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Evaluation of different planting methods for growth and yield of paddy (*Oryza sativa* L.)

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Abstract
Rice (*Oryza sativa* L.) is one of the most important food crops in the world, and staple food for more than 50% of the global population. In India rice is generally planted with transplanting, direct seeding and wet direct seeding methods. Increasing water scarcity, water loving nature of rice cultivation and increasing labour wages triggers the search for such efficient crop establishment methods which can increase water productivity. Three sowing methods (conventional transplanting, direct seeding in lines with seed drill and in broadcast fashion) were tested to study the response of rice cultivars IGKVR-1 (Rajeshwari) for paddy yield and growth. Rice seed was drilled in lines of 22.5 cm apart. Data were collected on plant height, tillers plant^{-1}, grains panicle^{-1}, 1000-grain weight and paddy yield. It was further revealed that although transplanting method produced greater plant height, grains panicle^{-1} and 1000-grain weight but produced similar paddy yield as obtained with direct line sowing. It was suggested that rice variety IGKVR-1 could be used for direct sowing to minimize cost of cultivation and it is more effective due to easy intercultural operations like weeding, spraying, etc. and uniform plant stand.

Keywords: Rice, transplanting, broadcasting, seed drill, yield

Introduction
Rice (*Oryza sativa* L.) is a member of poaceae family and it is the leading cereal of the world (Juraimi *et al.*, 2013) [7] and two third of the Asian peoples receive their daily calories from rice (Rahman and Masood, 2012) [10]. In India, rice occupied 39.16 million hectares area with a production of 85.59 million ton and average yield 2.2 t/ha (Anonymous 2013) [1]. Among the cereals, rice is the leading crop worldwide (Ashraf *et al.* 2006) [2], and more than half of the human race depend on rice for their daily sustenance (Chauhan and Johnson 2011) [4]. It is the primary source of income and employment for more than 100 million households in Asia. World's rice demand is projected to increase by 25% from 2001 to 2025 to keep pace with population growth (Maclean *et al.* 2002) [9], and therefore, meeting ever increasing rice demand in a sustainable way with shrinking natural resources is a great challenge. Transplanting after puddling (a process where soil is compacted to reduce water seepage) has been a major traditional method of rice establishment. Repeated puddling adversely affects soil physical properties by dismantling soil aggregates, reducing permeability in sub-surface layers, and forming hardpans at shallow depths which make land preparation becomes difficult and requires more energy to achieve proper soil tilth for succeeding crops. Rice production with transplanting method has been limited by a number of factors such as water scarcity, high input costs, shortage of skilled labor and suboptimal plant population. Now-a-days farmers are switching to other methods of sowing rice to minimize these expenses and difficulties. Direct sowing of rice was reported to reduce the labor cost by 30 percent and overall production cost by 40 percent in Malaysia (IIMI Annual Report, 1994) [5].

This study was, therefore, planned to determine the effect of three sowing methods on the growth and yield of rice under field conditions. Traditional method of transplanting is compared with direct sowing under the experiment on Evaluation of different Planting Methods for Growth and Yield of Paddy (*Oryza sativa* L.)

Materials and Methods

An experiment was conducted in research-cum-instructional farm of Krishi Vigyan Kendra, Anjora, Durg (CG) during *kharif* season 2013. The soil of experimental field was clayey (*Vertisols*) in texture, locally known as "*Kanhar*. Durg dist. of C.G. state comes under dry moist, sub humid region. The region receives 1200-1400 mm rainfall annually out of which about 88% received during the rainy season (June to September). The experiment was comprised with three treatments i.e. 1. Conventional transplanting with seed rate @ 40 kg ha^{-1}, 2. Line sowing by seed drill (row spacing 22.5 cm) with seed rate @ 75 kg ha^{-1} and 3. Broadcasting with seed rate @ 100 kg ha^{-1}. The variety of rice was IGKVR-1 (Rajeshwari), Crop was raised according to package of practices of the Indira Gandhi Krishi Vishvavidyalaya, Raipur (CG). Standard procedures were adopted to record the data on various growths and yield parameters during the course of study. Economic analysis was done by calculating the gross income considering the market rates of paddy and straw. Cost of production was calculated. Varying cost of all the sowing methods were added in each treatment Net income was calculated by formula as a difference of gross income and variable cost. Benefit Cost Ratio (BCR) was calculated by dividing gross income by total cost of production.

Results and Discussion

Plant Height

Perusal of data from table no.1 plant height was significantly affected by different sowing methods. Plants height depicts health and vigor of a crop. It is directly proportional with the development of root system and availability of nutrients to the plants. In present studies, the highest plant heights were recorded in transplanted crop in puddled soil (97.50 cm), which is not much differ to direct line sowing (95.30), whereas the lowest plant height was observed in broadcasting method. The results are in support with Mann *et al.* (2002) [9] and Ramzan & Rehman (2006) [11] who reported similar trends in their field studies.

Tillers $plant^{-1}$

From table no.1 it is revealed that Productive tillers in transplanting (16.45) were higher as compared with direct sowing methods. The tiller population in direct line seeding was not much differing with manually transplanted crop. It may be due to higher seed rates used at seeding time. Awan *et al.*, (2005) [3] discussed and reported similar results in the studies.

Grains $panicle^{-1}$

From table no.1 it is revealed that grains $panicle^{-1}$ in transplanting (141.20) were recorded higher as compared with direct line sowing methods (139.45). Whereas, minimum no. of grain $panicle^{-1}$ was recorded in broadcasting method.

1000-grain weight

The grain weight is an important component and has a major contribution towards grain yield. It is clear from the data in table no. 1 that higher grain weight (32.32 g) was recorded in conventional transplantation which is differed from other treatments. The results are in conformity with Awan *et al*., However minimum grain weight (32.23 g) was recorded in broadcast treatment. These findings are similar to those of Singh *et al*., Jana *et al*., and Tahir *et al.*, who reported that 1000 grain weight was higher in transplanted rice as compared to other methods of sowing.

Yield

The highest paddy yield (44.5 q/ha) was obtained from transplanting followed by line sowing (41.8 q/ha) whereas in broadcasting it was relatively low (33.9 q/ha). Low yields may be attributed to low tiller population. The findings are in line with those of Mahajan (1995) [8] who reported that grain yield increased significantly with transplanting over direct seeding.

Economics

Table no. 2 indicate that maximum net return of Rs. 35004/- is obtained in direct line seeding followed by conventional transplanting Rs.33100/-. Higher net income received from direct line sowing was due to lower cast of cultivation and minimum differ in paddy yield to conventional transplanting. The minimum net return (Rs. 24960/-) was obtained from broadcasting method. Table no 2 also showed that benefit cast ratio also increased in case of direct line seeding (2.77) whereas, the lowest benefit cast ratio (2.11) was obtained in broadcasting method.

Conclusion

The study revealed that maintaining optimum plant population in transplanting enhanced paddy yields but it requires maximum cast of cultivation to overcome this problem direct seeding on flat bed condition may become an alternate method of rice crop establishment where labour for transplanting is a serious problem.

Table 1: Effect of different planting methods on growth parameters

SN	Planting/Sowing methods	Plant Height (cm)	No. of tillers $plant^{-1}$	No. of grains $panicle^{-1}$	1000-grain weight (g)
1	Conventional transplanting	97.50	16.45	141.20	32.32
2	Line sowing by seed drill	95.30	15.60	139.45	32.28
3	Broadcasting	90.10	9.70	118.60	32.23

Table 2: Effect of different planting methods on economics

SN	Planting/Sowing methods	Grain Yield (q/ha)	Gross cost (Rs)	Gross return (Rs)	Net return (Rs)	B:C
1	Conventional transplanting	44.5	29200	62300	33100	2.13
2	Line sowing by seed drill	41.8	23600	58604	35004	2.77
3	Broadcasting	33.9	22500	47460	24960	2.11

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