**Comparative study of Dry Direct Seeded and Transplanted Rice in the Eastern Part of Uttar Pradesh, India**

**ABSTRACT**

The study was aimed at comparing dry direct seeding and transplanted systems of rice cultivation with the participation of farmers concerning rice growth, yield, water productivity, and economic returns. The study was carried out by Krishi Vigyan Kendra, Malhana, Deoria, Uttar Pradesh, under the administrative control of ICAR-IIVR, Varanasi, Uttar Pradesh, India during Kharif 2023 and Kharif 24. A total of 33 FLDs conducted in 2023 and 30 FLDs during 2024 at Deoria District as well as the KVK farm under dry direct seeding conditions with the Pusa Sambha 1850 paddy variety seeded in the midweek of June and harvested in the first to midweek of November. The rice grain yields of 11-12 percent were higher under DDSR during both the demonstration periods. Results of this study indicated that higher grain yield with dry direct seeding rice can be achieved by using rice cultivars that can produce more productive tillers and longer panicles. The 8003 Rs and 7988 Rs/ha cost of cultivation were saved under the dry direct seeding of rice than the transplanted rice during study period. Therefore the net return was 17387 and 20178 Rs. higher under DDSR than TPR during study periods. The benefit cost ratio 39.56 and 43. 37 percent higher compared with the transplanted rice in the demonstrated years. The dry-direct seeded of rice is more suitable, more the water saving, labor saving as well as the saving of the environment and more economical for paddy cultivation in eastern part of India. Furthermore, we require more demonstrations at various locations in this region.

**Keywords:** Front Line Demonstration, Dry Direct Seeding, Transplanting, Cost of Cultivation, Gross return, Paddy

**1. Introduction**

Rice (*Oryza sativa* L.), is grown widely throughout all continents as one of the world's staple crops, but primarily in Asia. The world's population is expected to double by 2050, which means that the targeted 70% increase in rations until 2050 will require an average annual increase in food production of 44 million metric tons, which should be maintained for the next 40 years (FAO, 2009). However, 35% of rice-producing regions are currently experiencing yield stagnation (Ray *et al.*, 2012), which could have a significant impact on global food security if rice production does not improve (Meena et al., 2022). Additionally, the possibility of alternative systems for developing and implementing better rice production using limited resources with minimal environmental impact is becoming necessary due to increased competition for land, energy, and water, as well as the growing negative environmental impact of current food production (*Tilman et al*., 2001; Ishfaq et al., 2020; Xu et al. 2019).India produced 137.83 million tons of rice in 47.82 million hectares of land with a productivity of 2882 kg/ha in 2023-24 (Agricultural Statistics at a Glance, 2023), ranking second in production in the world only to China. Uttar Pradesh produced 16.14 million tons of rice in 5.90 million hectares of land with a productivity of 2737 kg/ha in 2023-24 (Agricultural Statistics at a Glance, 2023). Uttar Pradesh is a large producer of rice across the country in 2023-24.The main problems faced by the rice growers for the sustainability of rice ecosystems is to increase production in line with population expansion with lesser inputs.. Irrigated rice systems account for 78 percent of all rice production. In India, direct seeded rice (DSR) can boost farmers' incomes by lowering expenses and raising yields.

**2. Material and Method**

The evaluation of the differences between dry direct seeded (DDS) and transplanted rice systems (TPR) was done using experimental data generated in FLDs at farmers' fields during Kharif 2023 and 2024.The study was carried out by Krishi Vigyan Kendra, Malhana, Deoria, Uttar Pradesh, under the administrative control of Indian Council of Agriculture Research-Indian Institute of Vegetable Research (ICAR-IIVR) Varanasi, Uttar Pradesh, India. A total of 30 FLDs in kharif 2023 and 33 FLDs in kharif 2024 were conducted among the farming community of Deoria District as well as the KVK farm under dry direct seeding conditions for PusaSambha 1850 paddy variety. The crop was seeded by a seed cum ferti-drill machine in the midweek of June and harvested in the first to midweek of November. The total cost, gross return, net return, and return-cost ratio of demonstrations were calculated as per the standard method. The yield and economic analysis were recorded for comparisons of the dry direct seeding condition with the traditional transplanting method used by the farming community. The critical inputs in the form of quality seed of PusaSambha 1850 were provided for FLDs by KVK to the farmers. The technical guidance was provided by the KVK staffs on various field operations like seeding, nutrient management, weed management, water management, plant protection measures, harvesting, and threshing, etc. The demonstrated technologies in the FLDs are presented in Table 1 and compared with traditional methods.

**Table 1: Agronomical practices used under front line demonstration and farmers practices**

|  |  |  |
| --- | --- | --- |
| **Growing Practice** | **Front Line Demonstration** | **Farmer Practice** |
| Farming Situation | : Irrigated sandy loam soils | Irrigated sandy loam soils |
| Varieties | : Pusasambha 1850 | Pusasambha 1850 |
| Date of DSR/Nursery Sowing | : Mid week of June | Mid week of June |
| Method of Sowing | : Dry Direct Seeding | Transplanting |
| Seed Rate (kg/ha) | : 35 kg/ha | 50 kg/ha |
| Seed Treatment | : Fungicide | Fungicide |
| Fertilizers (kg/ha) | : 120 N, 60 P, 50 K and 20 ZnSO4 | 120 N, 60 P, 50 K and 20 ZnSO4 |
| Herbicides | : Yes | Yes |
| Irrigation (No.) | : 2-3 | 2-3 |
| Date of harvesting | : First week of November | First week to mid week of November |

The biological yield, harvesting index, extension gap and technological gap were calculated by using the following formulas as given below

Biological yield = Grain yield + Straw Yield……….(i)

Harvest Index = Economical yield/Biological Yield X 100……….(ii)

**Economic study of front-line demonstration**

A number of aspects, such as the cost of cultivation, gross returns, net returns, and the B:C ratio, were assessed in order to calculate the economic study of different systems.

Cost of Cultivation = All input X prevailing market price…………………….(iii)

Gross Returns = Main and by product of crops X Prevailing market price…(iv)

Net Returns = Gross Returns ̶ Cost of cultivation……………………… (v)

Benefit: Cost ratio (B: C) = Gross Returns ̸ Cost of cultivation…………………………(vi)

**3. RESULT AND DISCUSSION**

**3. Interpretation of growth and Yield attributes**

**3.1.1 Plant Height**

The maximum plant height (118.5 cm) was recorded under transplanting rice than dry direct seeded rice, which was 1.01% higher than the dry direct seeded of rice in the Kharif 2023. While the maximum plant height (119.2 cm) was recorded under transplanting rice than the dry direct seeded rice, which was 2.05% higher than the dry direct seeded rice in the Kharif 2024 (Figure 1).

**Fig.1: Performance of plant height (cm) under DDSR and TPR in Eastern Uttar Pradesh.**

**3.1.2 Number of Tillers/Plant**

The data presented in Figure 2 highest number (772) of tillers m-2 were found under the dry direct seeded rice than the transplanted rice, which was 13.04 percent higher than the transplanting method in the kharif 2023. Therefore highest number of tillers m-2 (712) were recorded under the dry direct seeding rice than the transplanted rice, which was 11.11 percent higher than the transplanted rice in the Kharif 2024 (Figure 2).

**Fig. 2: Performance of number of tillers (m-2) under DDSR and TPR in the Deoria, District of Uttar Pradesh**

**3.1.3 Panicle Length (cm)**

Results revealed that the demonstration of Pusa Sambha 1850 recorded a maximum panicle length (19.9 cm) under dry direct seeded than the transplanted rice, which was 10.55% higher than transplanting method during the Kharif 2023. Hence the highest panicle length (21.6 cm) was recorded under dry direct seeding than the transplanted method, which was 11.91 percent higher than the transplanted rice during the Kharif 2024 (Fig.3).

**Fig. 3: Performance of panicle length (cm) under DDSR and TPR in Eastern Uttar Pradesh.**

**3.1.4 Number of Grains/Panicle**

The presented in Figure 4 maximum grains per panicle (189.2) was noted under the dry direct seeded rice than the transplanting method, which was 9.93 percent more than the transplanting techniques of rice during Kharif 2023. Therefore the highest grains per panicle (194.4) were noted under dry direct seeded rice than the transplanting technique, which was 10.74 percent more than the transplanted techniques during the Kharif 2024.

**Fig. 4: Performance of number of grains/panicles under DSR and TP method of rice**

**3.1.5 Test Weight (g)**

The data showed in Table 2, the maximum test weight (22.1 g) was found under the dry direct seeded rice than the transplanting method, which was 11.61 percent higher than the transplanting method during Kharif 2023. Hence the results revealed that the maximum test weight (23.7 g) was found under the dry direct seeding rice than the transplanting technique, which was 10.74 percent higher than the transplanting technique during demonstration year of Kharif 2024.

**Table 2: Performance of test weight, biological yield and yield (t/ha) under DSR and TP of rice**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters/Attributes** | **Year** | | | | | |
| **2023** | | | **2024** | | |
| **DSR** | **TP** | **Advantage (%)** | **DSR** | **TP** | **Advantage (%)** |
| **1000 grain weight (g)** | 22.1 | 19.8 | 11.61 | 23.7 | 21.4 | 10.74 |
| **Biological Yield (t/ha)** | 5.67 | 5.14 | 10.31 | 5.72 | 5.0 | 14.40 |
| **Yield (t/ha)** | 4.78 | 4.32 | 10.65 | 4.67 | 4.14 | 11.59 |

**3.1.6 Biological Yield (t/ha).**

The figures presented in Table 2, revealed that the highest biological yield (5.67 t/ha) was found under the dry direct seeded of rice than the transplanted technique, which was 10.31 percent higher than the transplanted technique used by farmers during the demonstration year of Kharif 2023. While the utmost biological yield (5.0 t/ha) of paddy variety demonstrated under dry direct seeded of rice than the transplanted techniques, which was 14.40 percent higher than the transplanted during the study period in Kharif 2024.

**3.1.7 Grain Yield (t/ha)**

The data shown in Figure 5, revealed that the maximum grain yield (4.78 t/ha) was noted under the dry direct seeding of rice than the transplanted rice, which was 10.65 percent higher than the transplanted system of rice during the demonstration period of Kharif 2023. However, the higher grain yield (4.67 t/ha) was recorded under the dry direct seeding of rice than the transplanted rice in the study period of Kharif 2024, which was 11.59 percent higher than the transplanted rice.

**Fig. 5:** Comparison of yield (t/ha) under DDSR and TPR during both years of 2023-24.

The disparity in rice yield between flooded and non-flooded conditions is related to the general fertility of the soil and the availability of plant nutrients; the latter results in an unfavorable nutritional regime for a number of plant nutrients (Sahrawat 2012). The rice productivity in India was 2882 kg/ha (Agricultural Statistics at a Glance, 2023), Uttar Pradesh was 2737 kg/ha (Agricultural Statistics at a Glance, 2023), and under the front line demonstration, it was 4725 kg/ha in kharif 2023-24. rice productivity in India was 2882 kg/ha (Agricultural Statistics at a Glance, 2023), Uttar Pradesh was 2737 kg/ha (Agricultural Statistics at a Glance, 2023), and under the front line demonstration, it was 4725 kg/ha in kharif 2023-24.

**Fig. 6:** Average productivity of rice in India, Uttar Pradesh, and FLD during the Kharif 2023-24

**3.2 Cost of Cultivation (Rs)**

The data presented in Table 1 , minimum gross cost (30340 Rs), was found under the dry direct-seeded of rice than the transplanted rice, which was 20.87 percent less than the transplanted rice during the study period of the Kharif 2023. However, the same trend was noted under the dry direct seeded of rice than the transplanted rice, which was 19.80 percent less than the transplanted rice during the demonstration year of the Kharif 2024. The 20.87 and 19.80 percent cos was saved under the dry direct seeded of rice than the transplanted system of rice during both the year of demonstration. These types of data were reported by Awanth*et al*. (2007). Short- to medium-term on-station studies reported 34-46% savings with machine labor used in zero tillage-dry-direct seeded rice (ZT-Dry-DSR) compared to puddled transplanted rice.

**Table 3: Analysis of Gross cost, Gross return, net return and B:C ratio (Rs/ha) under DDSR and TPR.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Particulars** | **Economics of demonstration (Rs./ha)** | | | | | |
| **2023** | | | **2024** | | |
| **DSR** | **TP** | **Advantage (%)** | **DSR** | **TP** | **Advantage (%)** |
| Gross Cost | 30340 | 38343 | -20.87 | 32350 | 40338 | -19.80 |
| Gross Return | 97512 | 88128 | 10.64 | 107410 | 95220 | 12.80 |
| Net Return | 67172 | 49785 | 34.92 | 75060 | 54882 | 36.77 |
| Benefit: Cost | 3.21 | 2.3 | 39.56 | 3.3 | 2.3 | 43.47 |

**3.3 Gross Return (Rs)**

The Maximum gross return (97512 Rs) was found under the dry direct seeded of rice than the transplanting method, which was 10.64 percent higher than the transplanting method during the study period of Kharif 2023. Therefore the maximum gross return (107410 Rs) was found under the dry direct seeded of rice than the transplanted rice, which was 12.80 percent more than the transplanting method during the demonstration year of the Kharif 2024 (Table 1). The 10.64 and 12.80 percent more gross return was found under dry direct seeded rice than transplanted rice respectively 2023 and 2024.

**4. Conclusion**

The dry-direct seeded of rice is more suitable, more the water saving, labor saving as well as the saving of the environment and more economical for paddy cultivation in eastern part of India.

**Disclaimer (Artificial intelligence)**

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