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Effect of Different Planting Techniques on Yield and Yield Attributing Characters of Medium Duration Rice Variety under Rainfed Ecosystem

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ABSTRACT
The field experiment was conducted at SG College of Agriculture and Research Station, Jagdalpur, during 2012. The experimental design was RCBD (randomized complete block design) with three replications. There were seven treatments were tested viz., broad casting, broad casting with Biasi (Beushening), line sowing by seed drill, conventional transplanting, improved transplanting, Lehi method and system of rice intensification (SRI). Significantly highest number of tillers, panicle length, yield, straw yield, biological and harvest index was recorded under SRI method followed by improved transplanting method, but in case of bulk density, improved transplanting was recorded significantly highest at 30 DAP which was at par with Lehi method, conventional transplanting and SRI method. However, at harvest SRI method was recorded higher bulk density among all the establishment methods but it was at par with improved transplanting, Lehi and line sowing by seed drill.
Key words- *Biasi, Lehi, Bulk density, RWUE*

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INTRODUCTION

Rice (*Oryza sativa* L.) is a member of gramineae family and is relished as staple food by majority of world's population. Rice is an important cereal crop of the world and nearly more than half of the population dependent on it. It is the main livelihood of rural population living in sub-tropical and tropical Asia [1]. In India, rice occupied 39.16 million hectares area with a production of 85.59 million tonnes and average yield 2.2 mt ha^{-1} [2]. Rice is grown in about 44 M ha in India of which 40% area are rainfed lowlands mostly located in the Eastern in India. The productivity of this mega ecosystem is very low (1.0 to 1.5 mt ha^{-1}) because of monoculture of rice [3]. In Chhattisgarh, 4.67 M ha area is being cultivated during *kharif* season, of which 3.55 m ha is occupied by rice crop [4]. In Australia and USA, direct seeded rice and bed planting are being used as resource conserving technologies which reduce pollution and improve living of the farming community by increasing profitability [5-7]. It was convinced that under puddled condition the yield of rice is high but it has its own limitations and ill effects on soil health [8]. In South–East Asia, rice is grown by transplanting of rice seedlings (21-30 days age) in the puddled fields which consumes 30 percent of total water requirement [9]. Repeated puddling adversely affects soil physical properties by dismantling soil aggregates, reducing permeability in subsurface layers, and forming hard-pans at shallow depths which make land preparation becomes difficult and requires more energy to achieve proper soil tilth for succeeding crops [10]. Due to puddling activity, physical changes in soil take place which is detrimental for non-Rice crops or the next crop *i.e.* wheat due to sub- soil compaction [11]. The direct seeding technique offers a useful option to reduce the limitations of transplanted paddy. Direct-seeded rice offers the advantage of faster and easier planting, ensure proper plant population, reduce labour and hence less drudgery, 10-12 days earlier crop maturity, more efficient water use and higher tolerance to water-deficit, and often high profit in areas with assured water supply [12]. Puddling processes reduce macropore volume in the upper portion of the soil profile while

increasing bulk density in the compacted, anthropogenic horizon that is alternately termed the plough sole or tillage pan [13-17].

MATERIAL AND METHODS

The field experiment was conducted at SG College of Agriculture and Research Station, Jagdalpur during 2012. The experiment site was sandy clay soil, low in organic carbon%, pH- 6.5, low available N kg ha^{-1}, low available P kg ha^{-1} and medium available K kg ha^{-1}. The experimental design was RCBD (randomized complete block design) with three replications. Variety MTU - 1010 was planted in plot size 10 x 20 m. The planting methods tested in the studies are given in Table 1.

The experiment was conducted in rainfed condition. Seeds were sown on 28 June 2012 for all the methods. In SRI method 10 days old seedlings were used for transplanting, but for the conventional transplanting and improved transplanting method 25 days old seedling was transplanted on 23 July 2012. Broadcasting, broad costing with *Biasi* and *Lehi* methods was sown on 28 June 2012. SRI and *Lehi* methods were irrigated for the puddling operation. In conventional transplanting and improved transplanting methods rain water was used for puddling. The field was fertilized with urea, single super phosphate and murate of potash at 100:60:30 kg N P K ha^{-1}. Full dose of phosphatic and potassic fertilizer was applied during last field preparation, except urea. 1/3 N was applied at the time of sowing and transplanting, remaining 1/3 N at the time of tillering and 1/3 N was given at the time of panicle initiation stage. All agronomic practices were performed uniformly for all the treatments. Maturity of rice occurred at different times irrespective of planting. The harvested crop was dried on the field; separately threshed, cleaned, necessary data was collected and analysed statistically for analysis of variance (ANOVA) following the method described by Gomez and Gomez [18].

Table 1. Different treatments and their specifications.

S.N.	Treatment	Remarks
1	Broadcasting	After two ploughing by country plough than broad casted the seed than planking and seed rate was taken @ 120kg ha^{-1}
2	Broadcasting with *Biasi*/ *Beushening*	After two ploughing by country plough than broad casted the seed and 30 days after sowing again ploughed by country plough on standing crop and leave for two days to decayed the weed and then done *chalai* (uniform plant population) for certain plant population . Seed rate was taken @ 120kg ha^{-1}
3	Line sowing by seed drill	Two ploughing was done by tractor drown cultivator than sown by tractor drown seed drill. Seed rate was used @ 90 kg ha^{-1}.
4	Conventional transplanting	Transplanting in puddled field. Conventional method of transplanting, where no line and row spacing was specified. Seed rate was used @ 35 kg ha^{-1}. Two to three seedlings were used per hill.
5	Improved transplanting	Transplanting in puddled field. In this method transplanting was done in plant to plant 10 cm and row to row was 20 cm a part. Seed rate was used @ 25 kg ha^{-1}. Two to three seedlings were used per hill.
6	*Lehi* method	Sprouted seeds were broad casted in puddled field. Seed rate was used @ 70 kg ha^{-1}
7	System of Rice Intensification (SRI)	Complete SRI technique was adopted. Seed rate was used @ 7.5 kg ha^{-1}. Spacing was 25 x 25 cm and 10 days old, single plant was planted in a hill.

RESULTS AND DISCUSSION

Table 2 depicted that plant height was recorded non significant in all planting technique during experimentation. Sharma and Ghosh [19] studied two establishment techniques (direct seeding and transplanting) did not influence plant height. Significantly highest number of tillers was recorded in SRI technique followed by improved transplanting method, but broad casting with *Biasi*, *Lehi* methods and conventional transplanting was recorded significantly on par to each other. In case of penicale length SRI was recorded significantly highest this was similar to improved transplanting, conventional transplanting and line sowing by seed drill. Days to flowering and days to maturity was recorded significantly earlier in SRI, Lehi, broadcasting and line sowing by seed drill than the *Biasi*, conventional transplanting and transplanting methods. This was due to better root establishment from the day of germination and lack of transplanting shock leads to early maturity than transplanted rice. Sharma *et al.* [20] reported that direct seeding of rice results in early maturity and short the crop duration than transplanted rice. Gill [21] reported that direct seeding results in early maturity. Laary *et al*. [22] reported that the direct seed drilling method recorded early flowering and shorter maturity days because it had better crop establishment, with higher intra competition due to shorter spacing and plant density per unit area,

triggering quicker reproductive phase responses. Test weight was recorded similar result in all the rice establishment techniques similar result was also reported by [23].

Table 3 shows that rice yield was recorded significantly highest under SRI followed by improved transplanting method, but conventional transplanting, line sowing by seed drill and broadcasting with *Biasi* was recorded significantly at par with each other. Straw yield was significantly higher in SRI method followed by improved transplanting which was on par with conventional transplanting. In case of biological yield and harvest index SRI method was recorded significant highest followed by improved transplanting technique among all the rice establishment techniques. In case of bulk density improved transplanting was recorded significantly highest at 30 DAP which was at par with *Lehi* method, conventional transplanting and SRI method. However, at harvest SRI method was recorded higher bulk density among all the establishment techniques but, it was at par with improved transplanting, *Lehi*, conventional and line sowing by seed drill. Higher value of bulk density was recorded under puddled conditions because puddling resulted in destruction of soil aggregates and dispersion of soil particles to form a compact layer with reduced porosity. Dhiman *et al.* [24] reported that bulk density (g cc^{-1}) was higher under transplanted rice compared with dry seeding of rice and this might be due the puddling effect under transplanting method. Available water content was higher in dry seeding of rice because with decrease in bulk density there was increase in available water content which was due to increased porosity with decrease in bulk density. Gangwar *et al.* [25] report that the higher infiltration was recorded under direct seeded rice which reveals the quality of seed bed prepared which allow greater amount of water to penetrate into the field and allowed subsequent crops to grow vigouraly.

Rainwater use efficiency and economics are depicted in Table 4. Rainwater use efficiency was recorded highest under SRI method among all the establishment method followed by improved transplanting method. Cost of cultivation, gross income and net income of different establishment methods was recorded numerically highest in SRI methods among all the techniques followed by improved transplanting method, but in case of benefit cost ratio SRI method was recorded statistically higher followed by *Lehi* but at par with broad cast wit *Biasi* method was at par.

Table 2: Effect of different planting techniques on plant height, number of effective tillers, days to 50% flowering, panicle length, days to maturity and 1000 seed weight.

Treatments	Plant height (cm)	No. of Effective tillers	Days to 50% flowering (days)	Panicle length (cm)	Days to maturity (days)	1000 seed wt(g)
Broadcasting	118.33	4.00	91	20.17	121	22.30
Broadcasting with *Biasi*	125.00	6.33	96	22.33	127	23.53
Line sowing by seed drill	120.67	3.33	92	25.67	123	23.80
Conventional transplanting	125.33	5.00	96	26.33	127	21.33
Improved transplanting	127.33	11.67	96	28.67	128	23.67
Lehi method	125.67	7.33	91	25.33	121	23.57
SRI	128.33	33.33	91	29.33	121	24.57
SE m±	2.19	0.96	0.74	1.54	0.79	0.64
CD at 5%	NS	2.99	2.32	4.82	2.47	NS

Table 3: Effect of different planting techniques on rice yield, straw yield, biological yield, harvest index and bulk densities at 30 DAP and at harvest.

Treatments	Yield (qha^{-1})	Straw yield (qha^{-1})	Biological yield (qha^{-1})	Harvest index (%)	30 DAP Bulk density (Mg m^{-3})	At harvest Bulk density (Mg m^{-3})
Broad casting	22.34	59.33	81.67	27.33	1.440	1.466
Broad casting with *Biasi*	27.83	65.00	92.83	29.94	1.447	1.470
Line sowing by seed drill	26.07	62.67	88.73	29.37	1.453	1.483
Conventional transplanting	31.63	72.33	103.97	30.38	1.480	1.490
Improved transplanting	40.73	77.00	117.73	34.51	1.490	1.497
Lehi method	29.30	65.33	94.63	30.92	1.480	1.490
SRI	71.98	104.67	176.65	40.71	1.477	1.500

SEm ±	**2.06**	**2.12**	**4.04**	**0.89**	**0.011**	**0.007**
CD at 5%	**6.44**	**6.63**	**12.6**	**1.96**	**0.033**	**0.023**

Table 4: Effect of different planting techniques on rain water use efficiency (RWUE) and economics

Treatments	RWUE	Cost of cultivation (Rs. ha^{-1})	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	B:C ratio
Broad casting	13.39	10000.00	29265.00	19265.00	1.93
Broad casting with *Biasi*	16.68	12000.00	36462.00	24462.00	2.04
Line sowing by seed drill	15.62	15000.00	34147.00	19147.00	1.28
Conventional transplanting	18.96	20000.00	41440.00	21440.00	1.07
Improved transplanting	24.41	22000.00	53361.00	31361.00	1.43
Lehi method	17.56	12000.00	38383.00	26383.00	2.20
SRI	43.15	25600.00	94298.00	68698.00	2.68
SEm±	**1.24**	**-**	**-**	**-**	**0.14**
CD at 5%	**3.86**	**-**	**-**	**-**	**0.44**

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