Madras Agric. J., 100 (10-12): 803-805, December 2013
https://doi.org/10.29321/MAJ.10.001410

Effect of Establishment Methods on Yield and Economics of Rice (*Oryza sativa* L.)

S.K. Swain, B.R. Nayak*, C.M. Khanda and A.K. Dash
Regional Research and Technology Transfer Station,
Chiplima, OUAT, Sambalpur-768025, Odisha.

A field experiment was conducted at Regional Research Technology and Transfer Station (RRTTS), Chiplima, Sambalpur during *kharif* 2010 & 2011 to evaluate the performance of different establishment methods for rice cultivation. The experiment was laid out in randomized block design with three replications and nine treatments. The treatments were; broadcasting of dry seeds (T_1), manual three row seed drill (T_2), line sowing using rope and guide (T_3), manual pre-germinated paddy seeder (T_4), line sowing of pre-germinated paddy seeds using rope and guide (T_5), random transplanting i.e. farmers' practice (T_6), self-propelled rice transplanter (T_7), line transplanting using low cost transplanting guide (T_8), line transplanting using rope and guide (T_9). Planting of rice by self-propelled rice transplanter (T_7) recorded significantly higher grain yield of 3.95 t ha^{-1} and better plant height, number of tillers per m_2, number of effective tillers per m_2 as compared to other establishment methods. The plot where seedling was transplanted by self-propelled rice transplanter recorded maximum net return (Rs. 18858/ha) and benefit: cost ratio (1.75) as compared to other establishment methods because of higher grain yield, less seed rate and labour requirement. The self propelled rice transplanter was superior to other establishment methods with respect to drudgery reduction and timely completion of transplanting in stipulated time.

Key words: Rice establishment method, self propelled transplanter, transplanting guide, pre germinated paddy seeder

Rice (*Oryza sativa* L.) is one of the most important staple food crops in the world. In India, rice occupies an area of 44 million hectares with an average production of 90 million tonnes and a productivity of 2.0 tonnes per hectare. Demand for rice is growing every year and it is estimated that in 2025 AD the requirement would be 140 million tonnes. To sustain present food self-sufficiency and to meet future food requirements, India has to increase its rice productivity by 3 per cent per annum (Thiyagarajan and Selvaraju, 2001). Mechanization of rice production is highly essential because of less labour availability for cultivation.

Transplanting is one of the important stages in rice cultivation. Transplanting is the dominant crop establishment practice in most of the tropical Asia. In this method, the land is puddled and seedlings are raised in a nursery and transplanted (Islam, 1987). Manual paddy transplanting is a tedious, laborious and time consuming operation, requiring about 30-35 man days per ha which is roughly 25 per cent of total labor requirement of rice production. It is reported that a delay in transplanting by one month reduces the yield by 25 per cent whereas yield reduction is 70 per cent if further delayed.

Due to introduction of new models of rice transplanter, farmers were encouraged for mechanization of rice transplanting because of higher yield and less time consumption. Direct seeding under puddled soil enhanced the crop establishment, vegetative growth and reduced crop duration (Garcia *et al.,* 1994). About 30 per cent increase in yield and a reduction of about 70 per cent in labour requirements in transplanting with machine as compared to the manual transplanting was reported by Mufti and Khan (1995). Direct- seeding can reduce the labor requirement, shorten crop duration by 7–10 days and provide grain yield comparable with that of transplanting (De Datta, 1986). The study on yield attributes and cost involvement in different paddy establishment methods are required to plan for mechanization strategy in Odisha where paddy is predominantly grown. Non availability of irrigation water and a shortage of labour during peak periods, hike in labour wages made delay in manual transplanting costlier, whereas causing delays in farm operations. Hike in labour wages and shortage of labourers during peak period encouraged the farmers of this zone to use self propelled transplanter for transplanting. The information regarding the efficiencies of different methods is scanty for which this study was conducted.

Materials and Methods

A field experiment was conducted at the Regional Research Technology and Transfer Station (RRTTS), Chiplima, Sambalpur during *kharif* 2010 and

*Corresponding author email: biswa.nayak@yahoo.co.in

2011 to evaluate the performance of different establishment methods of rice cultivation. The soil of the experimental field was sandy loam with acidic reaction (pH 5.78), high in organic carbon (0.78%), low in available N and medium in available P and K. The experiment was laid out in a randomized block design with nine treatments replicated thrice. Treatments consisted of different paddy establishment methods *viz*., broadcasting dry seeds (T_1), manual three row seed drill (T_2), line sowing using rope and guide (T_3), manual pre-germinated paddy seeder (T_4), line sowing of pre-germinated paddy seeds using rope and guide (T_5), random transplanting (farmers practice) (T_6), self propelled rice transplanter (T_7), line transplanting using low cost transplanting guide (T_8), line transplanting using rope and guide (T_9). Dry and pre-germinated seeds were sown with a spacing of 20 cm x 10 cm, transplanting of seedling with a spacing of 20 cm x 15 cm spacing and mat type seedlings with a spacing of 23.18 cm x 14 cm. Seed rate for broadcasting of dry seeds is 100 kg ha^{-1}, line sowing of dry seeds is 80 kg ha^{-1}, pre germinated seeds is 45 kg ha^{-1}, transplanting is 75 kg ha^{-1} and transplanting mat type seedlings is 40 kg ha^{-1}. Rice variety MTU-1001 was used test crop with recommended dose of fertilizer of 80: 40: 40 (N, P_20_5, K_20 kg ha^{-1}). Farm yard manure @ 5t ha^{-1} was applied uniformly to all the plots irrespective of the treatments. All the other cultural operations were carried out as per recommendation. The observations on yield attributes and yield were recorded. The collected data on various parameters were analyzed statistically as per the method suggested by Gomez and Gomez (1984).

Results and Discussion

Growth and yield attributes

Growth and yield attributes of rice crop due to different establishment methods are presented in Table -1. The Plant height varied from 87.29 cm to 105.97 cm. Significantly higher plant height of 105.97 cm was observed in the plot where transplanting of seedlings was done by self propelled rice transplanter (T_7) whereas lower value was observed in the plot where seeding was done by broad casting of dry seeds (T_1). The plant height due to random transplanting (T_6) was at pair with T_8 (Line transplanting using low cost transplanting guide) as well as T_5 (Line sowing of pre-germinated paddy seeds using rope and guide). Plant height was higher with transplanted rice than that of sowing or broadcasting of seeds. Significantly higher number of tillers per m² (349.3) was observed with T_7 where as lower value (267.3) observed with T_1. Among the sowing treatments, line sowing of seeds by pregerminated paddy seeder (T_4) produced higher no. of tillers per m² (344.7) which was at par with T_7 (Self propelled rice transplanter). The number of tillers per m² was less with farmer's practice (312.7) than that of T_4, T_7 and T_8 (Line transplanting using low cost transplanting guide). The number of effective panicles per hill varied from 4.50-7.53. Significantly higher number of effective panicles per hill was observed with T_7 (7.53) followed by T_4 (7.13). Farmer's practice recorded less effective panicles per hill (5.80) than that of T_4. Filled grains per panicle varied from 77.60 (T_1) to 88.87 (T_7).It was observed that number of filled grains per panicle for all the treatments except broadcasting of dry seed (T_1) and line sowing of seeds by manual three row seed drill (T_2) were statistically at par.

Table 1. Growth and yield attributes of rice in different establishment methods (pooled mean of 2010 & 2011)

No.	Treatment	Plant height (cm)	No.of tllers m_2/ hill	Effective panicles / hill	Filled grains / panicle
T_1	Broadcasting of dry seeds	87.27	267.3	4.50	77.60
T_2	Manual three row seed drill	92.13	283.7	4.80	78.23
T_3	Line sowing using rope and guide	91.93	286.0	4.70	83.57
T_4	Manual pre-germinated paddy seeder	98.60	344.7	7.13	79.03
T_5	Line sowing of pre-germinated paddy seeds using rope and guide	97.37	312.0	5.57	81.70
T_6	Random, transplanting (Farmer's Practice)	99.77	312.7	5.80	86.70
T_7	Self propelled rice transplanter	105.97	349.3	7.53	88.87
T_8	Line transplanting using low cost transplanting guide	102.27	335.3	6.60	86.50
T_9	Line transplanting using rope and guide	102.87	325.3	6.70	86.50
CD(0.05)		2.56	16.3	0.32	10.53

Grain and straw yield

Grain and straw yield as well as harvesting index of rice due to imposition of different treatments are presented in Table 2. Higher grain yield of 3.95 t ha^{-1} was recorded with T_7 (Self propelled rice transplanter) where as the lowest grain yield of 2.51 t ha^{-1} was observed T_1 (Broad casting of dry seeds). Among the sowing methods, higher grain yield of 3.68 t ha^{-1} was recorded with T_4 (Manual pre-germinated paddy seeder) where as the lowest value with T_1. Among transplanting methods, higher grain yield of 3.95 t ha^{-1} was recorded with T_7 where as the lowest value of 3.21 t ha^{-1} was observed with T_6 (Random

Table 2. Yield of rice in different establishment methods (pooled mean of 2010 & 2011)

No.	Treatment	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest Index (%)
T_1	Broadcasting of dry seeds	2.51	2.93	46.1
T_2	Manual three row seed drill	2.72	3.21	45.9
T_3	Line sowing using rope and guide	2.85	3.30	46.4
T_4	Manual pre-germinated paddy seeder	3.68	3.97	48.1
T_5	Line sowing of pre-germinated paddy seeds using rope and guide	3.35	3.73	47.3
T_6	Random transplanting (Farmer's Practice)	3.21	3.70	46.4
T_7	Self propelled rice transplanter	3.95	4.49	46.8
T_8	Line transplanting using low cost transplanting guide	3.50	3.92	47.2
T_9	Line transplanting using rope and guide	3.51	3.83	47.8
CD(0.05)		0.71	1.56	1.01

transplanting) . Significantly highest grain yield was observed with transplanting by self propelled transplanter may be due to the placement of seedling at uniform depth and as well spacing and equal number of seedling per hill along with optimum plant population which ultimately resulted uniform crop growth, efficient yield attributes and grain yield. This result corroborates the result of Singh *et al.* (1997) and Singh and Gangwar (2001). It was also revealed that line sowing of seeds by pre-germinated paddy seeder (T_4) recorded higher grain yield (3.68 t ha^{-1}) than that of plot where random transplanting (T_6) was done as observed by Manjunath *et al.* (2009) and Subbaiah *et al.* (2002).

The highest straw yield of 4.49 t ha^{-1} was recorded with T_7 where as lowest value of 2.93 t ha^{-1} was observed with T_1. The straw yield of other treatments followed the same trend like that of grain yield. Significantly higher harvest index (48.1%) was observed with T_4 (Manual pregerminated paddy seeder) followed by T_9 (Line transplanting using rope and guide) having value of 47.8%. The lowest harvest index value of 45.9% was observed with T_2 (Manual three row seed drill) which was statistically at par with T_7 (Self propelled rice transplanter) with a value of 46.8%.

Economics

Cost of cultivation, gross return, net return as well as benefit cost ratio (B:C) were calculated based on different parameters along with their prevailing market price. The cost of cultivation for treatments varied from Rs.18, 710 to Rs. 32,180 per hectare (Table 3). The cost of cultivation was higher (Rs. 32,180 / ha) with T_9 (line transplanting using rope and guide)

Table 3. Cost Involvement and Economics of rice in different paddy establishment methods (mean of two years)

No.	Treatment	Cost of cultivation (Rs/ha)	Gross Return (Rs/ ha)	Net Return (Rs/ha)	B:C ratio
T_1	Broadcasting of dry seeds	19585	32063	12478	1.64
T_2	Manual three row seed drill	18710	30410	11700	1.63
T_3	Line sowing using rope and guide	22095	31830	9735	1.44
T_4	Manual pre-germinated paddy seeder	27826	40803	12977	1.47
T_5	Line sowing of pre-germinated paddy seeds using rope and 31550 guide		37268	5718	1.18
T_6	Randomtransplanting (Farmer's Practice)	30380	35773	5393	1.18
T_7	Self propelled rice transplanter	25102	43960	18858	1.75
T_8	Line transplanting using low cost transplanting guide	31280	38953	7673	1.25
T_9	Line transplanting using rope and guide	32180	38900	6720	1.21

than the value observed (Rs. 31,280 / ha) with T_8 (Line transplanting using low cost transplanting guide). Self propelled rice transplanter (T_7) recorded lower cost of cultivation (Rs. 25102 / ha) than that of random transplanting i.e. farmers practice (T_6) as well as sowing seeds by manual pre-germinated paddy seeder (T_4) . The highest gross return (Rs.43, 960 / ha) was recorded with T_7 (Self propelled rice transplanter) where as lowest amount of Rs. 30, 410/ ha was recorded withT_2 (Manual three row seed drill). The highest net return of Rs.18, 858.
/ ha per hectare was arrived in T_7 followed by Rs. 12, 477 / ha in case of T_4. On the other hand, the lowest net return of Rs. 5, 393 per hectare was observed with T_6 (Random transplanting). Similarly the highest B:C ratio of 1.75 was observed with T_7 followed by T_1. The lowest B:C ratio of 1.18 was observed with T_6 and T_5 (line sowing of pre-germinated paddy seeds using rope and guide).

The study revealed that transplanting of mat formed rice seedling by self propelled rice transplanter produced higher grain and straw yield with higher B:C ratio. Similarly, sowing of pre germinated rice seeds with pre germinated paddy seeder is the viable option for the direct seeded wetland area for higher productivity and net return.

References

De Datta, S.K. 1986. Technology development and the spread of direct-seeded flooded rice in Southeast Asia. *Exp. Agric*., **22**: 417- 426.

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research. Wiley and Sons, New York. 108-127.

Garcia, F.V., Peng, S., Laz, M.R.C., Sanico, A.L. and Cassman, K.G. 1994. Growth characterstics and yield of wet seeded and transplanted rice at higher yield level. International Rice Research Institute, Los Banos, Launga (Philippines). Agronomy, Plant Physiology and Agroecology Div. 2. p.

Islam, M.A. 1987. Photoperiod sensitivity: A neglected issue-Bangladesh Rice Research Institute. In: Proc. International Seminar on Photoperiod sensitive Transplanted rice. Oct.1977, Dacca, pp10-11

Manjunath, M.V., Reddy, B.G.M. and Joshi, V.R. 2009. Performance of rice (*Oryza sativa*) under different methods of establishment in Tungabhadra canal. command, Karnataka. *Karnataka J. Agric. Sci,* **22**: 1151-1152

Mufti, A.I. and Khan, A.S. 1995. Performance evaluation of Yanmar paddy transplanter in Pakistan. Agric Mech, *Asia, Africa, Latin America*. **26**: 31-36.

Singh, K.K. and Gangwar, K.S. 2001. Increasing productivity of rice-wheat system by mechanizing the operations of tillage and crop establishment. Annual report. PDCSR, Modipuram, India pp 22-25

Singh, K.M., Pal, S.K., Verma, V.N., Thakur, R. and Singh, M.K. 1997. Effect of time and methods of planting on performance of rice (*Oryza sativa*) cultivars under medium land of Bihar plateau. *Indian J. Agron.,* **42**: 443-445

Subbaiah, S.V., Krishnaiah, K. and Balasubramanian, V. 2002. Evaluation of drum seeder in puddle rice. *Agril. Mech. Asia, Africa, Latin America,* **33**: 23-26.

Thiyagarajan, T.M. and Selvaraju, R. 2001. Water saving in rice cultivation in India. In: Proc. *International Workshop on Water Saving Rice Production Systems*. April 2- 4, 2001. Nanjing University, China, pp.15-45.

Received: May 13, 2013; Accepted: August 22, 2013