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Drum seeded: an improved technology in rice production system

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ABSTRACT

Transplanting of rice seedlings is a highly labour intensive and expensive operation that can be replaced by direct seeding which reduces labour needs by more than 20 per cent in terms of working hours required. With this aim, an initiation was undertaken by District Agricultural Advisory and Transfer of Technology Centre (DAATTC), Eluru, Acharya N. G. Ranga Agricultural University, Andhra Pradesh with a lead to promote direct sowing by drum seeder methodology instead of conventional system of transplanting among rice farming community. This was implemented following need based different extension methods (transfer of technology, ToT) in the areas. In this programme, 15 farmers were selected from 15 villages covering 12 mandals of West Godavari district in rabi season for direct rice seed sowing using drum seeder. Sensitization programmes like demonstrations and guidance to the farming community, exposure visits, field days, supply of various inputs, publications etc. were emphasized and wide publicity is being given through electronic and print media for easy understanding to the farming communities of West Godavari District. Results showed that there was an average yield increase to the tune of ₹ 243.0 kg ha^{-1} in direct sowing using drum seeder over conventional method of transplanting in the field. The cost involved for cultivation was reduced by ₹ 11,708.00 ha^{-1} and gross returns was increased by ₹ 2,965.00 ha^{-1} thereby increasing the net income by ₹ 14,673.00 ha^{-1} by direct sowing. Moreover, the cost-benefit ratio was significantly higher in direct sowing (2.9) than in transplanted rice (2.2). The number of tillers as well as number of effective tillers per unit area was also significantly higher in direct sown plots which resulted in higher yields compared to transplanted rice.

Keywords: Direct sowing, drum seeder, extension activities, rice

Rice is the principle food crop cultivated throughout India and is considered to be one of the original centres of rice cultivation, covering 44 million hectares. Its rice harvesting area is the largest in the world. Around 65% of the total population in India eats rice which accounts for 40% of the nation's food production. In Andhra Pradesh state rice is cultivated in an area of 28.03 lakh ha in *kharif* and 15.84 lakh ha in *rabi*. West Godavari District in Andhra Pradesh is popularly known as *"Rice Granary of Andhra Pradesh"* because it is contributing major share in state's rice production. The net area sown in the district was 2, 41,441 ha. in *kharif* and 1,62,752 ha. in *rabi* with an average productivity of 3.04 tonnes/ha in *kharif* and 4.6 tonnes ha^{-1} during *rabi* under rice. The main source of irrigation is through canals, tube wells, tanks and others (68.70, 21.72, 7.26 and 2.12 % respectively). The normal rainfall for the district is 1,153 mm. The climate is comparatively equitable but temperatures are very high in April and May (38ºC - 46ºC) which is conducive for rice cultivation. The important soils in the district comprise of red sandy loams (35.05 %), clay loams (22.89 %), alluvial (14.0 %), sandy loams (12.52 %), deltaic alluvial (9.98 %), coastal sandy loams (3.14 %), heavy clays (1.98 %) while salt affected soils are to the tune of 0.43 %. Cultivation of rice is shrinking owing to industrialization, urbanization, crop diversification and other economic factors. Similarly, the number of rice farmers is also declining fast due to many causative factors. The National Rural Employment Guarantee Programme (NREGP), has caused greater constraints in the availability of agricultural labour for regular farm operations. In the last five years the cost of production on different operations is increased by 30 % to 150 % especially the labour cost increased enormously by 150%. Because of increase in cost of production the cultivation of rice is no more profitable when compared to other crops.

Rice cultivation by transplanting has become a labour intensive and highly expensive that can be replaced by direct seeding which reduces the labour need by 20 % (Pradhan, 1969; Santhi *et al*., 1998; Sidhu *et al.*, 2014 With these objectives, studies were conducted to know the effectiveness of the drum seeder technology and transfer of technology (ToT) to the farmers at field level.

To promote direct sowing by drum seeder methodology among rice farming community, 15 villages covering 12 mandals of the district were selected and sensitization programmes were organised by different extension methods viz., demonstrations and guidance to the farming community, exposure visits, field days, supply of inputs, publications, etc. were undertaken and wide publicity is being given through electronic and print media by the DAATT Centre, Eluru

Short Communication

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to promote Direct sowing in West Godavari district during *rabi*, 2012-13. Drum seeder consists of four seed drums made of fibre mounted over a shaft, ground wheels, floats and handle. The seed drum is hyperboloid shape (truncated cone) with 200 mm diameter having 12 mm flat spikes of 25 mm length kept parallel to the axis of rotation. The slope of the cone facilitates the free flow of seeds towards the metering holes. Nine numbers of seed metering hole of 10 mm diameter were provided along the circumference of the drum at both the ends at a row to row spacing of 20 cm. The floats were provided on either side to restrict the shrinkage and to facilitate easy pulling of the drum seeder. In direct seeding method of rice cultivation, need for a nursery and tasks such as pulling, transporting and transplanting seedlings are avoided as the pre germinated seeds are directly sown using a drum seeder in a well puddled and leveled wet field. The seeds are dropped in rows @ 20 cm row to row spacing and the seed rate is about 25 – 37.5 kg ha^{-1}. In control plot *i.e.*, rice grown by conventional method, rice is being cultivated by raising nursery for about 30 days with seed rate of 50 to 75 kg ha^{-1}. Later seedlings were pulled and transplanted manually with a spacing of 20 x 15 cm in the main field after puddling. Weeding, fertiliser application, plant protection measures, irrigations were done for raising a good crop, then harvested and threshed. Data was collected from each field separately and analysis was done using 'Paired t test".

Drum seeder is light in weight, easy to operate and more area can be covered by a single man (Fig. 1). Advantages of drum seeder is uniformity in seed sowing (Fig. 2), reduction in seed rate and time for sowing, reducing thinning cost, hill dropping of the seed can be achieved with this improved system of planting.

Yield and economics

Front line demonstrations on direct sowing were conducted at 15 locations in 15 different villages of West Godavari district during *rabi,* 2012-13. The average cost of cultivation were computed from fifteen on farm trials separately for paddy by direct sowing through drum seeder and transplanted rice (Table 1).

The cost of land preparation, fertiliser, pesticides and harvesting were same in direct sown and transplanted rice. In the direct sown rice, the cost of labour for sowing or transplantation incurred a meagre amount (₹ 938.00) as compared to the transplanted rice (₹ 7983.00). The seed cost was low in direct sown rice (₹ 683) as against transplanted rice (₹ 1711.00) since seed rate used for sowing was less in direct sown rice @ 30 kg ha^{-1} when compared to transplanted rice (50 - 75 kg ha^{-1}). The cost incurred for nursery management in case of transplanted rice was high (₹ 2260.00), where as in drum seeder it was nil because the process of growing seedlings is not required. To control weeds in rice application of herbicide is essential (Upasani and Barala, 2014) The cost incurred on weed control was less (₹ 2985 ha^{-1}) in direct sown plots than transplanted rice (₹ 4360 ha^{-1}) where the farmers practised both manual and chemical methods.

Results revealed that the average yield of direct sown rice was 8463 kg ha^{-1} whereas in transplanted rice the yield was 8220 kg ha^{-1}. On an average there was an increase in yield of 243 kg ha^{-1} in direct sowing. The total cost of cultivation per hectare was lower in direct sown rice (₹ 36039.00) compared to transplanted rice (₹ 47747.00) *i.e.,* cost of cultivation reduced by 11,708.00 ha^{-1}.

Further it could be noted that the net returns were higher in direct sown rice (₹70,087.00) than transplanted rice (55,414.00). The net income increased by ₹ 14673.00 ha^{-1} in direct sown rice. It was mainly due to the reduction in cost of cultivation of paddy (₹ 11,708.00 ha^{-1}) and increased gross income through

Fig.1: Direct sowing by drum seeder

Fig. 2: Crop sown by drum seeder

Table 1: Yield improvement and average cost of cultivation of paddy under direct sowing by drum seeder and transplanting (control plot) method

Sl. No.	Name of the practice	Direct sown rice (kg ha^{-1})	Transplanted rice (kg ha^{-1})	SEm (±)	Sig. (2 tailed)
1.	Land preparation	6275	6275	-	-
2.	Seed	683	1711	**31.53**	**0.000**
3.	Nursery	0	2260	**119.59**	**0.000**
4.	Labour for sowing / transplantation	938	7983	**171.83**	**0.000**
5.	Herbicide	2985	4360	**209.71**	**0.000**
6.	Fertilizer	9346	9346	-	-
7.	Pesticide	5937	5937	-	-
8.	Harvesting	9875	9875	-	-
9.	Total cost of cultivation	36039	47747	**329.42**	**0.000**
10.	Grain yield (kg)	8463	8220	**53.59**	**0.000**
11.	Rate (₹ in kg)	12.55	12.55	-	-
12.	Income from grain (₹)	106126	103161	**679.67**	**0.001**
13.	Gross income (₹)	106126	103161	**679.67**	**0.001**
14.	Net income (₹)	70087	55414	**785.23**	**0.000**
15.	C:B ratio	2.9	2.2	**0.04**	**0.000**

yield by ₹ 2,965.00 ha^{-1}. It was also observed that the cost-benefit ratio was higher in direct sowing (2.9) which is significantly higher than in conventional method (2.2).

Direct sowing by drum seeder in rows facilitated to take up fertilizer application, plant protection measures and weed control in an efficient manner. In addition, crop duration is reduced by 7 days in direct sown rice which facilitated to raise third crop pulses in rice-rice-pulses cropping system. Wang and Sun (1990) noticed that duration can be shortened by 7-15 days in direct seeded rice compared to transplanted rice. Further, Chandrasekhararao *et al*. (2013) observed that duration can be reduced to 8-10 days.

No. of effective tillers per hill varies due to varying agronomic practices followed (Patra et al., 2008 and Tzudir and Ghosh, 2014) Observations showed that number of tillers per hill was more in direct sowing (19.03) than transplanted rice (15.90). Moreover, the effective tillers per hill was also higher in direct sowing (17.40) than transplanted rice (14.52) which resulted in higher grain yield in direct sowing (8463 kg ha^{-1}) than transplanted rice (8220 kg ha^{-1}) presented in table- 2. In contrast to our results, Shekar and Singh (1991) stated that direct seeding of sprouted seed under puddled condition results insignificant improvement in yield attributes like number of effective tillers and grain yield.

The farmers in OFTs had realised that direct sowing by drum seeder is only a viable option to reduce cost of cultivation of paddy and increase net returns due to less seed rate, less labour for sowing, no need of nursery raising and also increased number of effective tillers.

Extension activities

Extension activities like training programmes, front line demonstrations, group discussions, exposure visits, field days, *kisan melas*, review meetings, news paper coverage, and TV and Popular articles etc. were conducted by DAATT Centre, in collaboration with Dept of Agriculture, Farmers clubs and mass media to popularize the drum seeder technology. A total number of 6 off-campus training programmes were conducted for several farmers. Due to concerted efforts by DAATT

Table 2: Yield attributes

Treatments	No. tillers hill^{-1}	No. of effective tillers hill^{-1}	Duration in days	Grain yield per ha (kg ha^{-1})	Cost benefit ratio
Demo	19.03	17.40	112	8463	2.9
Control	15.90	14.52	119	8220	2.2
SEm (±)	**0.42**	**0.29**	**0.61**	**53.59**	**0.04**
Sig. (2 tailed)	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Farmers' feedback

Centre, Eluru this technology was spread other mandals in West Godavari district.

Farmers readily accepted this technology as seeing is believing. It involves less cost of cultivation than traditional method of transplanting. Mainly it reduces labour during peak periods *i.e.,* transplanting. Moreover it is technically viable and economically feasible and it is easy to practice without affecting the crop yields. As the crop duration is reduced by 7-10 days it facilitates in raising the summer pulse on conserved soil moisture without any moisture stress. The major problem encountered in direct sowing is weed management because thin film of water at initial stages. The weed problem in the initial stage of the crop growth can be managed by application of pre emergence as well as post emergence weedicides (Jitendranath *et al*., 2012).The main problem expressed by the farmers is lodging at the time of harvest. Hence screening of different varieties under direct sowing should be done to know the suitable variety for direct sowing. Previous sown seeds *i.e.,* self sown seeds/volunteer plants also a major problem. This can be addressed by allowing sufficient time for first puddling and last puddling before sowing by drum seeder.

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