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Evaluation of the Performance of Basmati Rice (*Oryza sativa*) Transplanting at Different Dates with Nutrient Sources under the Method of SRI

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ABSTRACT

Background: With growing fertilizer prices and fertilizer-related environmental concerns, Basmati 370 holds a unique position in the rice world due to its price, fragrance, quality and low fertilizer demands as compared to hybrid varieties; thus, shifting this crop to an organic or integrated nutrient management system is a feasible option.

Methods: A field experiment was carried out at Jammu (J and K) during the *Kharif* season of 2014 to evaluate the performance of Basmati 370 transplanted at three different dates with five integrated nutrient sources.

Result: The results of this investigation indicated that the rice transplanted on June 30 produced significantly higher dry matter accumulation (857.61 g/m^2) with a concomitant increase in the grain yield (3.3 t/ha) over July 15 (3.0 t/ha) and July 30 (2.8 t/ha). The application of 100% RDF in the form of inorganic fertilizer recorded significantly higher grain yield (3.3 t/ha) and straw yield (5.6 t/ha) being at par with VC+FYM+NOC and GM+VC. The highest net returns were recorded on June 30 transplanting (`80,501) with a benefit-cost ratio of 2.8. In the case of nutrient sources, higher net returns were fetched with 100% RDF (84,892) with a benefit-cost ratio of 3.4.

Key words: Basmati rice, Dates of transplanting, Organic sources, SRI.

INTRODUCTION

Rice (*Oryza sativa* L.) has been recognized as one of the most widely grown crops in the sub-tropical irrigated belt of Jammu and Kashmir on acreage with production and productivity of 2.71 lakh hectares, 5567 thousand quintals, 20.51 q/ha, respectively (Anonymous, 2014). Aromatic or basmati rice is the main crop of the farmers of sub-tropical irrigated belts of the Jammu region. In the Jammu region, the total area under rice is 111 thousand hectares and out of which 30 per cent is under basmati rice, which has a yielding potential of about 28-35 q/ha (Anonymous, 2014). Considering the importance of basmati rice in the Indian economy as an important asset for a country that fetches a special price in the international market and is a major source of foreign exchange of about 22,718.44 crores in terms of export earnings of India (Anonymous, 2015) but the productivity of basmati rice in Jammu is lesser than the national average (22.98 q/ha). Kumar, 2014 and Kumar, 2012 reported that proper demonstration of technology and development of location-specific integrated nutrient management (INM) technology would lead to improved soil health and ultimately sustain the yield.

Therefore, it becomes imperative to improve its production vertically rather than horizontally. It is an established fact that not only does the monitory input play important role in targeting the higher yield and profitability but also the non- monitory inputs are having a significant role.

The increasing scarcity of water for agriculture is becoming a major problem in many countries, particularly in the leading rice-producing countries like China and India, where competition for freshwater and growing demands of water for other sectors. In water scarcity situations, the use of water-saving approaches such as aerobic rice, direct-seeded rice and system of rice intensification (SRI) may prove beneficial for improving rice productivity (Ram *et al*., 2014). The SRI is the best alternative to a conventional method of rice cultivation that saves the expensive external inputs, improves soil health and protects the environment substantially (Ram *et al*., 2014). To ensure and enhance the success of SRI in relation to yield and quality of basmati rice, therefore, the transplanting at different dates with various organic fertilizers like green manuring, brown manuring with *Sesbania spp*. will play an important role by improving the water holding capacity and health of the soil, which may be resulted in optimizing rice productivity.

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Materials and Methods

A field experiment was conducted during the year 2014 at the Division of Agronomy, Main Campus, Chatha of the Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (J and K), which is situated at (32°-40′ N and 74°-58′ E with an altitude of 332 m above mean sea-level). The climate of the experimental site was subtropical with a hot and humid rainy season, hot days in summer, warm autumn and cool winter. The soil of the experimental site was sandy clay loam, slightly alkaline in reaction, low in organic carbon (0.35%) and available nitrogen (231.73 kg/ha) but medium in available phosphorus (13.86 kg/ha) and potassium (156.93 kg/ha). The experiment was laid out under a randomized block design, which consisted of three dates of transplanting (June 30; July 15 and July 30) and five nutrient sources (100% inorganic fertilizer (RDF); brown manuring with Sesbania spp. + 25% inorganic fertilizer (RDF); brown manuring with *Sesbania* spp (100%- only brown manuring was done without application of any proportion of RDF); FYM+vermicompost +neem oil cake (1:1:1- the N content of FYM vermicompost and neem cake was analyzed in the laboratory and accordingly quantity of said nutrients was applied to that contain an equal proportion of nitrogen) and green manuring with *Sesbania spp*+vermicompost (1:1 on N content basis). Rice variety basmati-370 was used in the study. Green manure crop was raised and incorporated in soil at 30 days crop stage, 10 days before puddling. The FYM, vermicompost and non-edible oil cake were applied 20 days before transplanting, whereas *Sesbania* in brown manuring treatments was sown one day after transplanting and knocked down by spraying 2-4, D at 30 days crop stage. Application of inorganic nutrients as RDF of 30-20-10 kg NPK/ha was applied. Nitrogen was applied in three splits *i.e.* 1/2 as basal and the remaining half in 2 equal splits at maximum tillering and panicle initiation stage as per the treatment. Transplanting of 12 days old seedling was done at a spacing of 25 cm × 25 cm apart. Growth and yield attributes were recorded at 30 days intervals the growth analysis was done using growth analysis formulae (Radford, 1967). The yields were recorded from the net plot area and expressed as t/ha. Economics was also calculated based on the prevailing cost of inputs and minimum support price (MSP) of grain and the local price of straw. All the data were statistically analyzed using the analysis of the variance (ANOVA) technique (Cochran and Cox, 1957). The critical differences at a 0.05% level of probability were calculated to assess the significance between treatments.

Results and Discussion

Transplanting dates and nutrient sources had a non-significant effect on plant height, relative growth rate and test weight of basmati rice (Table 1). Whereas the June 30 date of transplanting recorded a significant increase in dry matter accumulation, which was statistically at par with July 15 but superior over July 30. Among nutrient sources, maximum dry-matter accumulation (884.78 g/m^2) was recorded with the application of 100% inorganic nutrient followed by the application of FYM+vermicompost+neem oil cake, which accumulated 831.79 g/m^2 at harvest. June 30 date of transplanting increased LAI (3.43) significantly over July 15 and July 30. The basmati crop transplanted on June 30 recorded significantly more effective tillers/m^2 over July 15 and July 30. The earlier date of transplanting had a

Table 1: Growth and yield parameters of basmati rice as influenced by transplanting dates and nutrient sources.

Treatment	Plant height (cm)	Dry matter g/m^2 (At harvest)	CGR (30 to 60 DAT) (g/m^2/day)	RGR (30 to 60 DAT) (g/g/day)	LAI (60 DAT)	Effective tillers (m^2)	Grain sterility (%)	Test weight (g)
Transplanting date								
June 30	126.0	857.6	5.84	1.95	3.43	244	21.9	20.9
July 15	125.3	820.8	5.73	1.93	3.23	231	20.0	20.8
July 30	121.8	763.7	5.34	1.87	2.82	218	18.4	20.5
SEm±	2.4	12.3	0.12	0.35	0.05	3	0.7	0.2
CD (P=0.05)	NS	35.7	0.36	NS	0.15	9	2.1	NS
Nutrient source								
100% inorganic	125.9	884.8	6.25	2.00.	3.37	253	21.5	20.9
Brown manuring + 25% RDF	125.0	784.7	5.45	1.98	3.12	221	19.3	20.8
Brown manuring 100%	120.4	743.3	4.98	1.82	2.96	210	20.2	20.4
FYM+Vermicompost + neem oil cake (1:1:1)	125.5	831.8	5.83	1.95	3.20	236	19.6	20.8
Green manuring + Vermicompost (1:1)	124.8	825.7	5.68	1.92	3.15	234	20.0	20.8
SEm±	3.1	15.9	0.16	0.46	0.07	4	0.9	0.3
CD (P=0.05)	NS	46.1	0.46	NS	0.20	11	NS	NS

*CGR: Crop growth rate; RGR: Relative growth rate; LAI: Leaf area Index.

Table 2: Yield and economics of basmati rice as influenced by transplanting dates and nutrient sources.

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)	Cost of cultivation (×10^3 ` / ha)	Net returns (×10^3 `/ha)	Benefit: cost ratio
Transplanting date						
June 30	3.3	4.9	35.8	29.0	80.5	2.8
July 15	3.0	4.6	36.9	28.6	72.7	2.5
July 30	2.8	4.2	36.0	28.2	64.6	2.3
SEm±	0.1	0.1	0.63			
CD (P=0.05)	0.2	0.3	NS			
Nutrient sources						
100% inorganic	3.3	5.6	37.1	25.0	84.8	3.4
Brown manuring + 25% RDF	2.9	4.2	36.7	24.4	72.4	2.9
Brown manuring 100%	2.6	4.0	34.9	24.1	63.7	2.6
FYM + Vermicompost + neem oil cake (1:1:1)	3.0	4.6	36.3	41.2	59.8	1.5
Green manuring + Vermicompost (1:1)	3.0	4.5	36.1	28.2	71.6	2.5
SEm±	0.1	0.1	0.8			
CD (P=0.05)	0.3	0.4	NS			

prolonged vegetative phase, which might have resulted in increased leaf area index and dry matter accumulation. These results corroborate the findings of Nayak *et al.* (2003), Singh *et al.* (1997) and Mannan *et al.* (2009). Among different nutrient sources, 100% RDF observed a significantly higher number of effective tillers, dry matter, Crop growth rate (CGR) and leaf area index (LAI) over other treatments. Talking about organic sources these parameters were significantly higher with the application of organics, FYM+ vermicompost+neem oil cake was found at par with green manuring+vermicompost but then brown manuring+25% RDF and brown manuring (100%). The basmati rice transplanted on July 30 though at par with July 15 produced significantly lower grain sterility (20.0%) than transplanted on June 30 but remained non-significant under different nutrient sources. Similar results were obtained by Choudhary *et al.* (2011).

Basmati rice transplanted on June 30 produced significantly higher grain yield (3.3 t/ha) and straw yield (4.9 t/ha) than the other two dates of transplanting (Table 2). June 30 and July 15 transplanting dates were at par in terms of straw yield. Application of 100% RDF increased the grain yield (3.3 t/ha) of basmati rice significantly over other organic nutrient sources except for FYM+ vermicompost+neem oil cake and green manuring+ vermicompost. The significantly highest straw yield of basmati rice was observed on June 30 than on other dates of transplanting. The application of 100% inorganic nutrient showed significantly higher yield, which might be due to the availability at the initial growth stages of crop and adequacy of nitrogen probably favored various physiological processes including cell division and cell elongation of the plant resulting in better growth and development. These results are similar to the findings of Kumar *et al.* (1995).

Results based on economics (Table 2) revealed that the highest net returns were recorded in June 30 transplanting (` 80,501) with the benefit-cost ratio of 2.8 over July 15 (` 72,773 and B: C ratio of 2.5) and July 30 (` 64,653 and B: C 2.3). This might be due to early transplanting and a prolonged growth period giving higher yield resulting in high net returns (Fayaz *et al.*, 2015). The cost of cultivation decreased with delay in transplanting because of lower input regarding irrigation and weed management. In the case of nutrient sources, higher net returns were fetched in treatments supplied with 100% RDF (`84,892) with the benefit-cost ratio of 3.4 followed by brown manuring+25% RDF (2.9) as compared to the application of other organic sources of nutrients. The B:C in mentioned organic treatment was high due to comparatively lower input cost and higher yield.

CONCLUSION

Based on one-year data, it may be concluded that June 30 transplanting date was found more beneficial as it gave significantly higher grain and straw yield with a higher net returns benefit-cost ratio than July 15 and July 30. Among the nutrient sources, the 100% inorganic dose of fertilizer (recommended dose) followed by brown manuring+25% RDF was found to be the most suitable for achieving maximum economic yield.

Conflict of interest: None.

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