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INTERNATIONAL JOURNAL OF CURRENT AGRICULTURAL SCIENCES

ISSN: 2277:1026

RESEARCH ARTICLE

International Journal of Current Agricultural Sciences - Vol.2, Issue, 6, pp. 24- 27, June, 2012

INFLUENCE OF PLANTING METHODS AND DIFFERENT VERMICOMPOSTS ON THE YIELD AND NITROGEN USE EFFICIENCY IN RICE

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ARTICLE INFO

Article History:

Received20th , May,2011
Received in revised form 28th ,May,2011
Accepted 15thJune 2012
Published online 25th June,2012

Key words:

Planting method, rice yield, vermicomposts.

ABSTRACT

Field experiments were conducted at Annamalai University, Experimental Farm, Annamalainagar, Chidambaram during two seasons namely Navarai of 2009-2010 and late samba of 2010- 2011 to identify the influence of different cultivation systems and various vermicomposts on productivity and nitrogen use efficiency of rice. The experiment was laid out in a split plot design. The crop planting methods was assigned to main plot and different vermicomposts to sub plot. Three planting methods *viz*., M_1 (puddle direct sowing), M_2 (conventional transplanting), and M_3 (System of Rice Intensification) in main plot and different vermicompost *viz*., S_1 (Sewage sludge based vermicompost), S_2 (FYM based vermicompost), S_3 (Sugarcane trash based vermicompost), S_4 (Pressmud based vermicompost) and S_5 (No vermicompost-control) under sub plot were evaluated. The treatments were replicated thrice. Among vermicomposts, pressmud based vermicompost recorded better growth. The results revealed that crop raised with SRI registered higher grain, straw yield and harvest index among various methods of planting. With regard to different organic sources of vermicompost, pressmud based vermicompost application resulted in higher grain, straw yields and harvest index. The crop planting methods had significant influence on the Nitrogen use efficiency (NUE) and Economic nitrogen use efficiency (ENUE) by the crop at harvest. SRI recorded the highest Nitrogen use efficiency (NUE) and Economic nitrogen use efficiency (ENUE) followed by conventional method of planting. Among the different organic source of vermicompost, pressmud based vermicompost registered the highest Nitrogen use efficiency (NUE) and Economic nitrogen use efficiency (ENUE) values at harvest. Based on the above experimental results, it could be concluded that cultivation of rice with SRI method along with application of pressmud based vermicompost @ 3.0 t ha^{-1} will be a promising combination which not only resulted in higher yields but also superior in respect of nitrogen and economy .

INTRODUCTION

In India, rice occupies pivotal place and is the staple food of more than70 per cent population. It accounts for about 45 per cent of total food grain production and 55 per cent of cereals production. It occupies about 44.6 million hectares with a production of 86.0 million tonnes and it continues to hold the key to sustain food production by contributing 20 to 25 per cent of agriculture GDP and assures food security in India for more than half of the total population. To feed the exploding population, projection of India's rice production target for 2025 AD is 140 millon tonnes, which can be achieved only by increasing the rice production by over 2.0 million tonnes per year in the coming decade (Subbiah, 2006). In contrast, recent slow down or plateauing of yield in irrigated rice was noticed as a result of soil health and decline in productivity level (IRCN, 2001). In recent years different combination of organic manures are used along with inorganics for sustaining the rice production and vermicompost was one among them which excels most.

In order to test the potential of vermicompost and different planting methods on the yield and nitrogen economy of the soil of rice, the present investigation was under taken.

MATERIALS AND METHODS

Field experiments were conducted at Experimental Farm, Annamalai University, Annamalainagar, during Navarai

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Table 1 Effect of planting methods and different vermicompost application on Grain yield (kg ha^{-1}) and Straw yield (kg/ha^{-1})

	Grain yield (kg ha^{-1})								Straw yield (kg/ha^{-1})							
	Season I				Season II				Season I				Season II			
Treatments	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**
S_1	4299	5581	6524	5468	4382	5707	6733	38.55	5655	6823	7420	6633	5771	6958	7638	6789
S_2	4129	5410	6346	5295	4171	5516	6528	36.65	5524	6707	7256	6495	5583	6814	7452	6616
S_3	3964	5238	6174	5125	3965	5331	6329	34.76	5415	6548	7094	6352	5454	6655	7271	6460
S_4	4470	5765	6710	5649	4598	5897	6941	40.44	5705	6923	7500	6710	5873	7061	7739	6891
S_5	3053	3603	4261	3639	2948	3472	4066	24.99	4542	4957	5471	4990	4383	4798	5364	4849
Mean	3983	5120	6003		4013	5185	6119		5368	6392	6948		5413	6457	7093	
	Main	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**
S.E	450	80	232	855	500	100	290	950	250	25	72.5	475	300	40	112	570
CD (p=0.05)	900	160	448	1710	1000	200	560	1900	500	50	135	950	600	80	232	1140

Table 2 Effect of planting methods and different vermicompost application Nitrogen use efficiency in rice and Economic nitrogen use efficiency

	Nitrogen use efficiency in rice								Economic nitrogen use efficiency							
	Season I				Season II				Season I				Season II			
Treatments	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**
S_1	32.91	38.61	40.34	37.29	34.17	39.87	41.60	38.55	3.07	3.57	3.97	3.54	3.18	3.68	4.08	3.65
S_2	29.06	37.64	39.48	35.39	30.32	38.90	40.74	36.65	2.92	3.44	3.76	3.37	3.03	3.55	3.87	3.48
S_3	25.21	36.67	38.62	33.50	26.47	37.93	39.88	34.76	2.77	3.31	3.55	3.21	2.88	3.42	3.66	3.32
S_4	36.76	39.58	41.20	39.18	38.02	40.84	42.46	40.44	3.22	3.70	4.12	3.68	3.33	3.81	4.23	3.79
S_5	22.27	24.40	26.53	24.40	22.86	24.99	27.12	24.99	2.03	2.44	2.89	2.45	2.05	2.46	2.91	2.47
Mean	29.24	35.38	37.23		30.37	36.51	38.36		2.80	3.29	3.66		2.89	3.38	3.75	
	Main	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**
S.E	0.8	0.4	1.12	1.52	0.8	0.4	1.16	1.68	0.2	0.1	0.28	0.38	0.2	0.1	0.27	0.38
CD (p=0.05)	1.6	0.8	NS	NS	1.6	0.8	NS	NS	0.4	0.2	NS	NS	0.4	0.2	NS	NS

M_1 – Puddle direct sowing, M_2 – Conventional method, M_3 – SRI method

S_1 – Sewage based vermicompost, S_2 – FYM based vermicompost, S_3 – Sugar cane trash based vermicompost, S_4 – Pressmud based vermicompost, S_5 – Control

2009-2010 and Late samba 2010- 2011 to identify and formulate a suitable combination of vermicompost derived from different sources of raw materials under different cultivation systems of rice on growth and yield components, of rice varieties ADT 43 & BPT 5204. The experimental soil was deep clay, low in available soil nitrogen (192 ha^{-1}), medium in available soil phosphorus (21.9 ha^{-1}) and high in available soil potassium (273 kg ha^{-1}). Short duration rice cv ADT 43 was used for the I season and rice cv BPT 5204 for II season, respectively.

The experiment was laid out in split plot design with three replication. The crop planting methods was assigned to main plot and different vermicomposts to sub plot. Three planting methods *viz*., M_1 (puddle direct sowing), M_2 (conventional transplanting), and M_3 (System of Rice Intensification) in main plot and different vermicompost *viz*., S_1 (Sewage sludge based vermicompost), S_2 (FYM based vermicompost), S_3 (Sugarcane trash based vermicompost), S_4 (Pressmud based vermicompost) and S_5 (No vermicompost-control) under sub plot were evaluated. The treatments were replicated thrice. Observations on grain and straw yield were recorded and Nitrogen use efficiency (NUE) and Economic nitrogen use efficiency (ENUE) were derived. Nitrogen use efficiency (NUE) was calculated in terms of seed yield per kg of nitrogen fertilizer applied and Economic nitrogen use efficiency **(**ENUE) was calculated in terms of seed yield per rupee invested on nitrogen fertilizers.

RESULTS AND DISCUSSION

Results of the study revealed that SRI method of planting had salutary over other methods in respect of realizing higher grain and straw yield in rice over other methods of planting. It has recorded increased increased grain and straw yield by 50.24 and 29.12 per cent for season I and 52.47 and 31.03 per cent for season II, respectively over control. This might be due to the fact that SRI plot SRI plots might have received optimum supply of irrigation water with mechanical weeding resulted in higher nutrient availability, subsequently resulting in better source to sink conversion which in turn enhanced production lower spikelet sterility. Straw yields and Straw yield and harvest index also exhibited similar trend due to possible efficient translocation of assimilates to the sink. The results are in line with those of Sinclair and Sheety, (1999).

Among the various vermicompost treatments, substantial increase in grain and straw yields was realized in pressmud based vermicompost applied plots. Increased grain and straw yields of 55.23 and 25.63 per cent for season I and 66.24 and 42.11 per cent for season II, was recorded in pressmud based vermicomost applied plots over control. Sewage sludge based vermicompost and FYM based vermicompost follows the line in respect of grain and straw yields. The aforesaid increased yield attributes due to pressmud based vermicompost might be due to higher nutrient uptake and increased photosynthetic efficiency. In addition, the constant release of nitrogen from organic manure, particularly from vermicompost supplemented with NPK fertilizer might have satisfied the demand of the rice crop at every phenophase of rice crop.

In respect of nitrogen efficince, planting method to rice by SRI (M_3) showed greater nitrogen use efficiency (37.23 for season I and 38.36 for season II), respectively than the conventional method (M_2) and the puddle direct sowing method (M_1). In sub-plots, the highest NUE was recorded in S_4 (Pressmud based vermicompost) as 39.18 for season I and 40.44 for season II respectively. This was followed by S_1 (Sewage sludge based vermicompost), S_2 (FYM based vermicompost) and S3 (sugarcane thrash based vermicompost). The lowest values was observed in no vermicompost (S_5) plots. The interaction effect between planting method and different organic source of vermicompost was found to be non significant.

The ENUE (kg grain Rs^{-1} invested on N fertilizer) responded significantly to different treatments. SRI (M_3) planting in rice recorded higher ENUE (3.66 for season I and 3.75 for season II respectively) and was followed by conventional (M_2) and puddle direct sowing (M_1) methods. Among the sub-plot treatments, the plants which receive pressmud based vermicompost (S_4) showed higher ENUE (3.68 for season I and 3.76 for season II respectively). Application of sewage sluge based vermicompost (S_1) ranked second, followed by FYM based vermicompost (S_2) and sugarcane based vermicompost (S_3). The least value of ENUE was registered in treatment, S_5 (no vermicompost). The interaction between the main and sub-plot was found non significant.

The response to applied nitrogen was higher at SRI plots than the conventional transplanting and puddle direct sowing as indicated by higher grain yield kg^{-1} nitrogen applied (NUE) and higher grain yield per rupee invested on N fertilizer (ENUE). This was due to higher concentration of N in the foliage, reflecting better uptake of nutrients in SRI method by Barison,(2002). Similarly, application of pressmud based vermicompost @3 t ha^{-1} recorded higher values of NUE and there by ENUE. This was followed by sewage sludge based vermicompost and FYM based vermicompost. Increased NUE and ENUE with pressmud based vermicompost could be due to adequate nutrient supply, as opined by Chaudhary et al. (2004).

Thus from the present study it can be concluded that application of 3 t/ha pressmud based vermicompots to SRI rice produces higher grain and strew yields along with conserving nitrogen in rice soils which pave way for sustainability in rice cultivation.

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