ISSN: 2347-4688, Vol. 8, No.(3) 2020, pg. 219-223

Current Agriculture Research Journal

www.agriculturejournal.org

Alternate Crop Establishment Methods for Water-Saving and High Rice Productivity In North Coastal Andhra Pradesh

A.UPENDRA RAO[1]*, K.V.RAMANA MURTHY[2], K. MADHU KUMAR[3], V VISALAKASHMI[4], N HARI SATYA NARAYANA[5] and S. GOVINDA RAO[6]

[1,3,4,5]Agricultuiral Research Station, Ragolu, Andhra Pradesh, India.
[2,6]RARS, Anakapalle Andhra Pradesh, India.

Abstract

A field study was carried for two consecutive *kharif* and *rabi* seasons of 2013-14 and 2014-15 on farmer's fields across 15 locations each year during *kharif* and 9 locations each year during *rabi* in Srikakulam district, Andhra Pradesh. We tested five crop establishment methods viz., dry direct sowing using fertilizer-cum seed drill under irrigated conditions, drum seeding,systems of rice intensification (SRI), mechanized transplanting using rice 8 row yanmar transplanter, and manual transplanting. Study findings revealed that transplanting with rice planter emerged as high yielding method of establishment where the grain yield was higher by 9.21% over manual transplanting. Dry direct sowing was found to be highly profitable method of rice establishment by recording higher net returns Rs. 12596/ha compared to manual planting. Dry direct sowing and SRI proved as water productive rice establishment methods which took lesser water by 22.45% and 18.78% compared to manual transplanting during *kharif*. Whereas during *rabi*, drum seeding proved as profitable and water saving method of crop establishment in rice.

Article History

Received: 22 October 2020
Accepted: 10 December 2020

Keywords:

Economics;
Establishment Methods;
Rice;
Water Productivity;
Yield.

Introduction

Rice is the prime crop and considered as life and become sentiment for majority of the farmers in India, cultivated over44 million hectares with 109 million tonnes1of annual production.Though, India ranked 1st in area and 2nd in production, struggling tohave not able productivity among rice growing countries. Rice is the indispensable crop for coastal Andhra Pradesh including north coastal districts. More than 50% of cultivated area during *kharif*, in north coastal A.P. occupied by rice which is grown in about 4.2 lakh hectares and 2.2 t/ha1of productivity, this is lesser than state and country average is the major concern to the farm fraternity. Lack of assured irrigation, late release of canal water, poor soil fertility, abiotic stress particularly drought during early growth period and

CONTACT A.Uendra Rao draurao@gmail.Com Agricultuiral Research Station, Ragolu, Andhra Pradesh, India.

Doi: http://dx.doi.org/10.12944/CARJ.8.3.07

floods during later stages of the cropand emerging biotic stresses are some of the major reasons for realizing low yieldsof rice in this zone.

The traditional way of rice establishment by transplanting involves drudgery, excessive tillage consuming more energy, water and labour, besides deterioration of soil structure. In transplanting, important field operations accounts for 30-40% of total cost of cultivation of the crop. Due to shrinking of cost: benefit ratio and declining factor productivity taking the farmers away to traditional transplanting system even in intensive irrigated lowlands. Besides being laborious, this method of stand establishment also causes drudgery to womenfolk.[2] To reduce the manpower requirement and cost of production, there is a need to replace the manual transplanting with some scientifically sound, technically feasible, economically viable and environmentally safe establishment technique.[3]

Dry direct sowing, broadcasting or line sowing of pre-germinated seed, machine planting, systems of rice intensification are some of the options of crop establishment which require less water and labour compared to manual transplanting in rice.[4] Here and there some of the progressive farmers are practicing the alternate methods of crop establishment in rice and reaping good harvest with more returns with less water and less labour. Therefore a study was conducted on farmers' fields to evaluate the performance of alternate methods of rice crop establishment.

Materials and Methods

A field study was carried during two consecutive *kharif* and *rabi* seasons of 2013-14 and 2014-15 on farmer's fields across15 locations each year during *kharif* and 9 locations each year during *rabi* in Srikakulam district. Irrigation was provided through canal having good quality water. The study constituted five crop establishment methods viz.,dry direct sowing using fertilizer-cum seed drill under Irrigated conditions, drum seeding, systems of rice intensification (SRI), mechanized transplanting using rice 8 row yanmar transplanter,and manual transplanting. About 16 days old tray-raised seedlings were used for Yanmar transplanter and plantedat 30cm x 21 cm spacing. Bed-raised 10 days aged seedlings were planted at 25cm x 25 cm spacing of in case of SRI.Whereas, manual transplanting was done at a spacing of 20cm x 15 cm using 26 days nursery during *kharif* and 23 days seedlings were planted at a spacing of 15cm x 15 cm during *rabi*. MTU 7029 (150 days duration) was the test variety during *kharif* and MTU 1010 (120 days duration) during *rabi*.

Nursery was raised on thoroughly puddled and levelled nursery bed for normal planting method of establishment. Nursery was separately raised for SRI on beds and in trays for machine planting as per the procedure laid down for that on the same day of sowing of dry direct sowing. Weeds were managed by applying pendimethalin @ 2.5 L/ha on second day after sowing followed by using bispyribac sodium @250 ml/ha at 30 days after sowing in direct sown treatments and application of pretilachlor @1500ml ha within 3 days after planting followed by application of bispyribac sodium @250 ml/ha at 25 days after transplanting of rice in transplanting treatments. The left over weeds were removed by 2 hand weedings in direct seeded rice techniques and 1 hand weeding in transplanted rice techniques. A common dose of120 kg N/ha was applied uniformly through urea in 3 equal splits, at basal, at active tillering and at panicle initiation stage, 60 kg P_2O_5/ha as single super phosphate was applied as basal dressing and 50 kg K_2O/ha asmuriate of potash applied in 2 splits half at basal and half at panicle initiation stage along with urea. A common dose of $ZnSO_4$ @ 50 kg/ha was applied to all the treatments uniformly during field preparation. At all the locations followed Acharya N G Ranga University recommended package of practices for other aspects of cultivation.

Data on number of tillers/m^2, number of panicles/m^2, filled spikelets/panicle, test weight, were collected from 10 marked hills at random adopting standard procedures. Grain and straw yield were recorded from net plot of the experimental field after attaining maturity. Economic parameters were worked out treatment wise taking existing market rates for different output sand inputs of the experiment. Water requirement was measured with water meters and Parshall flume based on location. Data were analyzed using ANOVA considering each location as one replication and the significance was tested by Fisher's least significance difference (p= 0.05) by pooling two years data.

Results and Discussion

Methods of rice Establishment during *Kharif*

Perusal of the two years pooled data pertaining to *kharif* season revealed that, the maximum number of tillers/m2 were recorded with drum seeding, whereas more number of panicles were realized in dry direct sown rice. The increase in panicles number under direct sowing might be due to greater plant population rather than tillers/plant. Such an increase in panicle number with direct sowing method over transplanting methods was also reported earlier.[5] The maximum number of filled spikelets/panicle with higher test weight was recorded in SRI and machine planting. This might be due to maintenance of optimum plant population per unit area and uniform depth of planting which resulted into augmentation of filled spikelets/panicle in machine planting. Favorable growing environment in planting with machine exhibited during the vegetative stage would have converted larger proportion of tillers into effective tillers thereby increasing the panicle production. Effective translocation and partitioning of assimilates from source to the sink might have resulted in better filling of spikelets resulted to the highest number of filled spikelets per panicle.[6]

Table1: Effect of rice establishment methods on tillers, yield parameters, grain and straw yield of rice during kharif

Treatments	Number of tillers/m²	Number of panicles/m²	Filled spikelets/ panicle	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Dry direct sowing	601	439	111	21.39	4981	6276
Drum seeding	594	431	107	20.91	4640	5850
SRI	537	401	123	22.23	5063	6329
Machine planting	566	422	121	22.21	5210	6403
Transplanting	571	426	109	20.92	4770	5963
SEm±	7.42	4.24	3.18	0.36	123	151
CD (0.05)	21	12	9	1.02	349	428

It was observed that different crop establishment methods caused marked variations in grain yield. The highest grain yield and straw yield were recorded with machine planting followed by systems of rice intensification. The grain yield was higher by 9.21 and 6.13%in machine and SRI over manual transplanting, respectively. Whereas, drum seeding treatment recorded 2.74% lesser grain yield compared to manual planting. Optimum plant population and quick establishment of crop machine planting and SRI resulted in favorable yield structure which in turn leads to higher grain yield. Plant density plays a greater role in determining the efficiency of solar energy conversion to plant product per unit of land area. Excess plant population than required creates competition for various growth resources, either spatially or temporally and thus results in sub-optimal performance of the crop under a given environment. Similar results of better performance of machine planting over other crop establishments of rice were obtained earlier.[5]

Economic analysis revealed that higher gross returns were realized with machine planting (Rs. 73998/ha) followed by SRI. While net returns were maximum in dry direct sowing which was higher by Rs.12596/ha compared to manual planting. Rupee returned per rupee invested was also higher with dry direct sowing (0.61) followed by machine planting were superior among different crop establishment methods. Drum seeding recorded higher net returns (Rs.17177/ha), rupee retuned per rupee invested (0.35) compared to manual planting.These findings are in line to[7] who explained that, though the gross returns were higher with machine planting, net profits were maximum withdry direct sowing due to conspicuously lesser cost of cultivation of DDS rice compared to other establishment.[3] also observed similar findings and found more net profit under direct sowing over manual and mechanical transplanting.

Crop establishment methods exerted noticeable influence on water productivity of rice. Water

requirement was conspicuously lesser in dry direct sown rice (22.45%) and systems of rice intensification (18.78%) when compared to manual transplanting (1225mm). Drum seeding took 17.71% lesser water over manual transplanting. Similarly water use efficiency also higher with dry direct sowing (5.24 kg/ha-mm) followed by SRI.[8] also reported similar findings of higher water productivity with dry direct sown rice compared to machine planting and transplanting.

Table 2: Effect of methods of crop establishment on economic parameters and water requirement of rice during kharif

Treatments	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	Rupee returned per rupee invested	Water requirement (mm)	Water productivity (kg/ha-mm)
Dry direct sowing	44008	70708	26700	0.61	950	5.24
Drum seeding	48965	66142	17177	0.35	1008	4.60
SRI	55288	71899	16611	0.30	995	5.09
Machine planting	51000	73998	22998	0.45	1055	4.94
Transplanting	53750	67854	14104	0.26	1225	3.89
SEm±	745	1105	360	--	30.39	--
CD (0.05)	2109	3127	1020	--	86	--

Table 3: Effect of crop establishment methods on tillers, yield structure, grain and straw yield of rice during rabi

Treatments	Number of tillers/ m^2	Number of panicles/ m^2	Filled spikelets/ panicle	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Drum seeding	659	504	129	21.97	5761	6970
Transplanting	644	486	134	21.71	5730	6895
t-value (0.05%)	27	16	7	0.56	311	392

Table 4: Effect of rice establishment methods on economics and water productivity of rice during rabi

Treatments	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	Rupee returned per rupee invested	Water requirement (mm)	Water productivity (kg/ha-mm)
Drum seeding	54125	79709	25584	0.47	1090	5.29
Transplanting	58850	79274	20424	0.34	1320	4.34
t- value (0.05%)	2247	3461	1214	--	105	--

Methods of Rice Establishment During *Rabi*

Pooled data of two years study during *rabi* showed that, maximum tillers as well as panicles were recorded with drum seeding, whereas number of filled spikelets per panicle was higher with normal planting.There was no measurable difference between drum seeding and transplanting with regards to grain yieldand straw yield. However,

net returns, rupee retuned per rupee invested was noticeably higher in drum seeding compared to manual planting due to noticeably lesser cost of cultivation (Rs. 54125/ha) with drum seeding method of establishment. Higher water productivity with lesser water requirement (17.74%) was registered with drum seeding compared to manual planting (1320mm).[9] also reported similar findings of higher growth, yield, returns and water productivity with drum seeding over traditional transplanting in rice.

Conclusions

Perusal of two years field experimental data revealed that, mechanized transplanting with rice planter emerged as high yielding method of establishment where the grain yield was increased by 9.21% over manual transplanting. Dry direct sowing was stood as the highly profitable method of rice establishment by recording higher net returns Rs.12596/ha compared to manual planting. Dry direct sowing and systems of rice intensification proved as water productive rice establishment methods which took lesser water by 22.45 and 18.78% compared to manual transplanting, respectively during *kharif*. Whereas, during *rabi* drum seeding proved as profitable and water saving method of crop establishment in rice.

Acknowledgements

We are thankful to Acharya N G Ranga Agricultural University.

Funding

Acharya N G Ranga Agricultural University.

Conflict of Interest

There is no conflict of interest among authors regarding the work and publication of results pertaining to this article.

References

1. Laxmi, VK. 2020. Weed and nutrient management in dry direct sown rice in North-Coastal Andhra Pradesh. Ph. D Thesis, Department of Agronomy, Acharya NG Ranga Agricultural University, Andhra Pradesh.
2. Budhar M.N and Tamilselvan N. Effect of stand-establishment techniques on yield and economics of lowland irrigated rice (Oryzasativa). *Indian Journal of Agron.* 2002. 47 (1): 57-60.
3. Sanjay M.T., Setty T.K.P and Nanjappa H.V. Productivity, energetics and economics of different systems of crop establishment in rice. *Crop Res*, 2006. 31 (3): 350-353.
4. Mankotia B.S., Sekhar J and Negi S.C. Effect of crop establishment techniques on productivity of rice-wheat cropping system. *Oryza.* 2009. 46 (3): 205-208.
5. Amara JyothiP., Martin LutherM., Upendra Rao A., Narasimha Rao K .L and Ratna Prasad P. Evaluation of Crop Establishment Techniques and N Levels on Growth and Yield of Rice. *The Andhra Agric. J* , 2018.65 (2): 290-296.
6. Singh R.K., Singh A.N., Ram Hardev, Rajendra Prasad S and Chauhan R.K.Response of basmati (OryzasativaL.) rice varieties to system of rice intensification (SRI) and conventional methods of rice cultivation, *Annals of Agric. Res*, 2013. 34(1): 50-56.
7. Rao A.U., Murthy K.V.R., Visalakshmi V., Kumar K.M., and Rao N.V.G..Evaluation of establishment methods for productivity and profitability of rice cultivation.(In) *Abstract of papers International Rice Symposium* heldfrom 18-20 November 2015 at Hyderabad. pp.58.
8. Rao A.U.,Visalakashmi V., Kumar K.M., and Rao N.V.G., Evaluation of establishment methods and N management in rice.(In) Extended summaries of 4th *International Agronomy Congress*, held during Nov, 22-26, 2016, at New Delhi, India. PP.1188.
9. Guru prem, Rakesh choudhary, Amit kumar, Ramesh jhorarand Singh V.D. Recent production technologies of rice (*Oryza sativa L.*) for its sustainable cultivation in Haryana. *International Jof Agric.Sci,*2017.13(1): 83-92