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Impact of various organic sources of nitrogen on growth, yield attribbutes and yield of scented rice (*Oryza sativa* L.) under irrigated conditions of Chhattisgarh plains

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Abstract

A field experiment was conducted at Research cum Instructional Farm, IGKV, Raipur during *kharif* 2014 and 2015 to evaluate the impact of different organic sources of nitrogen on growth yield attributes and yield of scented rice. The six (6) treatments of nitrogen of organic sour *viz.* 100% N through 1/3 vermicompost+1/3 FYM+1/3 poultry manure at basal (T_1), 100% N through vermicompost at basal (T_2), 100% N through poultry manure at basal (T_3), 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (T_4), 100% N through 1/2 vermicompost as basal+ 1/2 vermicompost at 30 DAT (T_5) and Control - No application of any nutrients (T_6) were tested in randomized block design with four replications. The growth, yield attributing characters and yield of scented rice was significantly highest noted under treatment 100% N through 1/3 Vermicompost+1/3 FYM+1/3 Poultry manure at basal (T_1), which was at par to treatment 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (T_4).

Keywords: Scented rice, organic nitrogen sources, growth and yield

1. Introduction

Rice (*Oryza sativa* L.) occupies a pride place among the food crops cultivated and it has not only meets most of the needs on earth but also symbolizes revolution, industrialization, calorie and earth. It is the cause of revolution on earth in nutrition as well as on food security front (Pradhan and Moharana, 2015) [14]. In India, during the past three decades, intensive agriculture involving high yielding varieties of rice has lead to heavy withdrawal of nutrients from the soil. Further, imbalanced use of chemical fertilizers by farmers has also deteriorated soil health and declines soil organic carbon content, which is threat to sustainability. Nitrogen is commonly the most limiting nutrient for crop production in the major world’s agricultural areas and therefore, adoption of good N management strategies often results in large economic benefits to farmers.

Use of organic manures in present agriculture is increasing day by day, because of its utility not only improving the physical, chemical and biological properties of soil but also maintaining the good soil health and supplying almost all essential plant-nutrients for growth and development of crop plants. So, it is time to look for measures to stimulate sustainability in production of rice on long- term basis. Organic manures like FYM, poultry manure and vermicompost deserves priority for sustained production and better utilization in organic rice production (Dahiphale *et al.*, 2003) [4]. Organic farming is also preferred because of increasing consumer demand for safe, high quality, ethical organic foods and good monetary returns. There is a great demand for high quality products and organically grown foods in the international market and can capitalize on its potential to go for organic farming on a large scale. India had the least percentage of cultivated area under organic farming. There is thus considerable scope to increase the area under organic farming in India. The total volume of export during 2015-16 was 263687 MT. The organic food export realization was around 298 million USD (APEDA, 2015) [2]. The area under scented rice varieties is increasing day by day with the opening of the world market as well as increased domestic consumption due to their premium quality (Singh *et al.*,2008) [17]. Scented rice occupies a pivotal position in world because of their high quality and therefore earns premiumprices. In rice growing areas, organically produced scented rice has better scope to obtained better market price as well as good export opportunity. Keeping this in view, the present investigation was conducted to estimate growth and productivity of organically grown scented rice.

2. Material and methods

Field experiment was carried out at Research cum Instructional Farm, IGKV, Raipur during *kharif* 2014 and 2015. The soil of experimental field was '*Vertisols'* which is locally known as '*Kanhar'*. The soil was neutral in reaction and medium in fertility levels having low in N, medium in P and high in K. The six treatments of organic sources of nitrogen *viz.* 100% N through 1/3 vermicompost+1/3 FYM+1/3 poultry manure at basal (T_1), 100% N through vermicompost at basal (T_2), 100% N through poultry manure at basal (T_3), 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (T_4), 100% N through 1/2 vermicompost as basal+ 1/2 vermicompost at 30 DAT (T_5) and Control - No application of any nutrients (T_6) were tested on scented rice cultivar 'Indira Sugandhit Dhan-1' in randomized block design with four replications. All the organic sources of nutrients *i.e*. FYM, vermicompost and poultry manure were applied before transplanting and in split doses as per the treatments in respective plots to fulfill the nutrient requirement of 80:50:30 kg N: P_2O_5:K_2O ha^{-1}. The N, P and K content of different available organic manure/sources were determined in laboratory and accordingly, required quantity were applied in different treatment on the basis of nitrogen content (%) of organic sources**.** P was supplemented through rock phosphate (22% P_2O_5 grade) after adjusting the quantity of P supplied through manures. Entire quantity of all sources was applied as per the treatment on N basis four days before the transplanting. The following growth studies were made using the prescribed formulae:

Leaf area index (LAI)

Leaf area index (LAI) expresses the total leaf area in relation with the total ground area in which the crop is grown. LAI was determined as described by Watson (1947) [18].

$$\text{Leaf area index (LAI)} = \frac{\text{Total leaf area of plant}}{\text{Total ground area of plant}}$$

Crop growth rate (CGR)

It denotes overall growth rate of the crop per unit time, irrespective of the previous growth rate and it was calculated by using the formula as suggested by Gregory (1962) [6].

$$\text{Crop growth rate (CGR) (g hill}^{-1}\text{ day}^{-1}) = \frac{W_2 - W_1}{t_2 - t_1}$$

Where, W_2 and W_1 are the total dry weight of plant at the time t_1 and t_2 respectively.

Relative growth rate (RGR)

Relative growth rate indicates the increase in dry weight per unit of original dry weight over specific time interval. It was computed by using the formula as suggested by (Hoffman *et al.*, 2002) [7].

$$\text{Relative growth rate (g g}^{-1}\text{ day}^{-1}\text{ hill}^{-1}) = \frac{LnW_2 - LnW_1}{t_2 - t_1}$$

Where, LnW_1 and LnW_2 are the natural logarithm of total dry weight of plant at the time interval t_2 and t_1 respectively.

3. Results and Discussion

The impact of organic nitrogen sources on growth, yield attributes and yield of scented rice are summarized below.

Impact on Leaf area index of scented rice

Leaf area index increased from 30 DAT to 90 DAT, but the pace of increase was more from 30 DAT to 60 DAT and it decreased from 60 DAT to 90 DAT. Among the different organic sources of nitrogen treatments, significantly higher leaf area index at 30, 60 and 90 DAT was recorded under treatment 100% N through 1/3 Vermicompost+1/3 FYM+1/3 poultry manure at basal as compared to others. However, at 30 DAT, treatment 100% N through vermicompost and poultry manure at basal as well as treatments 100% N through 1/2 poultry manure at basal + 1/2 vermicompost at 30 DAT and 100% N through 1/2 vermicompost + 1/2 vermicompost at 30 DAT at 60 and 90 DAT also recorded comparable values (fig.1).

Crop growth rate (g $day^{-1}hill^{-1}$)

Crop growth rate increased from 0-30 DAT to 30-60 DAT and later on it declined from 60-90 DAT to 90 DAT- at harvest. Among various organic nitrogen sources, treatment with 100% N through 1/3 vermicompost+1/3 FYM+1/3 poultry manure at basal at 0-30 DAT, 30-60 DAT and 60-90 DAT recorded significantly higher crop growth rate as compared to others, but it was at par to treatment 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT at the above periods. Whereas, 90 DAT - at harvest, treatments had no significant effect on crop growth rate (fig.2).

Relative growth rate (g g^{-1} day^{-1} $hill^{-1}$)

Relative growth rate progressively decreased with advancement of crop age.

Relative growth rate at different periods of observation remained unaffected due to various organic nitrogen sources (fig.3).

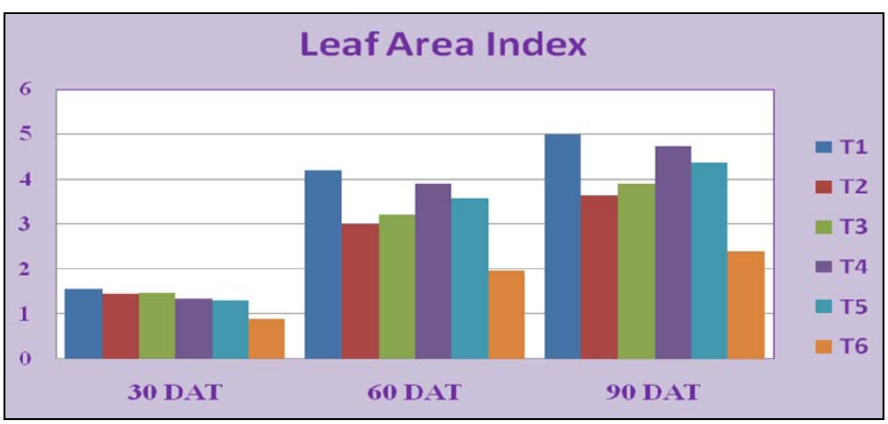

Fig 1: Leaf area index at various durations of scented rice as influenced by different organic sources of nitrogen (Mean of 2014 and 2015)

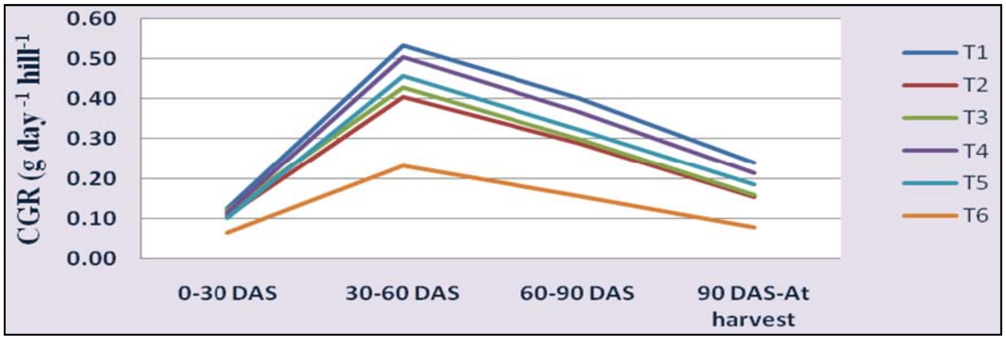

Fig. 2: Crop growth rate (g day-1hill-1) at various durations of scented rice as influenced by different organic sources of nitrogen (Mean of 2014 and 2015)

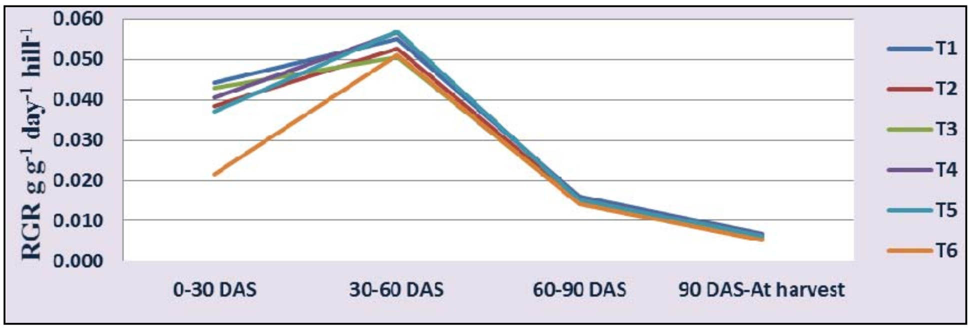

Fig 3: Relative growth rate (g g-1 day-1 hill-1) at various durations of scented rice as influenced by different organic sources of nitrogen (Mean of 2014 and 2015)

The variation in plant growth due to different organic manures was due to variation in availability of nutrients and their release pattern of nutrient (Rao *et al*., 2013) [15]. The treatment 100% N through 1/3 vermicompost + 1/3 FYM + 1/3 poultry manure at basal (T_1) produced highest growth parameters like LAI, CGR and RGR might be due to direct and higher availability and translocation of nutrients during development phase of crop growth, which accelerated the metabolic and physiological activity of the plant and put up more growth by assimilating more amounts of nutrients and facilitated more photosynthesis process and ultimately increased the growth parameters viz. LAI, CGR and RGR of scented rice. Similar findings were also reported by Pandey *et al.* (1999) [12]. and Lal *et al*. (2009) [8].

Impact on yield attributes and yield of scented rice

The data on yield attributing characters as influenced by different organic sources of nitrogen are presented in Table 1. Among the different organic sources of nitrogen treatments, significantly longest and heaviest panicle were recorded under 100% N through 1/3 Vermicompost+1/3 FYM+1/3 Poultry manure at basal (T_1), however, it was found comparable with 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (T_4). On the other hand, control plot (T_6) produced the shortest and lightest panicle. Netam *et al*. (2008) [11] concluded that the integrated application of organic manure *viz.* GM + FYM + poultry manure produced significantly higher panicle length, panicle weight and grain yield. Similarly treatment with 100% N through 1/3 Vermicompost+1/3 FYM+1/3 poultry manure at basal (T_1) showed significantly higher number of grains panicle^{-1} and filled grains panicle^{-1} as compared to others, but it was at par to treatment 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (T_4). However, unfilled grains panicle^{-1} and sterility percentage of scented rice remained unaffected due to different treatments of organic sources of nitrogen. Patel (2012) reported that application of cow dung manure (CDM) + composted crop residue (CCR) + vermicompost (VC) + BGA + PSB + *Azospirillum*+ rock phosphate + panchagavya recorded higher values of yield attributing characteristics like number of effective tillers, filled grains panicle^{-1}, panicle length, panicle weight and test weight. This is due to greater availability of nutrients and microbial stimulation effects of organic manures and gradual mineralization of N (Roy and Singh, 2004) [16] and might also be due to greater availability of nutrients from combined application of organics which increasing the N level and sink capacity, which ultimately resulted in increasing the yield attributes of scented rice. Among organic sources of nitrogen, significantly highest grain and straw yield of scented rice was recorded under treatment 100% N through 1/3 vermicompost + 1/3 FYM+1/3 poultry manure at basal (T_1), which was at par to treatment 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (T_4). Higher grain yield of Basmati rice was also obtained by Singh *et al*. (2011) [17] with the combined application of four organic sources of nutrients (*Azolla*, BGA, FYM and VC) over absolute control. Organic nutrition has increased the plant vigour with higher absorption of nutrients resulted in higher productive tiller production and ultimately higher grain yield (Nagaraju and Krishnappa, 1995) [10].The yield advantage on the application of organic sources is due to their capability to supply essential nutrients in addition to N, P and K (Alagappan and Venkitaswamy, 2016) [1]. The organic manure compost lies in the fact that it can supply the nutrients in soluble form for a quite longer period by not allowing the entire soluble form into solution, to come in contact with soil and other inorganic constituents, thereby minimizing fixation and precipitation from the manures, the plant roots can very well compete with loss mechanisms and absorb more nutrients leading to better yield (Mohandas *et al.*, 2008) [9]. Bejbaruah *et al*. (2013) [3] reported that the higher availability of nitrogen in soil with split application of manure coincides with higher NUE, and thus, split application did not promote N losses. Similar results were also recorded by Gangwar and Dubey (2013) [5].

Table 1: Growth, yield attributes and yield of scented rice as influenced by different organic sources of nitrogen (mean of two years)

Treatment	Panicle length (cm)	Panicle weight (g)	Total number of grains panicle^{-1}	Filled grains panicle^{-1}	Unfilled grains panicle^{-1}	Sterility (%)	Grain yield (q ha^{-1})
T_1 - 100% N through 1/3 vermicompost+1/3 FYM + 1/3 poultry manure at basal	26.63	2.84	174	140	34	19.03	39.55
T_2 - 100% N through vermicompost at basal	23.12	2.34	138	109	29	20.58	34.82
T_3 - 100% N through Poultry manure at basal	23.26	2.41	139	113	26	18.46	35.20
T_4 -100% N through ½ poultry manure at basal + ½ N through vermicompost at 30 DAT	25.73	2.64	163	132	31	18.79	38.25
T_5 -100% N through ½ vermicompost at basal + ½ vermicompost at 30 DAT	23.79	2.51	148	121	28	18.34	35.79
T_6 – Control	18.89	1.98	120	94	25	20.92	21.83
SEm ±	0.56	0.08	4	3	5	3	0.96
CD (P=0.05)	1.68	0.25	13	10	NS	NS	2.88

4. Conclusion

It can be concluded that, among the organic sources of nitrogen, treatment 100% N through 1/3 Vermicompost+1/3 FYM+1/3 Poultry manure at basal (T_1) was found superior in terms of growth, yield attributes and yield of scented rice as compared to other treatments. However, it was comparable to treatment 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (T_4).

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