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Economic Evaluations of Short Duration Coarse Rice under Direct Seeded and Transplanted Conditions with Different Doses of Nitrogen Fertilizer

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ABSTRACT: During the kharif season of 2020, a field experiment was conducted at the farm of College of Agriculture, Kaul (Kaithal) of CCS Haryana Agricultural University, Hisar. The main objective of the experiment was to examine how a short-duration non-scented rice variety named HKR-48 responded to nitrogen fertilization under two different crop establishment methods. The experiment utilized a randomized block design (RBD) factorial design, with the two establishment methods (direct seeding and transplanting) as the main plot treatments, and six levels of nitrogen (0, 30, 60, 90, 120, and 150 kg/ha) as the sub-plot treatments, with three replications. The results showed that the transplanted crop exhibited significantly higher grain yield and straw yield compared to the direct-seeded crop, with rise of 11.9% and 5% respectively. Although the cost of the transplanted crop was 21.6% higher, the 11% increase in gross returns compensated for it, resulting in equal net returns between the two establishment methods. Increasing the nitrogen dose from the control to 150 kg N/ha significantly improved grain and straw yield, but there were no significant differences between the doses of 120 and 150 kg N/ha. With each additional nitrogen application over the control, there was a gradual increase in gross returns, net returns, and benefit-cost ratio.

Keywords: Rice, Nitrogen, DSR, TPR, Economics, B:C.

INTRODUCTION

Rice is a staple crop, extensively cultivated in many countries, particularly in Asia. India holds the largest rice farming area, with 43.8 million hectares, and is the second-largest producer globally after China, with a production of 121.4 million metric tons (Anonymous, 2020). In recent years, there has been a shift in farmers' preference from coarse rice to basmati rice due to its economic advantages. However, the availability of a minimum support price for coarse rice has led to a renewed interest in dwarf rice among farmers. Now a days course rice is gaining impetus because of its guaranteed output and procurement at minimum support price.

Traditional methods of transplanting rice have resulted in excessive water usage, leading to negative environmental and soil effects such as declining water tables, increased methane emissions, compacted soil layers, reduced permeability, and decreased productivity of subsequent crops (Sharma *et al.*, 2003). As a result, direct seeding of rice (DSR) has emerged as a more sustainable and efficient approach. DSR conserves water, reduces methane emissions, requires less labor, lowers input costs, and prevents the formation of compacted soil layers, promoting better growth of subsequent crops. Nitrogen is a crucial element influencing rice growth and yield, impacting factors such as tillering, panicle formation, grain development, and overall grain yield. It is essential to apply the appropriate amount of nitrogen fertilizer to achieve optimal crop yield, quality, environmental sustainability, and economic considerations, especially in intensive rice cultivation. Coarse rice, in particular, requires higher nitrogen levels compared to aromatic rice. Therefore, determining the most suitable nitrogen fertilizer amount is critical for achieving higher yields in coarse rice farming.

In different crop establishment methods like direct seeding, it is important to assess the response of nitrogen application. Nutrient dynamics in DSR may differ from traditional transplanting methods due to alternating wetting and drying conditions. Taking these factors into account, the current experiment was undertaken to investigate the effect of different crop establishment methods and nitrogen levels on the economic aspects of coarse rice cultivation.

MATERIALS AND METHODS

The field experiment was carried out in the Kharif season of 2020 at the Research Farm of CCS HAU, College of Agriculture, Kaul (Kaithal), Haryana. The soil in the field had a sandy clay loam texture and moderate organic carbon content (0.52%). The soil's nutrient composition showed low available nitrogen (182 kg/ha), medium phosphorus (32 kg/ha), and high potash (385 kg/ha) levels. The pH of the soil was slightly alkaline (8.1), and the electrical conductivity (EC) was 2.8 dS/m. The rice variety used in the experiment was HKR-48. The experimental design used was a randomized block design (RBD) factorial design, with two establishment methods (direct seeding and transplanting) as the main plots and six nitrogen levels (0, 30, 60, 90, 120, and 150 kg/ha) as the subplots. The experiment was replicated three times.

After harvesting, the paddy from each plot was threshed and weighed at a moisture level of 14%. These weights were then converted to grain yield (kg)/ha. The biological yield was determined by combining the weights of grain and straw from each plot after sun-drying the straw for 5 days. The biological yield of each plot was then converted to biological yield (kg/ha).

Economic evaluations were made to assess the financial aspects of the experiment. The following parameters were considered:

1. Gross return (Rs/ha): The gross return for each treatment was determined by considering the prevailing market rates at the time of selling the crop, which were Rs 1888/quintal for rice grain and Rs 60/quintal for rice straw.

2. Net return (Rs/ha): The cost of production was calculated based on the market prices of the inputs used throughout the crop season. The net return was obtained by subtracting the cost of cultivation (Rs./ha) from the gross return (Rs./ha).

3. Benefit-Cost ratio (B:C): The B:C was computed for each treatment to assess the economic viability. This ratio indicate the benefits derived from the treatment in relation to the costs incurred. The B:C ratio was calculated using the formula: B:C = Gross return (Rs./ha) divided by Cost of cultivation (Rs./ha).

RESULTS AND DISCUSSION

The adoption of direct seeding of rice (DSR) led to a 21.6% reduction in the cost of cultivation (amounting to Rs. 10,550/ha) compared to traditional transplanting method. This reduction was attributed to the elimination of puddling, nursery raising, and seedling transplanting. On the other hand, the DSR method resulted in approximately 12% higher yields, leading to an increase of Rs. 10,625/ha in gross returns compared to transplanting (TPR). The net returns for direct-seeded and transplanted crops were Rs. 55,346/ha and Rs 55,421/ha, respectively. The benefit-cost ratio (B:C) was 39.8% higher in DSR (1.45) than in TPR (1.13). These findings are in line with previous studies conducted by Kumar and Ladha (2011); Nainwal and Verma (2013); Lamma and Marahatta (2017); Bandumula *et al*. (2018).

Regarding nitrogen doses, the highest cost of production (Rs. 44,727/ha), gross return (Rs 110,165/ha), net return (Rs. 65,438/ha), and B:C (1.48) were observed under the application of 150 kg N/ha. Conversely, the control treatment had the lowest values. Gross return, net return, and B:C increased as nitrogen dosage increased from the control to 150 kg N/ha. The higher net return and B:C under 150 kg N/ha were attributed to increased yields. Although the production cost was higher under 150 kg N/ha, the rate of increase in cost was not greater than the rate of increase in net return. As a result, a higher B:C was observed at 150 kg N/ha. These results are consistent with the findings of Patel *et al.* (2018); Patel *et al.* (2019) (Tables 1-3).

Table 1: Yield of coarse rice as affected by methods of establishment and nitrogen levels.

Treatments	Yield			
	Grain yield (kg/ha)	**Straw yield (kg/ha)**	**Biological yield (kg/ha)**	**Harvest index (%)**
DSR	4754	5943	10698	44.4
TPR	5319	6243	11572	45.9
SE(m) ±	28	36	65	0.1
CD (P=0.05)	84	105	192	0.3
Nitrogen levels (kgha^{-1})				
N_1:0	4111	4975	9116	45.1
N_2:30	4658	5661	10319	45.1
N_3:60	5048	6127	11175	45.1
N_4:90	5294	6350	11644	45.4
N_5:120	5488	6647	12135	45.2
N_6:150	5620	6799	12419	45.2
SE(m) ±	49	62	112	0.2
CD (P=0.05)	145	182	332	NS

Table 2: Cost of cultivation (Rs./ha) under different methods of establishment with no nitrogen.

	Methods of establishment	
Different operations	**TPR**	**DSR**
Nursery sowing and preparatory tillage	6750	2975
Pre-sowing irrigation	425	425
Seed	1225	1225
Sowing/transplanting	9000	2250
Ridging	475	475
DAP	2975	2975
Potash	2000	2000
Zinc Sulphate	665	665
Irrigation	7625	4475
Plant protection	6625	6625
Weed management	900	4025
Harvesting	8812	8812
Total	47777	36927

Table 3: Economics of coarse rice under different methods of establishment and nitrogen levels.

Treatments	**Economics**			
Methods of establishment	**Cost of cultivation (Rs. ha^{-1})**	**Gross return (Rs. ha^{-1})**	**Net return (Rs. ha^{-1})**	**B:C**
DSR	38189	93535	55346	1.45
TPR	48739	104160	55421	1.13
Nitrogen levels (kg ha^{-1})				
N_1:0	42202	80616	38414	0.92
N_2:30	42707	91349	48642	1.15
N_3:60	43212	98979	55767	1.31
N_4:90	43717	104374	60657	1.40
N_5:120	44222	107601	63379	1.45
N_6:150	44727	110165	65438	1.48

CONCLUSIONS

The rice variety HKR-48 demonstrated superior performance when transplanted instead of directly seeded. Transplanted crop exhibited a notable increase in grain yield (11.9%) and straw yield (5%) compared to directly seeded crop. Despite the higher cultivation cost associated with transplanting (21.6% higher), the 11% higher gross return offset the difference, resulting in equivalent net returns for both establishment methods. The application of increasing nitrogen doses from the control to 150 kg N/ha had a significant positive impact on grain and straw yield. However, there were no significant differences between the yields obtained with 120 kg N/ha and 150 kg N/ha.

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Conflict of Interest. None.

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