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# Effect of different date of sowing and crop establishment methods on performance of rice cultivars

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**Abstract**
A field experiment was conducted at Farm of College of Agriculture, Rewa. The present investigation was carried out during the Kharif season 2020 &2021 in split plot design replicated four times. The variety used is MTU 1010. The main plot treatments i.e. Date of sowing at three different stages, at sowing time, Delayed sowing by 15 days & Delayed sowing by 30 days and sub plot treatments were broadcasting of seeds, Manual line sowing of seed, system of Rice Intensification methods, Conventional transplanting method and drum seeder. The height of the plants and number of tillers/hill were influenced Significant variation in plants height was found due different dates of sowing (Normal sowing time $M_1$) sowed significantly greater height (28.90, 72.16and 102.16 cm) over all other dates of sowing at 30, 60 DAS/DAT and at harvest. Among the different dates of sowing Normal sowing time ($M_1$) showed superiority with respect to panicle number and length of panicle, grain weight/panicle, test weight, which are the contributors of grain yield Among the cost of cultivation varied due to different dates of sowing (Normal sowing time $M_1$) (Rs. 28800.8/ha), Delayed sowing by 15 day ($M_2$)(Rs. 28500.8/ha) and Delayed sowing by 30 day($M_3$) (Rs. 28300.8/ha).

**Keywords:** Rice (*Oryza sativa* L.), seed, agriculture, rice intensification methods

## Introduction

Rice (*Oryza sativa* L.) is the staple food for about 2.5 billion world's population which might escalate to 4.6 billion by 2050 onward. It is one of the significant cereal commodities that has been referred as "Global Grain" as being prime staple food for fulfilling the nutritional requirements of half of the world's population. In India, this crop occupies 43.39 million hectare with a production of 108.52 million tonnes and productivity of 2404 kg/ha, similarly in Madhya Pradesh it covers an area of 2.02 million hectare with a production of 3.58 million tonnes and productivity of 1768 kg/ha (Anonymous 2016) while 1.76 m ha i.e. 80 per cent is under rainfed as it is and grown as direct seeding in rainfed uplands with very low productivity (0.6 to 0.9 t/ha) due to non-adoption of high yielding varieties and proven technologies as compared to national average (1.9 t/ha). Amongst the various cultural practices, date of planting is the most important factor for yield maximization. Date of transplanting and use of appropriate age of seedling are important non-cash inputs for realizing higher productivity in rice. Early transplanting of rice seedlings assumes special significance and principal means of obtaining higher yields in cultivation. Performance of a genotype entirely depends upon the time of planting. Delayed planting generally results in yield reduction as this crop has relatively higher degree of thermo sensitivity during flowering and grain filling stages as compared to high yielding varieties. High or low environmental changes in temperature cause significant damage on flowering and prevent pollen shedding leading to increased infertility and production of chaffy grains. In order to ensure normal flowering, fertilization and avoid damages due to high or low temperature, it is necessary to properly organize the date of nursery sowing and transplanting of rice. Timely transplanting of rice results in earlier harvest and allows timely planting of succeeding *rabi* crops. Timely transplanting of rice crop is also found to increase the rain water use efficiency as compared to the delayed planting. Although variation in climatic parameters makes it difficult to decide optimum planting times for rice, but attempt is needed to find most appropriate time of growing rice in order to avoid the risk in rice cultivation. Among the cost of cultivation varied due to different dates of sowing (Normal sowing time $M_1$) (Rs. 28800.8/ha), Delayed sowing by 15 day ($M_2$)(Rs. 28500.8/ha) and Delayed sowing by 30 day($M_3$) (Rs. 28300.8/ha).

## Material and Methods

A field experiment was conducted at Farm of College of Agriculture, Rewa. The present investigation was carried out during the Kharif season 2020 &2021 in split plot design replicated four times. The region falls under subtropical climate having extreme winter and summer seasons. The soil if the experimental area was clay loam on texture with medium organic matter and available Nitrogen is 238 kg/ha, Phosphorus is 18.5kg/ha and available potassium is 357 kg/ha. The variety used is MTU 1010. The main plot treatments i.e. Date of sowing at three different stages, at sowing time, Delayed sowing by 15 days & Delayed sowing by 30 days and sub plot treatments were broadcasting of seeds, Manual line sowing of seed, system of Rice Intensification methods, Conventional transplanting method and drum seeder. As per the recommendation, all the agronomic practices were followed throughout the crop growth period.

## Result and Discussion

### Effect on Growth Parameters

The height of the plants and number of tillers/hill were influenced Significant variation in plants height was found due different dates of sowing (Normal sowing time $M_1$) sowed significantly greater height (28.90, 72.16and 102.16 cm) over all other dates of sowing at 30, 60 DAS/DAT and at harvest. Different dates of sowing (Normal sowing time $M_1$) showed superiority throughout the growth period in respect of number of tillers and leaves as compared to other dates of sowing. These findings pertaining to differential response of sowing methods were also supported by Verma *et al*. (2009) [14], Brar *et al*. (2012) [2] and Akhilesh *et al*. (2016) [1]. The height of the plants and number of tillers/hill were influenced significantly due to crop sowing methods and nutrient. The methods of sowing tested under study *viz*. Broad casting of seed, Manual line sowing of seed, System of Rice Intensification Method (SRI), Conventional transplanting method and Drum seeder significantly influenced the performance of rice crop. Better performance of crop was observed under Manual line sowing of seed with respect to plant height. The Plant height under Manual line sowing of seed was higher than Broad casting of seed, SRI, Conventional transplanting and Drum seeder methods at 30, 60 DAS/DAT and at harvest. At harvest, Manual line sowing of seed planting method possessed highest plant height (102.97 cm) than Broad casting of seed methods (102.38 cm). SRI planting method produced significantly maximum number of tillers and leaves at 30, 60 DAS/DAT and at harvest than other planting methods. The better growth of plant under SRI might be due to the planting of younger seedling (13 days old) might have encouraged vigour and deeper root system which in turn resulted into more vigorous, taller and profuse tillering with increased number of leaves. These findings are in agreement with the finding of Tao long Xing *et al.* (2002) [13], Nissanka and Bandara (2004) [11] and Priyanka *et al.* (2013) [12].

### Effect on Yield attributes

Among the different dates of sowing Normal sowing time ($M_1$) showed superiority with respect to panicle number and length of panicle, grain weight/panicle, test weight, which are the contributors of grain yield. It might be due to the differential genetic makeup of the nutrient over the other dates of sowing. These findings are close conformity with the findings of Gill *et al*. (2006) [4] and Kumar *et al*. (2013) [9], Number of panicle/m$^2$ (307.67m$^2$), panicle length (21.69cm), grains/panicle (123.07) and test weight (22.82 g) were significantly more in SRI method as compared to Broad casting of seed, manual line sowing of seed, Conventional transplanting method and Drum seeder methods. These findings are close conformity with the findings of Javaid *et al.* (2012) [16], Subhash Babu *et al.* (2014) [17], Singh *et al.* (2015) [18] and Dendup *et al.* (2018) [3]. The different dates of sowing (Normal sowing time $M_1$) produced highest grain yield (4113.87 kg/ha), straw yield (9538.96 kg/ha) and harvest index (30.15%) over other dates of sowing. Similar type of results has also been reported by Chaudhary *et al.* (2011) [19], Kabat and Satapathy (2013) [20]. Grain yield (4256.70 kg/ha.) and straw yield (9926.73q/ha) and harvest index (29.62%)were higher in case of SRI panting as compared to lowest in Broadcasting of seed method with grain yield (3500.76 kg/ha) and straw yield (8749.44 kg/ha) and harvest index (28.93%). Sunil Kumar *et al*. (2015) [21], Kumar *et al*. (2018) [8] and Dendup *et al.* (2018) [3].

### Effect on Economics of the treatments

The economic analysis of the treatments is very important for acceptability of the treatments by the farmers. The economic analysis of treatments consists of different economic factors *viz*. cost of cultivation and gross monetary returns as well as net monetary returns per hectare basis. The profitability was also determined to assess the economic viability of the treatments as profit and expenditures relationship. These economic factors are affected by different dates of sowing and crop establishment method. The determination of cost of cultivation incurred under a particular treatment has its own importance to plan the use of different inputs by the farmers. Among the cost of cultivation varied due to different dates of sowing (Normal sowing time $M_1$) (Rs. 28800.8/ha), Delayed sowing by 15 day ($M_2$) (Rs. 28500.8/ha) and Delayed sowing by 30 day($M_3$) (Rs. 28300.8/ha).The cost of cultivation varied due to different methods of planting because of different seed rate requirement for the different planting methods. Cost of cultivation under SRI planting was Rs. 30045.00/ha being less than the Drum seeder method (Rs. 25934.33/ha). The gross monetary returns are directly related to the value of grain yield including by products. The value of both grains and straw yields obtained under a particularly treatment was taken into consideration for Gross Monetary Returns. Among the Gross Monetary Returns varied due to different dates of sowing (Normal sowing time $M_1$) fetched the highest GMR of (Rs. 84181.6/ha). It is clear from the data presented in Table 4.8 that GMR under SRI planting was higher (Rs. 87177.33/ha.) as compared to the lowest in the Broadcasting of seed (Rs.70254.67/ha) finding of Tripathi *et al.* (2014) [22] The net monetary return is the actual monetary profit under particular treatments, because it is determined by subtracting the cost of cultivation from the GMR under the same treatments. It is apparent from the data given in Table 4.9. Among the different dates of sowing (Normal sowing time $M_1$) gave the maximum NMR (Rs. 55380.8/ha), followed by Delayed sowing by 15 day ($M_2$) (Rs. 49569/ha). The lowest NMR Delayed sowing by 30 day ($M_3$) (Rs. 47762.8/ha). Has also been reported by Milon Jyoti *et al*. (2018) [10]. That the maximum NMR was obtained under the SRI planting (Rs. 57132.33/ha) over lowest under Broadcasting of seed (Rs.

43173.67/ha). Similar findings were also reported by Jagadish Kumar *et al* (2010) [6]. B: C ratio was calculated to know the income obtained from per rupee investment. Data on B:C ratio given in Table 4.9.Among the different dates of sowing (Normal sowing time $M_1$) gave the maximum B:C ratio (2.93), followed by Delayed sowing by 15 day ($M_2$) (2.74). Has also been reported by Jena *et al.* (2010) [7]. Reveals that the highest B:C ratio was found under SRI planting method (2.90) as compared to Conventional transplanting method (2.77)and then Broadcasting of seed method (2.59). Has also been reported by Hugar (2009) [5] and Jagadish Kumar *et al* (2010) [6].

**Table 1:** Average Number of panicle/m2, Length of panicle (cm) and Number of grain/panicle influenced by different dates of sowing, crop establishment method and their interactions

| Establishment | Number of panicle/m2 | | | | Length of panicle (cm) | | | | Number of grain/panicle | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Different sowing date | | | | | | | | | | | |
| methods | $M_1$ | $M_2$ | $M_3$ | Mean | $M_1$ | $M_2$ | $M_3$ | Mean | $M_1$ | $M_2$ | $M_3$ | Mean |
| $S_1$ | 275.37 | 252.58 | 245.60 | 257.85 | 17.92 | 17.26 | 17.01 | 17.40 | 110.15 | 101.03 | 98.99 | 103.39 |
| $S_2$ | 279.53 | 259.70 | 251.40 | 263.54 | 18.73 | 18.61 | 18.51 | 18.61 | 111.82 | 103.88 | 107.57 | 107.75 |
| $S_3$ | 326.72 | 303.81 | 292.50 | 307.67 | 22.10 | 20.73 | 22.25 | 21.69 | 130.69 | 121.53 | 117.00 | 123.07 |
| $S_4$ | 314.64 | 288.90 | 282.50 | 295.34 | 19.02 | 19.02 | 18.64 | 18.89 | 125.86 | 115.56 | 112.25 | 117.89 |
| $S_5$ | 290.17 | 280.20 | 278.59 | 282.98 | 18.58 | 18.63 | 18.53 | 18.58 | 116.07 | 112.08 | 111.46 | 113.20 |
| Mean | 297.28 | 277.03 | 270.11 | | 19.27 | 18.85 | 18.99 | | 118.91 | 110.81 | 109.45 | |
| | S | M | S x M | | S | M | S x M | | S | M | S x M | |
| S.Em+ | 5.99 | 4.54 | 7.86 | | 0.58 | 0.51 | 0.88 | | 2.41 | 1.67 | 2.88 | |
| CD 5% | 17.96 | 13.61 | NS | | NS | 1.52 | NS | | 7.22 | 5.00 | NS | |

**Table 2:** Average weight of panicle (g), Test weight (g) and Leaf area index influenced by different dates of sowing, crop establishment method and their interactions

| Establishment | weight of panicle (g) | | | | Test weight (g) | | | | Leaf area index | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Different sowing date | | | | | | | | | | | |
| Methods | $M_1$ | $M_2$ | $M_3$ | Mean | $M_1$ | $M_2$ | $M_3$ | Mean | $M_1$ | $M_2$ | $M_3$ | Mean |
| $S_1$ | 2.43 | 2.22 | 2.16 | 2.27 | 20.25 | 20.47 | 20.22 | 20.31 | 0.97 | 0.90 | 0.87 | 0.91 |
| $S_2$ | 2.46 | 2.29 | 2.22 | 2.32 | 22.43 | 21.98 | 22.48 | 22.29 | 0.99 | 0.92 | 0.89 | 0.93 |
| $S_3$ | 2.88 | 2.68 | 2.58 | 2.71 | 24.16 | 22.77 | 21.52 | 22.82 | 1.15 | 1.07 | 1.03 | 1.08 |
| $S_4$ | 2.77 | 2.55 | 2.49 | 2.60 | 22.05 | 22.60 | 22.35 | 22.33 | 1.11 | 1.02 | 1.00 | 1.04 |
| $S_5$ | 2.55 | 2.47 | 2.46 | 2.49 | 22.01 | 22.42 | 22.10 | 22.17 | 1.02 | 0.99 | 0.99 | 1.00 |
| Mean | 2.62 | 2.44 | 2.38 | | 22.18 | 22.05 | 21.73 | | 1.05 | 0.98 | 0.95 | |
| | S | M | S x M | | S | M | S x M | | S | M | S x M | |
| S.Em+ | 0.07 | 0.05 | 0.09 | | 0.79 | 0.65 | 1.12 | | 0.02 | 0.01 | 0.03 | |
| CD 5% | NS | 0.16 | NS | | NS | NS | NS | | 0.06 | 0.04 | NS | |

**Table 3:** Average Grain yield (kg/ha), Straw yield (kg/ha) and Harvest index (%) influenced by different dates of sowing, crop establishment method and their interactions

| Establishment | Grain yield (kg/ha) | | | | Straw yield (kg/ha) | | | | Harvest index (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Different sowing date | | | | | | | | | | | |
| Methods | Normal sowing time ($M_1$) | Delayed sowing by 15 day ($M_2$) | Delayed sowing by 30 day ($M_3$) | Mean | Normal sowing time ($M_1$) | Delayed sowing by 15 day ($M_2$) | Delayed sowing by 30 day ($M_3$) | Mean | Normal sowing time ($M_1$) | Delayed sowing by 15 day ($M_2$) | Delayed sowing by 30 day ($M_3$) | Mean |
| Broadcasting of seed($S_1$) | 3546.72 | 3355.56 | 3600.01 | 3500.76 | 8758.44 | 8798.70 | 8691.20 | 8749.44 | 28.93 | 30.59 | 27.27 | 28.93 |
| Manual line sowing of seed($S_2$) | 4044.68 | 3753.36 | 3593.36 | 3797.13 | 9644.39 | 9448.52 | 9283.52 | 9458.81 | 29.53 | 27.61 | 28.06 | 28.40 |
| System of Rice Intensification Method ($S_3$) | 4574.53 | 4142.23 | 4053.34 | 4256.70 | 10279.69 | 9816.57 | 9683.94 | 9926.73 | 30.79 | 28.46 | 29.60 | 29.62 |
| Conventional transplanting method($S_4$) | 4237.38 | 3844.45 | 3755.56 | 3945.80 | 9480.40 | 9717.56 | 9610.06 | 9602.67 | 30.75 | 29.78 | 28.08 | 29.53 |
| Drum seeder($S_5$) | 4166.04 | 3622.23 | 3711.12 | 3833.13 | 9531.90 | 9638.01 | 9502.56 | 9557.49 | 30.79 | 28.47 | 27.82 | 29.02 |
| Mean | 4113.87 | 3743.56 | 3742.68 | | 9538.96 | 9483.87 | 9354.25 | | 30.15 | 28.98 | 28.16 | |
| | S | M | S x M | | S | M | S x M | | S | M | S x M | |
| S.Em+ | 76.78 | 115.64 | 200.29 | | 38.80 | 38.69 | 67.02 | | 0.28 | 0.29 | 0.50 | |
| CD 5% | 230.34 | 346.91 | NS | | 116.39 | 116.07 | NS | | 0.85 | 0.86 | NS | |

**Table 4:** Total cost of cultivation (Rs/ha) and Gross Monetary Returns (Rs/ha) influenced by different dates of sowing, crop establishment method and their interactions

| Establishment Methods | Total cost of cultivation | | | | Gross Monetary Returns | | | |
|---|---|---|---|---|---|---|---|---|
| | Different sowing date | | | | | | | |
| | Normal sowing time ($M_1$) | Delayed sowing by 15 day ($M_2$) | Delayed sowing by 30 day ($M_3$) | Mean | Normal sowing time ($M_1$) | Delayed sowing by 15 day ($M_2$) | Delayed sowing by 30 day ($M_3$) | Mean |
| Broadcasting of seed($S_1$) | 27331 | 27331 | 26581 | 27081.00 | 73081 | 69702 | 67981 | 70254.67 |
| Manual line sowing of seed($S_2$) | 30921 | 30421 | 29671 | 30337.67 | 83055 | 77572 | 74453 | 78360.00 |
| System of Rice Intensification Method ($S_3$) | 30295 | 29795 | 30045 | 30045.00 | 93307 | 84973 | 83252 | 87177.33 |
| Conventional transplanting method($S_4$) | 29356 | 29106 | 29356 | 29272.67 | 86390 | 79494 | 77773 | 81219.00 |
| Drum seeder($S_5$) | 26101 | 25851 | 25851 | 25934.33 | 85075 | 78608 | 76859 | 80180.67 |
| Mean | 28800.8 | 28500.8 | 28300.8 | | 84181.6 | 78069.8 | 76063.6 | |

**Table 5:** Net Monetary Returns (Rs/ha) and Benefit: Cost ratio influenced by different dates of sowing, crop establishment method and their interactions

| Establishment Methods | Net Monetary Returns | | | | Benefit: Cost ratio | | | |
|---|---|---|---|---|---|---|---|---|
| | Different sowing date | | | | | | | |
| | Normal sowing time ($M_1$) | Delayed sowing by 15 day ($M_2$) | Delayed sowing by 30 day ($M_3$) | Mean | Normal sowing time ($M_1$) | Delayed sowing by 15 day ($M_2$) | Delayed sowing by 30 day ($M_3$) | Mean |
| Broadcasting of seed($S_1$) | 45750 | 42371 | 41400 | 43173.67 | 2.67 | 2.55 | 2.56 | 2.59 |
| Manual line sowing of seed($S_2$) | 52134 | 47151 | 44782 | 48022.33 | 2.69 | 2.55 | 2.51 | 2.58 |
| System of Rice Intensification Method ($S_3$) | 63012 | 55178 | 53207 | 57132.33 | 3.08 | 2.85 | 2.77 | 2.90 |
| Conventional transplanting method($S_4$) | 57034 | 50388 | 48417 | 51946.33 | 2.94 | 2.73 | 2.65 | 2.77 |
| Drum seeder($S_5$) | 58974 | 52757 | 51008 | 54246.33 | 3.26 | 3.04 | 2.97 | 3.09 |
| Mean | 55380.8 | 49569 | 47762.8 | | 2.93 | 2.74 | 2.69 | |

## Conclusion

System of rice intensification (SIR) was superior in terms of growth parameters, root growth characteristics, yield attributes, grain and straw yield over Broadcasting of seed, manual line sowing of seed, Conventional transplanting method and normal durmseeder. The dates of sowing, normal sowing time (M1) registered higher growth parameters, root growth characteristics, yield attributes, grain yield straw yield and water productivity over Delayed sowing by 15 day (M2) and delayed sowing by 30 day (M3). Significantly higher gross returns were recorded with SIR over other establishment methods. Net returns and Benefit cost ratio recorded by SRI with each other during all the season. Gross returns were higher with dates of sowing, normal sowing time (M1).

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