Original Research Article

Comparative study onCost Analysis of Mechanical and Manual Transplanting of Rice (*Oryza sativa L.*)

ABSTRACT

Telangana is the rice bowl of South India, with rice being considered the staple foodaccountingfor about two-third of the state's total cultivated area. Telangana's agroclimaticconditions areideal for rice cultivation. Most of the rice cultivation in thestateisdone through manual transplanting methods, which require a large numberof workers.Themigrationoffarmworkerstourbanareas for better wages creates a shortage of labour during the peak transplanting season. In this context, there is an urgent need for a cheap and flexiblemethod of rice transplantingthatdoesnot compromise crop yields. In this context, KrishiVigyanKendraofJammikunta, Karimnagar district,Telanganastate,conducted30frontlinedemonstrations from 2018-19 to 2020-21 todemonstratemechanicaltransplantationof rice in various parts of Karimnagar district using a self-propelled six-row mechanicaltransplanter.

Data such as plant height (cm), number of tillers produced per hill, panicle length, numberofgrainsper panicle and grain yield (kg/ha) were collected and comparedwiththecontrolplotswhereonly manualtransplantation was done. Also, the cost of cultivation for both thedemonstrationand controlplots was determined and an economic analysis wasconducted.The analysis showed that the gross profit of mechanical and manualtransplantationwasRs.135,956andRs.128,629respectivelyand the net profit of mechani cal and manualtransplantationwasRs.95,106andRs.82,204respectively for both the transplantationmethods.The benefit-cost ratio was also calculated and found to be 3.32 and 2.77 for mechanical and manual transplanting, respectively.

Keywords: Rice, mechanization, front line demonstrations, mechanical transplanting

INTRODUCTION

Among cereals, rice (Oryza sativa L.) is the staple food of the majority of the Indian population and is one of the most important crops, grown in an area of 94.99 lakh hectares with a production of 129.66 million tonnes (Paddy Outlook, July 2022). The total rice cultivation area in Telangana is about 2.8 million hectares with a total production of 98 million tonnes and an average yield of 35 q/ha (Socio-Economic Outlook 2020). Telangana is the 9th largest state in India in terms of rice cultivation area and the 8th largest state in terms of rice production. It is the fourth largest state in terms of rice production after Punjab, Andhra Pradesh and Tamil Nadu.

Traditional manual transplanting is the most preferred method of rice cultivation in this area. Although it is an effective method of rice cultivation, it is tedious, labour-intensive, time-consuming, and requires drudgery, including labour shortages during the peak farming season. This increases the cost of transplanting, and results in delayed transplanting due to insufficient labour. Moreover, it is very difficult to cover a large area in a short period of time by manual labour. If transplanting is delayed compared to usual, rice yields decrease by 9%. (Islam *et al.,* 2008). Ved Prakash Chaudhary and Varshney (2003) reported that about 250-300 man-hours are required per hectare for transplanting, which is about 25% of the total labour required for the crop. In such a scenario, there is an urgent need for cheaper and labour-saving methods of transplanting rice without compromising the grain yield. Mechanical transplantation of riceis an alternative and promising option that can save labour, ensure timely transplantation and help in increasing the grain yield. With this in mind, Krishi Vigyan Kendra of Jammikuntaconducted 30 demonstrations on mechanical transplanting of rice cultivation in Karimnagar district using a self-propelled six-row mechanical transplanter.

MATERIALS AND METHODS

The present study was conducted by Krishi Vigyan Kendra in the fields of farmers from four villages in Karimnagar district of Telangana during the rabi season from 2018-19 to

2020-21. The seedlings were grown using a special mat method during mechanical transplantation. Raised beds measuring 10 m in length, 1.2 m in width and 2.5 cm in height were prepared and covered with polyethylene film measuring 1.2 m in width and 50 microns in thickness. Iron frames measuring 21x50 cm were placed on the plastic film to produce a uniform size seedling mat suitable for feeding into the transplanter for easy planting. The frames were filled with soft, moist soil free from debris and rocks and mixed with well decomposed farm manure for better growth. Spreading the sprouted rice seeds evenly on moist ground and covering them with straw helps prevent damage from birds and helps the seedlings grow well. The seedling beds were watered for 4–5 days using pink cans, after which the straw was removed and the seedlings were grown in the usual way with regular watering. The seedlings were ready for transplantation 16–18 days after sowing, when the plants had reached a height of 10–15 cm with 3–4 leaves. Mechanical transplantation was done using a self-propelled six-row manual transplanter. After preparing the ground and levelling the main field, the field was left for 12 hours to prevent the transplanter from sinking. The machine covers six rows with 22.8 cm spacing between rows and 15 cm between hills. The rice seedlings were grown using the recommended hand transplanting method package.

Various data on parameters such as plant height (cm), number of productive tillers/hill, panicle length, number of grains/panicles and yield (kg/ha) were collected and compared with the control. An economic analysis was also conducted on the two sites and the benefit-cost ratio (B:C) was compared.

Results and discussion

In the experimental results conducted during three consecutive rabi seasons in 2019, 2020 and 2021, it was observed that the number of transplanted seedlings per hill was 4-6 and the depth of planting of seedlings was about 5 cm in case of mechanized transplanting. The productivity of the transplanter was 0.20 ha/hr and the time taken to cover 1 hectare was 5.10 hours. The transplanter cannot change the distance between rows but the spacing between hills can be adjusted to 12, 15 or 17 cm.

The studyfound that the average plant height (cm), productive number of tillers/hill, panicle length, number of grains/panicle and grain yield (kg/ha) of KNM-118 in mechanically transplanted plots were 106 cm, 21,16.8 cm, 130 and 7048 kg/ha respectively. In the control plots where manual transplantation was performed, they were 102 cm, 16, 14.9 cm, 108 and 6671 kg/ha.

The difference in yield and the characteristics that determine the yield may vary depending on the age of the seedlings in the nursery. Transplanting young seedlings (20-day-old seedlings) with intact soil and rootsresulted in early adaptation of the seedlings to the soil and better yields than manual transplanting of twentyfive to thirty days old seedlings (Uphoff, 2002). Moreover, the roots of the seedlings in mat nurseries are less likely to be damaged when the mats are uprooted or cut for replanting. In mechanicaltransplantation,2-3 seedlings were planted per hill, whereas in manual transplantation, usually 4-5 seedlings were planted. The difference in the number of seedlings transplanted in the two methods also affected the differences in yield and yield attributing traits. The reasons for the differences are well explained by Maiti and Bhattacharya (2011) and Rasool *et al.*, (2013),who reported that planting fewer seedlings per hill resulted in healthier leaves and tillers, which ultimately resulted in higher grain yield. More number of tillers and higher yields may also result from proper spacing between rows and plants in mechanically transplanted rice compared to randomly transplanted manual method.

The cost of paddy cultivation by mechanical transplanting and manual transplanting was also studied and is given in Table 1. From Table 1, it can be seen that the cost of preparing mat seedlings for mechanical transplanting of paddy (Rs. 1950) was higher than the cost of preparing conventional beds for manual transplanting (Rs. 800). It is also concluded from the table that the nursery cost for transplanting (Rs. 8125/ha) and weeding (Rs. 2250/ha) was lower in mechanical transplanting compared to manual transplanting (Rs. 12000/ha) and manual weeding (Rs. 5250/ha) due to use of mechanical rice transplanter and power weeder.

Table.1 Cost of cultivation (Rs/ha)

S.No	Operations	Manual transplanting	Mechanical transplanting
1	Nursery bed preparation	800	1950
2	Seed cost	2000	2000
3	Land preparation	6600	6600
4	Fertilizers	7875	7875
5	Labour cost for transplanting	12000	8125
6	Fuel cost for machine	-	648

7	Labour cost for weeding	5250	2250
8	Fuel for power weeder	-	825
9	Plant protection	2850	2185
10	Harvesting	5000	5000
11	Transport	1800	1800
12	Threshing	2250	2250

It can also be seen from the table that the cost of plant protection is lower in mechanical transplanting (Rs. 2,185) than in manual transplanting (Rs. 2,850). This may be due to maintenance of proper spacing between row to row and plant to plant in mechanical transplanting. Previous studies have also shown that the use of power tillers in paddy fields reduces the incidence of pests and diseases. Some pathogens overwinter or spend summer in weeds, which serve as a source of inoculum for the main crop during the season, and the use of power tillers significantly reduces the weed burden in the field, thereby helping in increasing yield. According to Rajendran *et al.*, (2018), the use of power tillers provides more air to the roots, which leads to increased sprouting of more tillers per hill and also increases the uptake of nutrients from the soil, ultimately resulting in higher yields compared to conventional method.

The economic analysis of the two transplanting methods (Table 2) shows that the cultivation cost of manual transplanting (Rs. 46,425) was higher than that of mechanical transplanting (Rs. 41,508). Gross returns for both manual and mechanical transplanting was Rs 1,28,629 and Rs 1,35,956, respectively. Net returns of mechanical transplanting (Rs. 95,106) was also higher than that of manual transplanting (Rs. 82,204). From the study it was found that the average cultivation cost of mechanical transplanting was reduced by Rs 4,917/ha compared to manual transplanting.

Table.2 Economic analysis

Particulars	**Cost of Cultivation (Rs/ha)**	**Gross returns (Rs/ha)**	**Net returns (Rs/ha)**	**C:B Ratio**
Manual transplanting	46425	128629	82204	1:2.77
Mechanical transplanting	41508	135956	95106	1:3.32

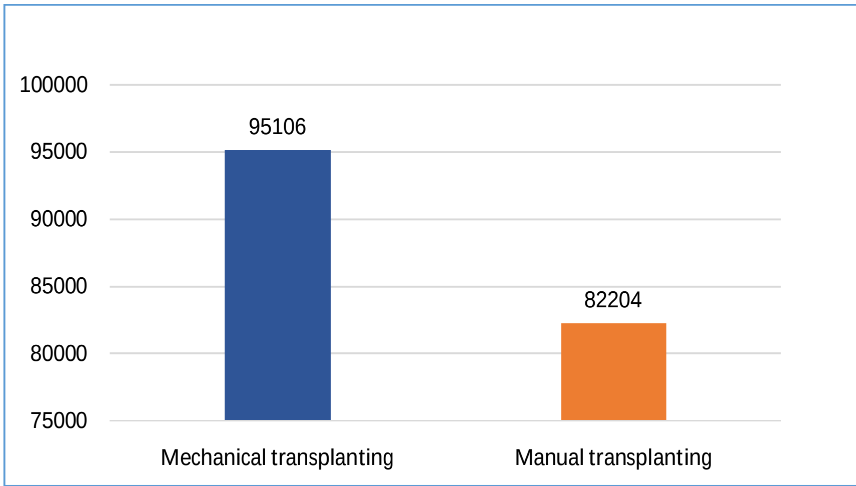

Fig 1: Comparative analysis of net returns (Rs/ha)

It was observed that an additional benefit of Rs.12,902/- was obtained through mechanical transplanting over manual transplanting. This was because the labour cost of transplanting and weeding was lower in mechanical transplanting. Mohapatra *et al.*, (2012) and Sheeja *etal.*, (2012) also reported that the cost of cultivation was reduced and net returns were increased by using transplanter in rice. Similarly, the highest benefit cost ratio (3.32) was obtained with mechanical transplanting compared to manual transplanting (2.77). Sajitha Rani and Jayakiran, (2010), Sreenivasulu *et al.*, (2014) also reported higher benefit-cost ratio in mechanical transplanting.

Conclusion

From the study, it has been found out that mechanical transplanting of paddy is emerging as an utmost necessity in present situation. The shortage of labourers in main cropping season and low cost of cultivation involved greatly necessitates this technology in farmer's field over conventional manual transplanting.

The popularization of mechanical transplanting can be achieved through establishment of different custom hiring centres. Such centres will facilitate economic way of cultivation of paddy over conventional methods. Through mechanical transplanting of paddy cost of labourers, reduction of disease and pest incidence, reduction of weed incidence and less time for cultivation of paddy can be achieved.

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