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Enhancing the Productivity and Profitability in Rice Cultivation by Planting Methods

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A field experiment was conducted during *kharif* 2011 to evaluate the economic feasibility of different planting methods viz., mechanized transplanting (22x14 cm), manual transplanting (20x10 cm), manual transplanting with wider spacing (25x10 cm) and power weeding, drum seeding (20x10 cm) and broadcasting for enhancing the productivity and profitability of rice cultivation. The experiment, replicated four times was laid out in randomized block design in plots of 60 m^2 size. Results indicated that plant height, tillers m^{-2}, panicles m^{-2} and grains per panicle were higher in mechanized transplanting compared to all other treatments. Mechanized transplanting recorded the highest grain yield (7418 kg ha^{-1}) as well as gross returns (Rs 96434 ha^{-1}) and net returns (Rs 72348 ha^{-1}) with a benefit cost ratio of 3.0, while broad casting method registered the lowest grain yield (5308 kg ha^{-1}), gross returns (Rs 68998 ha^{-1}) and net returns (Rs 40693 ha^{-1}). Drum seeding recorded benefit cost ratio of 2.7 with higher grain yield compared to manual planting.

Key words: Mechanized transplanting, manual transplanting, broadcasting, net returns, and benefit cost ratio.

Rice is the major cereal crop which plays a key role in food security in India. It is grown in an area of 44.1 million ha with a production of 103.4 million tons (USDA, 2012). The country has to produce about 130 million tons of rice by 2025 to meet the food requirement of the growing population (Hugar *et al*., 2009). There is a decreasing trend in the area cultivated with rice due to less profitability from rice farming. Some of the reasons identified for less profitability are (1) decreased yield due to reduced plant population and (2) increased cost of cultivation due to increased cost on transplanting and weeding. Moreover, industrialization has led to increased labour migration to city areas and shift towards alternative rural employment causing severe farm labour shortage. Consequently, it has also increased the cost of labour during peak farming operations such as transplanting, weeding and harvesting.

Comparative studies conducted throughout the country have revealed that higher and more stable yields are obtained from transplanted rice than direct seeded rice. Jaiswal and Singh (2001) reported that transplanted rice produced maximum grain yield which was significantly higher than broadcasting and direct seeding techniques. Moreover, transplanting ensures uniform crop stand, better control of weeds, uniform ripening and less lodging. In spite of all these advantages, manual transplanting is quite expensive, laborious, time consuming and causes lot of drudgery. Manual transplanting takes about 300 to 350 man hours / ha which is roughly 25 % of the total labour requirement of the crop (Goel *et al*., 2008). Non-availability of laborers for transplanting at appropriate time leads to delay in transplanting. Delay in transplanting from normal date causes considerable reduction in yield (Safdar *et al.,* 2008; Islam *et al*., 2008). Optimizing plant density and timeliness of operation is considered essential for maximizing yield in paddy. In order to get the maximum returns, cost of cultivation has to be reduced through minimizing the dependence on labour for transplanting. Under such conditions mechanized transplanting of rice can be considered as the most promising option, as it saves labour, ensures timely transplanting and attains optimum plant density that attributes to high productivity. Keeping this in view, a study was conducted at Rice Research Station, Moncompu, Kerala during *kharif* 2011 to evaluate the economic feasibility of different planting methods for enhancing the productivity and profitability in rice cultivation.

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Materials and Methods

The field experiment was conducted at Rice Research Station, Moncompu, Kerala (geographically situated at 9 º 5' N latitude and 76 º 5' E longitude and at an altitude 1m below MSL) during *kharif* 2011. The soil is silty clay with pH 6.2, organic carbon 1.1%, available P and K 13.8 and 142 kg ha^{-1}, respectively. The experiment was laid out in randomized block design with four replications in plots of 60 m^2 size. The selected package of treatment details are furnished in Table 1.

In mechanized and manual transplanting,

seedlings were raised by dapog and wet nursery methods, respectively. Fifteen day old seedlings were used for transplanting in both these methods. In drum seeding and broadcasting methods, pregerminated seeds were used for sowing on the same day when seedlings were transplanted by machine and manual methods. Self-propelled Yanji eight row paddy transplanter was used for mechanized transplanting. After the land preparation and leveling, sedimentation period of four days was given to avoid the float sinkage in machine transplanted plots. The variety used was Uma (MO 16), a medium duration variety. The crop was fertilized with 90:45:45 kg ha^{-1} of N, P_2O_5 and K_2O, respectively. 1/3rd dose of N and K_2O and full dose of P_2O_5 were applied at 12 DAT, 1/3rd dose of N and K_2O at 35 DAT and remaining 1/3rd dose of N and K_2O were applied at 55 DAT. In all treatments except T3, weed control was attained by spraying bispyribac sodium @ 30 g ha^{-1} on 15 DAT followed by one hand weeding at 40 DAT. In T3, weeding was done thrice at 15, 30 and 45 DAT using power weeder.

Observations on growth parameters viz., plant height and tillers per square meter were recorded at flowering stage and yield parameters viz., productive tillers per square meter, panicle length, panicle weight, fertile grains per panicle, 1000 grain weight, grain and straw yield per plot were recorded at harvest. The cost of cultivation was worked out based on the labour and input cost incurred towards rice cultivation in different methods. Economics of cultivation was worked out based on the minimum support price for paddy given by the Government of Kerala during 2011. All data were analyzed using ANOVA and the least significant difference (LSD) values at 5% level of significance was calculated to test significant difference between treatment means.

Results and Discussion

Growth attributes

The data on plant height at flowering stage revealed that plants tend to be taller (mean plant height of 107.1 cm) in broadcasting method followed by mechanized planting (102.6 cm), while drum seeding recorded the minimum plant height of 91.2 cm (Table 2). This might be due to lesser leaf area during the initial growth stages which stimulates increased cell division causing more cell elongation and increased plant height (Kim *et al*., 1999). Tiller production was also significantly influenced by different methods of planting. Mechanized transplanting recorded the highest number of tillers (629 m^{-2}) and the least (355 m^{-2}) in broadcasting method. Under mechanized transplanting, the plant gets sufficient space to grow and the increased light transmission in the canopy leads to increased number of tillers. Increased number of tillers in drum seeding might be due to higher tiller density of individual hills. Hugar *et al*. (2009) reported that maximum number of tillers per square meter was observed in SRI method followed by machine planting and drum seeding.

Table 1. Treatment details of the experiment

Treatment	Spacing (cm)	Weeding
Mechanized Transplanting (T1)	22x 14	Post emergence herbicide application at 15 DAT and one hand weeding at 40 DAT
Manual Transplanting(farmers practice) (T2)	20x10	Post emergence herbicide application at 15 DAT and one hand weeding at 40 DAT
Manual Transplanting(wider spacing) (T3)	25x10	Power weeding at 15,30 and 45 DAT
Drum seeding (T4)	20x10	Post emergence herbicide application at 15 DAT and one hand weeding at 40 DAT
Broad casting (T5)		Post emergence herbicide application at 15 DAT and one hand weeding at 40 DAT

DAT, Days after transplanting

Table 2. Effect of different methods of planting on the growth and yield attributes of rice

Treatment	At flowering stage		At harvest stage				
	Plant height (cm)	Tillers m^{-2}	Panicles m^{-2}	Grain per panicle	Panicle length (cm)	Panicle weight (g)	Thousand grain weight (g)
Mechanized transplanting (22x14 cm) (T1)	102.6	629	408	153.2	21.73	3.95	23.5
Manual planting (20 x10 cm) (T2)	99.7	424	345	151.5	21.85	4.05	23.6
Manual planting wider spacing (25x10 cm) (T3)	100.9	470	371	147.0	21.38	3.75	22.7
Drum seeding (20 x10 cm) (T4)	91.2	605	335	132.1	21.32	3.67	23.1
Broadcasting (T5)	107.1	355	269	103.4	21.5	2.92	26.9
CD (P=0.05)	3.3	77	67	20.5	NS	2.98	0.6

Yield attributes

Among the yield attributing characters studied, panicles per square meter and fertile grains per panicle were higher in machine planting. Higher panicle length and panicle weight were recorded in farmer's practice of manual transplanting which was on par with mechanized transplanting. A positive correlation was found between panicle length and number of grains per panicle, greater the panicle length more was the number of grains per panicle. Broadcasting method recorded significantly higher test weight of grains compared to other methods (Table 2). Machine transplanting provides more room for both canopy and root growth resulting in increased uptake of nutrients which would have favoured increased production of panicles as well as grains per panicle. This result is in conformity with the findings of Manjappa and Kataraki (2004).

Table 3. Yield and economics of rice as influenced by different methods of cultivation

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
Mechanized transplanting(22x14 cm) (T1)	7418	8828	96434	72348	3.0
Manual planting (20x10 cm) (T2)	6375	7479	82869	51574	1.66
Manual planting wider spacing (25x10 cm) (T3)	6922	8688	89969	60878	2.10
Drum seeding (20x10 cm) (T4)	6746	8806	87701	63776	2.70
Broadcasting (T5)	5308	7401	68998	40693	1.43
CD (p= 0.05)	785	NS			

Yield and economics

The data on grain yield revealed that mechanized planting recorded the highest grain yield (7418 kg ha^{-1})followed by manual transplanting with wider spacing and the lowest in broadcasting (Table 3). Highest yield realized with mechanized planting might be due to the use of younger seedlings, which preserves a potential for higher tillering and rooting. Better vegetative growth and assimilate translocation leads to increased number of panicles per square meter and fertile grains per panicle resulting in higher grain yield. Javaid *et al*. (2012) also reported higher grain yield in transplanting compared to drill sowing and broadcasting. Increased yield in T3 might be due to the fact that wider spacing enabled mechanical weeding which not only helped in reducing the weed competition but also increased the root activity by stimulating new cell division in roots. Pruning of some upper roots encouraged deeper growth and helped in increased nutrient uptake and increased number of panicles (Uphoff, 2001). Though straw yield from different methods of planting was not significantly different, higher straw yield was recorded in mechanized transplanting (8828 kg ha^{-1}) and lower in broadcasting (7401 kg ha^{-1}). Manjappa and Koppad (2005) also observed that straw yield did not show much variation in different methods of planting. The data on gross and net returns revealed that mechanized transplanting gave the highest returns of Rs 96434 and Rs 72348 per hectare, respectively. Even though the gross return was higher in manual transplanting with wider spacing (T3), the net return was less compared to drum seeding (Table 3). This was mainly due to the lower labour cost involved in drum seeding, which also contributed to higher B: C ratio. The higher net returns and B: C ratio in mechanized transplanting was mainly due to higher yield and reduction in labour cost. Sajitha Rani and Jayakiran (2010) has also reported higher benefit cost ratio in transplanting using power transplanter.

Conclusion

Mechanized transplanting can be recommended as an economic and viable method compared to manual transplanting and broadcasting wherever labour is expensive and scarce for getting higher yield and net returns. Drum seeding can also be considered as an alternate strategy, as the net return realized was higher than that of manual transplanting and broadcasting. Mechanical transplanting and drum seeding can be recommended in Kuttanad (the rice bowl of Kerala) as an alternativeto the common practice of broadcasting of wet seeded rice, where more labour is required for gap filling and weeding, and reduces the benefit cost ratio.

References

USDA. 2012. India Grain and Feed Update (Quarterly Update- May 2012), *Global Agricultural Information Network,* USDA Foreign Agricultural Service. p. 5.

Goel, A.K., Behera, D. and Swain, S. 2008. Effect of sedimentation period on performance of rice trans planter. *Agricultural Engineering International: The CIGR e -journal* **X**: 1-13.

Hugar, A.Y., Chandrappa, H., Jayadeva, H.M., Satish, A. and Mallikarjun, G.B. 2009. Comparative performance of different rice establishment methods in Bhadra command area. *Karnataka J. Agric. Sci*., **22**: 992-994.

Islam, M.S., Hossaln, M.A., Chowdhury, M. A. H. and Hannan, M.A. 2008. Effect of nitrogen and transplanting date on yield and yield components of aromatic rice. *J. Bangaladesh Agril. Univ*., **6**: 291-296.

Jaiswal, V.P. and Singh, G.R. 2001. Effect of planting methods, source and level of nitrogen on the growth and yield of rice (*Oryza sativa* L.) and on succeeding wheat (*Triticum aestivum*). *Indian J. Agron*., **46**: 5-11.

Javaid, T., Awan, U., Baloch, M.S., Shah, I. H., Nadim, M. A., Khan, E.A., Khakwani, A.A. and Abuzar, M.R. 2012. Effect of planting methods on the growth and yield of coarse rice. *J. Anim. Plant Sci*., **22**: 358-362.

Kim, S.S., Kin, B.K., Choi, M.G., Back, N.Y., Choi, W.Y. and Lee, S.Y. 1999. Effect of seedling age on growth and yield of machine transplanted rice in southern plain region. *Korean J. Crop Sci*., **44**: 122-128.

Manjappa, K. and Kataraki, N.G. 2004. Use of drum seeder and transplanter for increasing rice profitability. *Karnataka J. Agric. Sci*., **17**: 682-685.

Manjappa, K. and Koppad, A.G. 2005. Evaluation of different methods of rice cultivation in hilly zone of Karnataka. *Kartanaka J. Agric. Sci*., **18**: 485-486.

Safdar, M.E., Ali, A., Mohamed, S., Sarwar, G. and Awan, T. H. 2008. Effect of transplanting dates on paddy yield of fine grain rice genotypes. *Pak. J. Bot*., **40**: 2403-2411.

Sajitha Rani, T. and Jayakiran, K. 2010. Evaluation of different planting techniques for economic feasibility in rice. *EJEAF Che*., **9**: 150-153.

Uphoff, N. 2001. Scientific issues raised by the system of rice intensification: A less water rice cultivation system. In *Proceedings of International Workshop on Water Saving Rice Production System,* H. Hengsdijk and P. Bindraban (Eds.), April, 2-4, Nanjing University, China, p. 69-82.

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