aggregation, higher nutrient availability and enhanced soil microbial activity resulting in congenial soil condition. As a consequent improved uptake of nutrients has led to more vegetative growth of the plants and also dry matter. Higher dry matter production was perhaps due to the higher leaf dry weight and stem dry weight recorded at different stages. This has provided more photosynthetically active leaf area resulting in higher dry matter accumulation. Apart from that, nitrogen might have involved in various physiological activities like increased photosynthetic activity and better light interception in turn

Table 3 : Nutrient uptake as influenced by levels of nitrogen through organic sources in irrigated aerobic rice

Treatments	Nitrogen uptake (kg ha^{-1})	Phosphorus uptake (kg ha^{-1})	Potassium uptake (kg ha^{-1})
T_1 : Recommended dose of fertilizer (100:50:50 kg N:P:K ha^{-1})	113.0	26.5	82.3
T_2 : Recommended dose of fertilizer + 10 tonnes of FYM ha^{-1}	124.2	30.6	93.9
T_3 : 100 % RDN equivalent through FYM ha^{-1}	109.8	23.4	79.5
T_4 : 100 % RDN equivalent through vermicompost ha^{-1}	108.7	24.1	80.2
T_5 : 100 % RDN equivalent through poultry manure ha^{-1}	117.6	27.8	86.7
T_6 : 150 % RDN equivalent through FYM ha^{-1}	111.5	25.0	81.5
T_7 : 150 % RDN equivalent through vermicompost ha^{-1}	118.9	28.2	88.0
T_8 : 150 % RDN equivalent through poultry manure ha^{-1}	106.5	22.8	78.7
T_9 : 200 % RDN equivalent through FYM ha^{-1}	120.9	28.9	89.6
T_{10} : 200 % RDN equivalent through vermicompost ha^{-1}	122.0	29.4	92.1
T_{11} : 200 % RDN equivalent through poultry manure ha^{-1}	105.7	22.6	76.3
S.E. ±	2.43	1.18	2.48
C.D. (P=0.05)	7.16	3.48	7.32

FYM - Farm yard manure
RDN - Recommended dose of nitrogen

resulted in higher dry matter accumulation. Kenchaiah (1997) also reported that higher growth indices recorded in paddy had a positive association with higher dry matter accumulation. Similar results were reported by Reddy (1985) and Rajeswari (1990). As nitrogen could enhance tillers production and leaf area development, naturally total dry matter production also increased with increased levels of nitrogen.

Nutrient uptake:

Significantly higher nitrogen, phosphorus and potassium uptake (124.2, 30.6 and 93.9 kg ha^{-1}, respectively) recorded with recommended dose of fertilizer (100:50:50 kg N: P: K ha^{-1}) along with 10 tonnes of FYM ha^{-1} (Table 3). However, it was at par with 200 % RDN equivalent through vermicompost ha^{-1} (122, 29.4 and 92.1 kg ha^{-1} of N, P and K, respectively), 200 % RDN equivalent through FYM ha^{-1} (120.9, 28.9 and 89.6 kg ha^{-1} of N, P and K, respectively), 150 % RDN equivalent through vermicompost ha^{-1} (118.9, 28.2 and 88 kg ha^{-1} of N, P and K, respectively) and 100 % RDN equivalent through poultry manure ha^{-1} (117.6, 27.8 and 86.7 kg ha^{-1} of N, P and K, respectively). According to Thomas (1996), higher N levels had marked influence on N, P and K uptake due to increased dry matter production. The present findings are in close association with Sharma and Mittra (1990) and Paikaray *et al*. (2001). They stated that use of higher dose of nitrogen might have helped for good vegetative growth and root system, which increased the higher N uptake by plants and hence increased yield and yield components of rice. Joshi and Setty (2005) inferred that application of poultry manure was superior than application FYM in improving available P_2O_5, K_2O, Ca and Mg in acid soils with low organic matter status. The poultry manure was responsible for increased uptake of Mn and Zn in sandy soils and increased N mineralization. It improves mineralization of organic carbon and improve uptake of P (Das *et al.,* 1992).

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Received : November, 2009; Accepted : March, 2010