ORIGINAL PAPER

INFLUENCE OF ORGANIC MANURES ON PRODUCTIVITY OF TWO VARIETIES OF RICE

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ABSTRACT

Field experiment was conducted during 2003-04 to study the effect of vermicompost, farmyard manure and water hyacinth compost in comparison to chemically fertilized and unfertilized plots on crop-plants in HYV Swarna and local variety Magaisal. The experiment followed split plot design with two varieties of rice in the main plots and five nutrient sources randomized in sub plots. Significant variation in grain yield between the varieties, among the nutrient sources and their interactions was observed. Grain yield recorded in HYV Swarna was higher to local variety Mugaisal irrespective of the treatments and hence Swarna was considered to be more tolerant to Mugaisal. Among the nutrient sources, treatment with vermicompost imparted maximum grain yield to all other nutrient sources irrespective of varieties.

Key words: Organic manure, HYV Swarna, root dry mass density ,grain yield

INTRODUCTION

The term “organic” describes production systems that optimize natural processes. Organic farming systems rely on ecologically-based practices such as cultural and biological pest management, and virtually exclude the use of synthetic chemicals in crop production and prohibit the use of antibiotics and hormones in livestock production [13]. The food produced through such farming is commonly termed as “organic food” and is relatively free from toxic residues [1]. Such food, presumably of better quality, is gaining popularity among the health conscious consumers of advanced countries and urban consumers in India. With the gaining popularity of organic farming, demand for organic manures have risen sharply. Information regarding influence of manures on resistance and tolerance by crop-plants to insect-pests and disease-pathogens is very important to farmers engaged in organic farming. The other concern has been the quality of organic manures, which depends upon the content of N, P and K and minor elements [12].

The organic manures show considerable diversity in physical, chemical and biological properties [3] and their efficiency in crop production depends upon the agro-ecological environment where the crop is grown [9]. Relative efficiency of different organic manures in crop production therefore, has to be established considering different agro-ecological environment and the crops grown. In addition to this, the quantity and proportion of N, P and K required by crops can vary and thereby limit the efficiency of the organic manures.

The organic manures show considerable diversity in physical, chemical and biological properties [3, 11] and their efficacy in crop production. Field experiments conducted during 2003 and 2004 aimed at investigating the the hypothesis that nutrients supplied from different organic sources vary the varietal reponse of a particular crop in an acid alluvial soil.

MATERIALS AND METHODS

The experiment was conducted during the kharif season in the year 2003 and 2004 in a farmers plot in new alluvial region of West Bengal, India ($pH_{(H2O)}$ 5.6, organic C 3.9g kg^{-1}, contained 16% clay, 24% silt and 7.3 ppm P (Bray.1).

The paddy varieties tested in the investigation were HYV Swarna Dhan and Local variety Mugaisal. Plant to plant spacing of 15 cm and row to row spacing of 20

Table 1 Plant height (cm), tillers $hill^{-1}$ (no) and root dry mass density (kg m^{-3}) as influenced by varieties, nutrient sources and their interaction (average of two years)

Treatments	Varieties (V)								
	Plant height (cm)			Tillers $hill^{-1}$ (no)			Root dry mass density (kg m^{-3})		
Nutrient Sources (S)	Swarna Dhan	Mugaisal	Mean	Swarna Dhan	Mugaisal	Mean	Swarna Dhan	Mugaisal	Mean
Vermicompost	86	102	94.0	17	13	15	86	102	94.0
Farmyard manure	80	97	88.5	15	11	13	80	97	88.5
Water hyacinth compost	70	86	78.0	08	07	7.5	70	86	78.0
Chemical fertilizers	90	112	101.0	12	10	11.0	90	112	101.0
Untreated control	65	82	73.5	06	05	5.5	65	82	73.5
Mean	78.2	95.8		11.6	9.2		78.2	95.8	
	V	**S**	**V X S**	**V**	**S**	**V X S**	**V**	**S**	**V X S**
SEm±	0.180	0.542	0.766	0.683	0.398	0.563	0.180	0.542	0.766
CD	0.573	1.119	NS	1.537	1.161	NS	0.573	1.119	NS

cm was adopted. Two to three seedlings per hill were transplanted. Five nutrient sources, namely (i) Farmyard manure (ii) Vermicompost (iii) Water hyacinth compost (iv) Chemical fertilizers and (v) untreated control were undertaken for study. Each plot 8m x 4m were arranged in split plot design with four replications. Chemical fertilizers were applied at recommended level of 80 kg N, 60 kg P_2O_5 and 40 K_2O ha^{-1}. Organic manures were applied at recommended nitrogen equivalent basis to supply 80 Kg N per hectare. All the organic manures were applied one month prior to transplanting of paddy seedlings while full dose of P_2O_5 and K_2O and 1/3rd N was applied as basal dose. The remaining 2/3rd N was applied in two equal splits during active tillering and panicle initiation stage.

Observations on plant height and tillers per hill were recorded from randomly selected 10 hills at harvest. For calculating RDMD, roots were collected through single root auger (inside diameter 8 cm, length 15 cm, and volume 750 cm) by collecting undisturbed soil sample between the rows, within the rows and on the hill, randomly at about 12 places in the plot to a depth of 30 cm. The roots were then carefully washed under the running water using different mesh size sieves and oven dried to calculate dry root mass density. Number of panicles in a meter square were recorded from randomly selected 33 hills (hills in one m^2 area). To record number of grains per panicle, 10 panicles were selected at random from the harvested lot and completely filled grains were considered for calculations. The tolerance of rice plants to attack by pests was measured in terms of grain yield. Yield was recorded on net plot basis by eliminating two boarder rows. Grain yield was reported at 14 per cent moisture content.

RESULTS AND DISCUSSIONS

Plant growth differed significant among treatments and between varieties were significant while their interactions remained non significant (Table 1). The order of plant growth was Chemical fertilizer >Vermicompost > Farmyard manure> Water hyacinth compost > Untreated control. Growth in untreated control remained generally flat and well below other treatments. This trend remained same for both the varieties, although height of the plant recorded was higher for local variety Mugaisal than in case of high yielding variety Swarna. As regards influence of nutrient sources on tillering, the order of extent of tillering was Vermicompost > Farmyard

Table 2 Grain yield (Mg ha^{-1}), panicles $hill^{-1}$ and grains $panicle^{-1}$ as influenced by varieties, nutrient sources and their interaction (average of two years)

Treatments	**Varieties (V)**								
	Grain yield (Mg ha^{-1})			Panicles $hill^{-1}$			Grains $panicle^{-1}$		
Nutrient Sources (S)	Swarna Dhan	Mugaisal	Mean	Swarna Dhan	Mugaisal	Mean	Swarna Dhan	Mugaisal	Mean
Vermicompost	2.94	1.41	2.18	16	12	14	126	113	119.5
Farmyard manure	2.62	1.37	1.99	14	10	12	96	108	102.0
Water hyacinth compost	2.06	1.21	1.63	07	06	6.5	90	88	89.0
Chemical fertilizers	2.75	1.25	2.00	11	08	9.5	106	99	102.5
Untreated control	1.87	1.17	1.52	06	05	5.5	86	75	80.5
Mean	2.45	1.28		10.8	8.2		100.8	96.6	
	V	**S**	**V X S**	**V**	**S**	**V X S**	**V**	**S**	**V X S**
SEm±	0.004	0.016	0.023	0.216	0.464	0.657	0.535	1.316	1.861
CD	0.017	0.048	0.068	0.972	1.355	NS	2.409	3.842	5.433

Table 3 Population of green leaf hoppers per hill recorded at 6th week, 7th week and 8th week of DAT under influence of different nutritional sources

	6th week			7th week			8th week		
	Swarna Dhan	Mugaisal	Mean	Swarna Dhan	Mugaisal	Mean	Swarna Dhan	Mugaisal	Mean
Treatments									
Vermicompost	1	-	0.37	2	2	2	4	2	2.25
FYM	1	-	0.25	4	2	3	6	4	4.00
Water hyacinath compost	6	2	4.00	14	4	8	12	6	6.62
Chemical fertilizer	11	4	7.50	16	5	9.5	12	6	9.00
Untreated control	14	6	9.50	17	7	12.0	15	7	11.00
Mean	6.45	2.2		9.8	4.0			3.9	
	V	**S**	**VXS**	**V**	**S**	**VXS**	**V**	**S**	**VXS**
SEm±	0.149	0.260	0.368	0.173	0.326	0.461	0.154	0.286	0.404
CD	0.675	0.760	1.074	0.779	0.952	1.346	0.743	0.835	1.180

manure > Chemical fertilizer > Water hyacinth compost > Untreated control (Table 1). The trend remained similar for both the varieties. These differences among treatments and between varieties were significant while their interaction were found to be non significant.

The variation in plant height due to nutrient sources was considered to be due to variation in the availability of major nutrients. Chemical fertilizer offers nutrients which are readily soluble in soil solution and thereby instantaneously available to plants. Nutrient availability from organic sources are due to microbial action and thereby slow and steady. However, organic sources offer more balanced nutrition to the plants, especially micro nutrients which has caused better tillering in plants grown with Vermicompost and FYM. Plants grown with water hyacinth compost did not show similar results in tillering possibly due to poor nutritional quality and thereby comparatively lower ability to sustain nutrient demand of crop.

The data on pest attack presented in Table.3 showed that pest attack was minimum in the vermicompost followed by FYM and was maximum under untreated and chemical fertilizer treatments. Among the varieties, the local variety was lush affected by pest. The release of balanced amount of nutrient both macro and micro by vermicompost and by FYM along with genetic response of to varieties were responsible for differences in pest attack.

The order of root dry mass density (RDMD) was Vermicompost > Farmyard manure > Water hyacinth compost > Chemical Fertilizer > Untreated control (Table 1). Although the trend remained same for both the varieties, root dry mass density recorded in HYV Swarna was higher over locai variety Mugaisal (Table 1). Organic manures besides making macro and micro nutrients available to crop continuously, also improve soil structure favoring better root growth [2,10].

Grain Yield

There was significant difference in the yield between the varieties, amount various nutritional sources and their interactions (Table 2). The order of yield was Vermicompost > Chemical fertilizer > FYM > Water hyacinth compost > Untreated control for Swarna Dhan. However, the order of yield in Mugaisal was Vermicompost > FYM > Chemical fertilizer > Water hyacinth compost > Untreated control. Between the varieties, the yield recorded in Swarna Dhan was comparative higher to local variety Mugaisal.

Grain yield is a function number of panicle bearing tillers per hill and grains per panicle besides grain weight. The results suggest that vermisompost and FYM offered better nutritional quality and favourable balance of nutrients than in the case of water hyacinth compost, chemical fertilizers and untreated control which resulted in more effective tillers in Swarna as well as Mugaisal (Table 2). However number of grains per panicle recorded mode in chemical fertilized HYV Swarna was higher (Table 2). This explains higher yield obtained from chemical fertilizer over FYM in Swarna inspite of more effective tillers recorded in FYM treatment plots.

Higher yield in HYV Swarna over local variety Mugaisal could be mainly attributed to their genetic response. Root proliferation, expressed as root dry mass density, significantly varied between the varieties (Table 1). Higher root proliferation provided for better nutrient uptake and as a consequence grain yield recorded in HYV Swarna was higher [3].

It can be concluded from the study that the influence of nutrient sources varied in evoking crop response in terms of tolerance to pathogens and pests. The mechanisms involved are different and related to the biology of the pest or disease. Sometimes physiological changes in the plant tissue (proteins, amino acids, sugar content) are responsible for the pest/disease incidence; sometimes plant growth stimulates the pest or disease by creating more feeding sites or better microclimate conditions (14). A balanced nutrient supply from the nutrient sources that ensured optimal plant growth was also found to be optimal for plant tolerance and thereby supports the earlier findings of (5,6,7,8,). This may be due to thicker cell walls and lower levels of free amino acids (6) in organic manure treated plots in the present experiment. Plant susceptibility to insect herbivory has been shown in numerous studies to be associated with high plant N levels on account of high inputs of soluble N fertilizers. Organic N is available slowly as the plant grows and thus acts as self-control against the tolerance to pest attack.

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