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Long Term Effect of Organic, Integrated and Inorganic Nutrient Management Practices on Crop Performance and Quality Parameters of Rice (*Oryza sativa L.*) in a Vertisol

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A B S T R A C T

A field experiment on paddy (var-BPT-5204) was conducted for eleven years (2005-06 to 2016-17) on a deep black clayey vertisol at Agricultural Research Station, Gangavati, UAS, Raichur to compare the influence of organic and conventional farming systems on productivity and grain quality parameters of rice with the following treatments viz., T_1: 100 % N through organics, T_2: 75 % N through organics,T_3: Integrated N management (50 % N through organics & 50 % N through organics), T_4: 100 % N through in-organics along with FYM @ 7 t/ha, T_5: 100 % RDF (150: 75:75 kg/ha). The experiment was laid out in a Randomized Block Design and treatments were replicated four times. The observation pertaining to crop performance and quality parameters were recorded. Results revealed that yield attributing characters viz., number of panicle, seed count and 10 panicle weight and grain yield were significantly higher due to application 100 per cent N through organics compared to other treatments. The physical, cooking and nutritional quality of rice was remained to be non -significant among the treatments due to application of organic, in-organic and their integration. But there was significant difference in Head Rice Recovery (Physical quality) due to application of 100% N through organics and also P and K (nutritional quality) compared to application of 100% N through in-organics.

Introduction

In recent years, chemical fertilizer have played significant role in providing nutrients for in providing nutrients for intensive crop production. But long-term use of chemical fertilizer in unbalanced manner has created problems of multiple nutrient deficiencies, diminishing soil fertility and un-sustainable crop yields. As our dependence on the chemical fertilizer is in-escapable, we have to devise systems where we can prolong the period of their use as for as possible. Thus, for sustainable agriculture, the renewable and

recyclable nutrient sources need to be integrated with chemical fertilizer in a manner that the high production systems of intensive agriculture are not only further improved but our soil as nature resource is also properly conserved. Keeping this in view, long-term field experiment on rice-rice system was conducted on a fixed location since 2005-06 at Agriculture Research Station, Gangavathi, to know the impact of repeated application of organic sources with or without chemical fertilizers on crop performance and quality of paddy. The information on long term effect of organic, integrated and inorganic nutrient management practises on yield attributes, yield and quality of paddy is lacking, observations were recorded during 2016-17 from the long term experiment.

Materials and Methods

The present investigation entitled "Long term effect of organic, in-organic and integrated nutrient management practices on yield and quality parameters of paddy (var. BPT-5204*)* in a Vertisol of TBP command area" is being carried out since 2005-06 on a fixed location during *Kharif* season at ARS, Gangavathi, UAS, Raichur (Northern Dry Zone-Zone 3) of Karnataka state. Experiment consisted of 5 treatments, which were replicated four times and laid out in RCBD design. The treatments were: T_1: 100 % N through organics, T_2: 75 % N through organics, T_3: Integrated N management (50 % N through organics & 50 % N through organics), T_4: 100 % N through in-organics along with FYM @ 7 t/ha, T_5: 100 % RDF (150: 75:75 kg/ha). The experimental soil characteristics were: slightly alkaline (pH 8.1); non-saline (EC 0.45 dS/m); and medium soil organic carbon (0.65%) content. Soil available N was low (220 kg/ha); available phosphorus was medium (45.0 kg P2O5 /ha); available potassium was high (650 kg K2O /ha) .The organic sources used were: crop residue, FYM, neem cake and poultry manure. The recommended dose of inorganic fertilizers were given at the rate of 150:75:75 kg N, P_2O_5, K_2O/ha and 25 kg $ZnSO_4$ /ha were applied . Nitrogen was given in three equal splits at basal, maximum tillering and panicle initiation stages, while P, K and Zn were given as basal doses only. Through organics (crop residues, FYM, poultry manure & neem cake), N dose was adjusted to recommended level based on their moisture content and 'N' concentration on dry weight basis. Recommended cultural practises were followed .Yield and quality parameters of rice were recorded as per the standard procedures.

Yield parameters

Number of panicle /sq.mt.

Number of panicle/sq.mts was significantly influenced by treatments (table 1 & fig.1). Treatment receiving 100% nitrogen through organics recorded the higher panicle/sq.mts (T1:376) and the least number of panicle/sq.mts was recorded in the treatment that receiving recommended dose of chemical fertilizer (T5:293). The reason attributed for higher number of panicle/sq.mts might be due improvement in physical condition of soil with addition of organics, better availability of nutrients in soil and absorption of nutrients in the treatment which received organic sources. Similar findings were also reported by Hemalatha *et al.,* (2000) and Shukla *et al.,* (2016).

Panicle weight and seed count per panicle

Individual panicle weight is important from final yield point of view. Supply of nutrients through organic source recorded significantly more panicle weight and seed count (4.03 g & 256, respectively) than that through chemical fertilizers (3.03 g & 192) (Table 1& fig.1). This may be due to more number of filled grains per panicle and lengthy panicles

produced, which intern resulted in higher panicle weight. These results are in conformity with the findings of Dwivedi and Thakur (2000) and Hemalatha *et al.,* (2000).

Grain yield

Significantly higher grain yield of 55.93 q/ha was recorded in the treatment which received 100% nitrogen through organic source (table 1& fig.1) followed by 75% nitrogen supplement through organics (50.93q/ha) and integration of both organic and inorganic source (48.31q/ha). The higher yield recorded is due to improved physical condition of soil, better availability of plant nutrients throughout growth period, higher microbial population and their activity as supported by data presented in previous tables, which reflected in realizing more number of panicle/sq.mts and higher yield in these treatments. It is in line with findings of Thiagarajan (1991) and Gopalasamy and Vidhyasekaran (1987).

Table.1

Table.1 Yield parameters and yield of paddy as influenced by different treatments (after 11 years)

Treatment	No. of panicle (per sq.m.)	Seed count/panicle	10 Panicle weight (g)	Grain yield (q ha^{-1})
T_1: 100 % N through organics	376	256	4.03	55.93
T_2: 75 % N through organics	331	233	3.67	50.93
T_3: 50 % N through organics & 50 % N through inorganic	358	219	3.50	48.31
T_4: 100 % N through in-organics and FYM @ 7 t/ha	363	186	2.94	39.25
T_5: 100 % RDF, 150: 75:75 kg/ha	293	192	3.03	40.25
SEm ±	8.36	11.84	0.13	0.98
CD@5%	25.76	36.50	0.42	3.03

Table.2 Physical quality parameters of paddy grains as influenced by different treatments (after 11 years)

Treatment	Hulling (%)	Milling (%)	Head Rice Recovery (%)	L/B ratio
T_1: 100 % N through organics	77.3	68.8	53.6	2.81
T_2: 75 % N through organics	77.2	68.3	50.7	2.84
T_3: 50 % N through organics & 50 % N through in-organic	77.3	69.1	50.9	2.85
T_4: 100 % N through in-organics and FYM @ 7 t/ha	77.2	69.0	50.9	2.83
T_5: 100 % RDF, 150: 75:75 kg/ha	77.2	68.7	49.9	2.79
SEm ±	0.33	0.43	0.75	0.04
CD@5%	NS	NS	2.33	NS

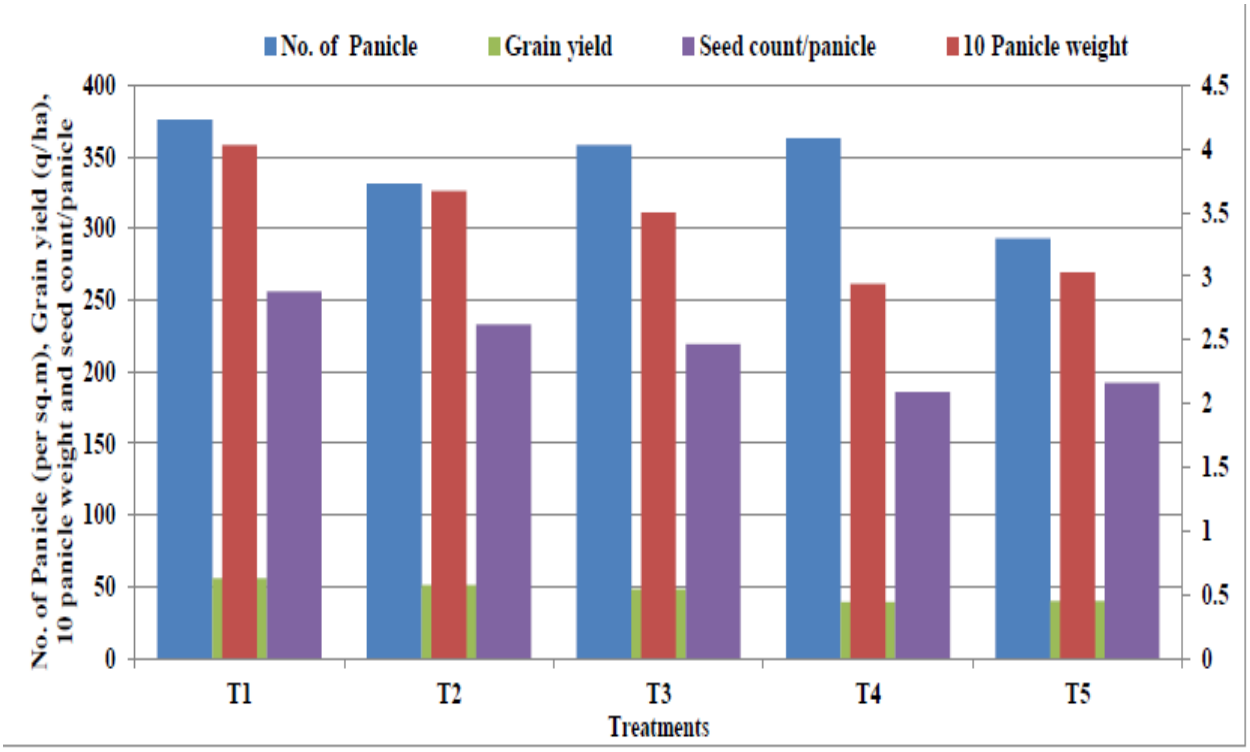
Table.3 Cooking quality parameters of paddy grain as influenced by different treatments (after 11 years)

Treatment	Amylose content (%)	Elongation Ratio (%)	Gel Consistency (%)
T_1: 100 % N through organics	19.7	1.80	40.0
T_2: 75 % N through organics	19.1	1.76	41.7
T_3: 50 % N through organics & 50 % N through in-organic	20.3	1.74	31.5
T_4: 100 % N through in-organics and FYM @ 7 t/ha	19.0	1.78	32.7
T_5: 100 % RDF, 150: 75:75 kg/ha	18.9	1.76	34.7
SEm ±	0.83	0.02	6.52
CD@5%	NS	NS	NS

Table.4 Nutritional quality parameters of paddy grain as influenced by different treatments (after 11 years)

Treatment	Protein (%)	Lysine g per 16 g N	Tryptophan g per 16 g N	P (g/kg)	K (g/kg)	Zn (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	Cu (mg/kg)
T_1: 100 % N through organics	7.05	3.67	1.12	39.4	34.9	11.3	16.7	3.02	3.63
T_2: 75 % N through organics	6.84	3.50	1.09	32.1	29.3	10.1	19.3	2.35	2.47
T_3: 50 % N through organics & 50 % N through in-organic	6.58	3.47	1.15	33.5	28.1	11.0	15.9	3.10	2.67
T_4: 100 % N through in-organics and FYM @ 7 t/ha	6.89	3.85	1.14	39.0	36.8	9.57	17.3	2.31	3.38
T_5: 100 % RDF, 150: 75:75 kg/ha	6.87	3.57	1.07	28.8	28.8	10.3	16.1	2.23	2.30
SEm ±	0.25	0.18	0.03	0.94	1.20	0.72	0.95	0.32	0.27
CD@5%	NS	NS	NS	2.90	3.70	NS	NS	NS	NS

Fig.1 Yield parameters of paddy as influenced by treatments



Legend:
T1: 100 % N through organics
T2: 75 % N through organics.
T3: Integrated N management(50 % N through organics & 50 % N through inorganic)
T4: 100 % N through inorganics and FYM @ 7 t ha^{-1}
T5: 100 % RDF, 150: 75:75 kg ha^{-1}

Nutritional parameters of rice grain

Nutritional parameters such as protein, lysine, tryptophan and micronutrients namely, Zn, Fe, Mn and Cu were not influenced significantly by application of organic sources of nutrients (table 4). However the content of P and K differed significantly among the treatments. Though there was a non significant difference in the content of protein, lysine and tryptophan, a marginal increase in their content was recorded due to supply of 100 per cent nitrogen through organic source compared to inorganic source. Similarly, there was a slight increase in the accumulation of Zn, Fe, Mn and Cu in rice grain in the treatment which received entire nitrogen through organics alone compared to in-organic source. Besides, significant increase in the content of P and K (39.4 & 34.9 g/kg) was recorded due to supplement of entire nitrogen through different organic manures, whereas the treatment which received in-organic fertilizers accumulated lower P and K content in rice grain (28.8 & 23.0 g/kg, respectively). These findings are in line with the findings of Surekha and Ali (2010).

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