Website : www.asthafoundation.in
Frontiers in Crop Improvement
Vol 9 (2) : 156-159 (July-2021) Print ISSN : 2393-8234 Online ISSN : 2454-6011
Astha Foundation, Meerut (U.P.) India

Performance of Rice under Different Crop Establishment Methods in Cauvery Command Area

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Abstract

The field experiment was carried at 'I' Block of ZARS, V.C. Farm, Mandya during *Kharif* 2019 and 2020 for two years to evaluate the performance of rice under different crop establishment methods in Cauvery Command Area. The seven rice establishment methods *viz.,* traditional transplanting, mechanical transplanting, system of rice intensification, drum seeding, wet direct seeding (broadcasting), dry direct sowing (multicrop planter) and aerobic method of rice cultivation were evaluated in RCBD design with three replications. The results of two years pooled data revealed that, among the rice establishment methods, direct dry seeding of treated paddy seeds in well prepared land through multicrop planter at row to row spacing of 22.5 cm found to record almost at par yield (73.25 q/ha) as that traditional transplanted rice (74.52 q/ha) with higher net returns (Rs. 65,431/ha) and B:C ratio (2.72) and saves 55% irrigation water and matures 10 to 12 days early. As compared to traditional transplanting methods, SRI recorded 7-8 % higher yield, while other methods recorded lower yield. The significantly lower yield as compared to traditional transplanted rice noticed in wet direct sowing (8.0%) and aerobic rice (18%). While, the mechanical transplanting, drum seeding and dry direct sowing recorded almost comparable yield as that of traditional transplanting method.

Key words : *Aerobic rice, dry direct seeding, sri, transplanted rice and wet direct seeding.*

Introduction

Food security depends on the ability to increase production with decreasing availability of water to grow crops. Rice, as a submerged crop, is a prime target for water conservation because it is the most widely grown of all crops under irrigation. To produce 1 kg of grain, farmers have to supply 3-4 times more water in rice fields than other cereals (1). The study revealed that to grow one kg of rice 4000-5000 litre of water is required. In Asia, more than 80% of the developed freshwater resources are used for irrigation purposes; about half of which is used for rice production (Dawe *et al.,* 1998). Rapidly depleting water resources threaten the sustainability of the irrigated rice and hence the food security and livelihood of rice producers and consumers (2). In Asia, 17 million hectare (Mha) of irrigated rice areas may experience physical water scarcity and 22 M ha may have economic water scarcity by 2025 (3). There is also much evidence that water scarcity already prevails in rice-growing areas, where rice farmers need technologies to cope with water shortage and ways must be sought to grow rice with lesser amount of available water (3).

In Karnataka rice is grown under a variety of soils and wide range of rainfall and temperature. Only around 44 per cent of the total acreage is under irrigation while the rest is under the regime of monsoon. Rice is cultivated in places where the rains are as heavy as 3000 mm and in others where it is just 600 mm. In some areas only one crop is grown and in certain other areas three crops are raised. In Southern Karnataka rice is mainly grown in Cauvery Command Area by utilizing canal water in area of 1.5 lakh ha. However, in recent years, the area of rice and productivity is declining year by year in the Cauvery Command Area due to low rainfall in transitional belt due to shifting climate. As a results, it takes time for filling up of the dam and tanks and hence, authorities delaying the release of water into the canal. As a result of delay in release of water into the canal, transplanting of paddy getting delayed and consequently great loss in productivity was observed due to prevalence of low temperature during panicle initiation to flowering.

Rice is very sensitive to water stress, especially during panicle initiation to flowering period and attempts to reduce water inputs may tax true yield potential. The challenge is to develop novel technologies and production systems that would allow rice production to be maintained or increased at the face of declining water availability with reduced labour cost (4). Several strategies are in vogue to reduce the labour dependency, rice water requirements, such as system of rice intensification (SRI), mechanical transplanting, drum seeding, wet direct sowing (broadcasting), dry direct sowing (multicrop planter) and aerobic method of rice cultivation. All these alternative rice production system are evaluated in the field to study its performance with respect to growth, yield, water productivity and economics.

Received : June-2021; Revised : June-2020; Accepted : July-2021

Table-1 : Growth and yield parameters of rice as influenced by establishment methods (Pooled data of two years).

Treatment	Plant height at harvest (cm)	Days to 50% flowering	Days to maturity	No. of panicles/ hill	Panicle length (cm)	No. of filled grains/ panicle	1000 seed weight (gm)
Conventional transplanting	129.56	91	125	15.56	22.36	166.41	19.62
Mechanical transplanting	128.54	92	124	16.12	22.32	167.41	19.73
SRI method	131.52	93	127	19.52	25.36	182.41	20.02
Drum seeding	127.36	88	116	15.05	22.52	164.25	19.28
Wet direct seeding	123.56	87	115	13.65	19.85	162.23	19.02
Dry direct seeding	128.84	86	110	16.63	23.85	168.96	19.38
Aerobio rice	120.63	86	109	15.03	18.96	155.21	18.52
S.Em.+	2.25	3.12	3.52	2.02	1.36	5.52	0.99
C.D. @ 5%	6.72	NS	10.56	6.02	4.08	16.56	NS

Table-2 : Yield, economics and water productivity of rice as influenced by establishment methods.

Treatment	Grain yield (q/ha)	Straw yield	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio	Irrigation Water applied (mm)	Water productivity (kg/ha cm)
Conventional transplanting	74.52	91.51	45800	105243	59443	2.30	992	7.51
Mechanical transplanting	73.21	88.15	42800	103376	60576	2.42	942	7.77
SRI method	80.75	99.52	47500	114045	66545	2.40	825	9.79
Drum seeding	71.21	87.41	40800	100568	59768	2.46	820	8.68
Wet direct seeding	67.65	85.45	38800	95565	56765	2.46	825	8.20
Dry direct seeding	73.25	88.12	38000	103431	65431	2.72	425	17.24
Aerobic rice	61.15	76.21	40500	86372	45872	2.13	412	14.84
S.Em.+	3.12	3.85	-	-	-	-	12.12	-
C.D. @ 5%	9.36	11.55	-	-	-	-	35.62	-

Materials and Methods

The field experiment was carried at 'I' Block of ZARS, V.C. Farm, Mandya during *Kharif* 2019 and 2020 for two years.The initial soil analysis of the experimental site indicated that, the soil was slightly alkaline with a pH of 7.87, low in organic carbon (0.37%), low in available nitrogen (235 kg/ha), available P_2O_5 (22.5 kg/ha) and available K_2O (121 kg/ha). The experiment comprising of seven rice establishment methods *viz.,* traditional transplanting, mechanical transplanting, system of rice intensification, drum seeding, wet direct seeding (broadcasting), dry direct sowing (multicrop planter) and aerobic method of rice cultivation. These 7 establishment method were tested in completely randomized design with four replications. The prominent rice hybrid KRH-4 developed at Zonal Agricultural Research Station was grown as a test crop. The recommended fertilizers dose 100:50:50 kg/ha was applied for all the treatments commonly. The seed rate used was 15 kg/ha in all the treatments except SRI method and aerobic rice where 2.5 kg/ha seeds were used. Under traditional transplanting method, 22 days old seedlings were transplanted in the field at a spacing of 20 cm 10 cm. In mechanical transplanting, 20 days old seedlings were transplanted to main filed at a spacing of 22.5 cm 10 cm by using Korean model 8 row paddy transplanter. In drum seeding the pre-germinated (soaking in water for 24 hours and kept in gunny bag for 36 hours) seeds were put into the seeder drum (4 number drum seeder with 8 rows at a spacing of 20 cm between row) and pulled manually in the puddled field to drop the seeds in the mud. Whereas, in wet direct seeded rice, the pre-germinated seeds were broad casted in the well puddled land and care has been taken to ensure that seeds were dropped in mud. In dry direct seeded rice, the recommended seeds were treatment with chemical and then sown by using multicrop planter in a well prepared field. The spacing given was 22.5 cm between the rows. In SRI method 12 days young seedlings were transplanted in the well puddled field with a spacing of 25 cm 25 cm. In aerobic rice, the treated seeds were sown at a spacing of 25 cm 25 cm in a well prepared field and 2-3 seeds were sown per hill. In all the treatments, the crop was fertilized with 100:50:50 kg $N:P_2O_5:K_2O$/ha and 50% nitrogen, entire dose of phosphorous and potassium was applied as basal in addition to zinc sulphate @ 25 kg/ha. The remaining 50% of the nitrogen was top dressed at two equal splits at tillering and panicle initiation stage. In transplanted rice and mechanical transplanted rice, 5 cm water was

maintained throughout the cropping season and irrigation was stopped 20 days prior to harvest. In SRI method soil moisture was maintained at saturation point throughout the cropping season.in drum seeding and wet direct seeded rice, saturation point was maintained up to germination and then crop flooded with 2-3 cm of water. While in aerobic and dry direct seeded rice moisture level at field capacity was maintained throughout the crop period. The gross plot size was 40 m^2. All other agronomic and plant protection measures were adopted as per the recommended packages of UAS, Bangalore. The observations on crop growth and yield parameters and yield were recorded at regular intervals. The economics *viz.,* cost of cultivation, gross returns, net returns and B:C ratio were worked out by considering prevailing market rates of input and output during the cropping period. All the data obtained in the study were statistically analysed using F-test, the procedure given by (5). Critical difference values at P=0.05 were used to determine the significance of differences between means.

Results and Discussion

Growth and yield attributes of rice : Plant height indicate the health and vigour of the plant. It is directly proportional with the development of root system and availability and uptake of moisture and nutrient from the soil. Rice establishment methods had significant influence on the plant height. Among the establishment methods, significantly taller plants were observed in SRI method of rice cultivation (131.52 cm) at harvest as compared to others. However, it was on par with conventional transplanting, mechanical transplanting, drum seeding and dry direct sowing with multi crop planter. While, the lower plant height was observed in wet direct seeding and aerobic rice (123.56 and 120.63 cm, respectively). The days taken for 50% flowering not varied significantly among the rice establishment methods. However, the rice transplanted in puddled soil takes more days as compared to direct sowing treatments. Whereas, days to maturity varied significantly and direct sown rice matured 10-12 days early as compared to seedling transplanted treatments. Among the establishment methods, dry direct seeding and aerobic rice took significantly lesser days (110 and 109 days, respectively) for maturity as compared to others. The similar findings are also reported by (6).

As a consequence of higher growth parameters, SRI method recorded significantly higher yield attributing parameters *viz.,* No. of panicles/hill (19.52), panicle length (25.36 cm) and No. of filled grains/panicle (182.41) as compared to others. However it was on par with conventional transplanting, mechanical transplanting and dry direct sowing by multicrop planter. This enhanced yield attributes in these treatments was mainly attributed to availability of more moisture, nutrients and space for individual plant and this in turn enhance the growth attributes and lead to production and translocation of more photosynthates sink. These results are in agreement with (7,8,9). The 1000 grain weight was not varied significantly among the rice establishment methods.

Yield of rice : The grain and straw yield of rice varied significantly among rice establishment methods. Among them, system of rice intensification records significantly higher grain and straw yield (80.75 and 99.52 q/ha, respectively) as compared to others. However it was on par with conventional transplanting, mechanical transplanting and dry direct sowing through multicrop planter. This increased yield in these treatments was mainly attributed to enhanced yield attributes, as a result of translocation of more photosynthates reproductive parts due to availability of more moisture, nutrients and space for individual plant. The results are in line with the earlier findings of (10). As compared to traditional transplanting methods, SRI recorded 7-8 % higher yield, while other methods recorded lower yield. The significantly lower yield as compared to traditional transplanted rice noticed in wet direct sowing (8.0%) and aerobic rice (18%). While, the mechanical trans planting, drum seeding and dry direct sowing recorded almost comparable yield as that of traditional transplanting method.

Economics : The cost of cultivation was lower in direct seeded rice as compared to traditional seedling transplanting. Among the different methods, lower cost of cultivation was observed in dry direct seeding through multicrop planter (Rs. 38000/ha) due to reduced nursery and transplanting cost and highest was observed in SRI method (Rs. 47500/ha) due to more labour requirement for transplanting. The higher net returns and B:C ratio was obtained with dry direct seeding (Rs. 65431 and 2.72, respectively) as compared to others. This was mainly due to reduced labour cost as compared to traditional transplanting. The next beat treatments were drum seeding and wet direct seeding through broadcasting.

Irrigation water used and IWUE : Among the rice establishment methods, lower irrigation water used in dry direct sowing and aerobic method of rice (295 and 306 mm, respectively). These two method required 55-58% lower irrigation water as compared to traditional transplanted rice. As a result this, the water productivity was also highest in these treatments (17.24 and 14.84 kg/ha cm of water, respectively). This lower water requirement in these treatments was mainly attributed to elimination of puddling and maintenance of moisture level at near field capacity throughout the cropping season. The

similar findings are also reported by (10,11). As compared to traditional transplanting method, the water saving in mechanical transplanting was 5.0%, SRI was 16.8%, drum seeding was 17.3% and wet direct seeding was 16.8%%.

Conclusion

Direct dry seeding of treated paddy seeds in well prepared land through multicrop planter at row to row spacing of 22.5 cm found to almost at par yield as that traditional transplanted rice with higher net returns and B:C ratio and saves 55% irrigation water and matures 10 to 12 days early.

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