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Original Research Article

Effect of Crop Establishment Methods on Productivity, Manpower Consumption and Profitability of Rice (*Oryza sativa* L.) Under Rice-Wheat Cropping System

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A B S T R A C T

Rice-wheat cropping system (RWCS) had played a great role in the food security of India. A field experiment on clay loam soil was conducted during *kharif* seasons of 2014 and 2015 at the Krishi Vigyan Kendra, Aurangabad and at farmer's field to study the "Effect of crop establishment methods on productivity, manpower consumption and profitability of rice (*Oryza sativa* L.) under rice-wheat cropping system." The experiment was conducted in completely randomized block design with three crop establishment methods (Hand transplanting, direct seedling by zero till drill and direct seedling of sprouted seeds by drum seeder) in rice. Highest value of B: C ratio, grain yield were obtained with direct seedling by zero till drill but it was found at par with and direct seedling of sprouted seeds by drum seeder. Highest no of effective tiller/m2, no of grain per panicle were recorded with direct seedling by zero till drill. However, lowest man power involve in direct seedling by zero till drill in so this treatment could be an efficient alternative method to produce high yield and income as compare to hand transplanting, particularly under labour constrained conditions.

Keywords

Direct seeding, grain yield, Net return, transplanting, zero-tillage

Introduction

Rice (*Oryza sativa* L.) is the most important crop of the world as it feeds about 70% of the world's population. In the country, it is cultivated on 44 million hectares (mha), producing 103 million tonnes (mt) of grain annually with productivity of 2.4 t/ha (DAC, 2016). Rice is mostly grown by manual transplanting method to realize good yields and manage weed. Manual transplanting of rice is not only tedious, costly and time consuming, but it also deteriorates the soil-properties due to formation of compacted hard soil surface (Gopal *et al.*, 2010). Therefore, it is imperative that alternate method of growing crops that are more water efficient and less labour intensive need to be developed to enable farmers to produce more with less cost of production.

Huge labours are needed to accomplish transplanting of rice seedlings and mostly it is delayed to a greater extent due to unavailability of adequate labours during peak transplanting. Thus, the late planted rice takes more time to reach maturity which not only reduces the rice yield, but also delays the sowing of succeeding crop particularly wheat (Bhushan *et al.*, 2007). In Aurangabad, mostly the mediums to late maturity rice varieties are planted under

puddled condition. This accompanied with labour scarcity at planting and most often late onset of monsoon delays wheat sowing affecting adversely its productivity due to grain filling at maturity coinciding with hot winds in March onward. Rice yield depends upon not only the genetic characteristics but also the agronomic practices (Chen *et al.*, 2007). Paradoxically, labour availability is limited because an increasing amount of young farmers opting for jobs. The alternative tillage and crop establishment are site specific and therefore evaluations under wider agro-ecological conditions is important to have significant adoption (Ladha *et al.*, 2009a). Thus, keeping all the above facts in consideration a study was conducted in South Bihar, to evaluate the "Effect of crop establishment methods on productivity, manpower consumption and profitability of rice (*Oryza sativa* L.) under rice-wheat cropping system."

Materials and Methods

A field experiment on clay loam soil was conducted during *kharif* seasons of 2014 and2 015 at the Krishi Vigyan Kendra, Aurangabad and at farmer's field at $24^0.50^,$ N, $84^0.70'$ E, and at 332'above mean sea level. The maximum temperature remained above 36.92°C and 36.04°C. Soil of the experimental field was clay loam in texture and slightly alkaline in reaction (pH 7.8), low in organic C (0.52%), and available N (208.6 kg/ha), medium in available K (196.7 kg/ha) and P (18.5 kg/ha). The total rainfall received was 528.75 and 579.74 mm during 2014 and 2015, respectively. Most of the rainfall was received during vegetative phase from 25^{th} (sowing time) to 39^{th} standard meteorological week. The experiment was conducted in randomized block design with three crop establishment methods in rice (Manual transplanting Direct seedling by zero till drill and direct seedling of sprouted seeds by drum seeder,). The total number of treatments combinations was 16. The treatments were replicated six time to avoid any effect of heterogeneity and the treatments were randomly allocated as per standard procedure. The rice variety 'Rajendra Sweta' was sown and in all the methods of rice-establishment. The fields were leveled with leveler to allow drill to place seeds at a uniform distance and proper depth in all the replications. The experimental plots meant for zero-till drill (ZTD) sowing were subjected to two ploughing followed by harrowing and planking before sowing with direct seeded rice machine followed by planking on 28^{th} June, 2014 and 2015. In same date Drum seeding field was ploughed twice and puddling done in ponded water. Nursery was also sown in same date on slightly raised seed bed on 28^{th} June, 2014 and 2015 to get seedlings for transplanting. Twenty-one days old seedling uprooted from wet-bed nurseries were transplanted after proper field preparation(as was done in DSR) after ponding the field and transplanting done with puddling in transplanted rice experimental plots using two seedling per hill and maintaining a row spacing of 20 cm and 15 cm distance between hills. After seven days of transplanting, missing hills were filled up to attain uniform plant population and growth. In each plot, uniform plant stand was maintained and standard agronomic practices were followed for raising and maintenance of crop a row-to-row and plant-to plant distance was kept 20 × 15 cm, using a seed rate of 25 kg/ha.. However, seed rate of 25 kg/ ha was used under zero till drill and drum seeder method. The nutrients were applied @ 120 kg N, 60 kg P2O5 and 40 kg K2O ha^{-1}. Half dose of nitrogen and full doses of phosphorus and potassium were applied as basal at the time of sowing/transplating. Remaining nitrogen

was applied in two equal splits through urea by top dressing at tillering and panicle initiation stage. Pre sowing irrigation applied and Pendimethalin 30 EC @ 3.3 L/ha as pre-emergence spray were applied in zero till drill sown rice. In rest of the treatment pre-emergence application of pretilachlor 50 EC @ 1.5 L/ha was applied 5 DAS in drum seeding and in transplanting 5-7 days after transplanting. One hand weeding was done at 30 DAS/DAT. Irrigation was aupplied to the experimental crops as per need at different growth stages of crop growth. Five plants in each plot were selected randomly, tagged and plant height of tagged plant were measured from base to the tip of the most expanded leaf at maturity. The crop was harvested from the net plots. The crop was sun-dried for a week and manual threshing was done separately from each experimental plot. Grain and straw yield was expressed at 12% and 15% moisture level, respectively.

Results and Discussion

Yield and yield attributes

The findings of the present investigation indicated profound effect of different crop establishment methods of rice on yield attributes and yield (Table 1). It was noted that different planting methods caused marked variations in number of productive panicle/m2, no of grain/ panicle and 1000-grain weight. Highest values of all these parameters were found with direct seeded rice machine. Maximum grain yield was recorded under direct seeding with zero tillage machine which was significantly more over drum seeder and transplanting method. Direct seeded rice with zero tillage machine produced which was 12.61% and 20.19% respectively over paddy drum seeded and transplanting.

The higher number of panicle/m2 recorded in DSR with zero tillage machine over paddy drum seeder and transplanting method. Direct seeded rice with zero tillage machine of rice is attributed due to the improved tiller production and the taller plants. The higher yield under direct seeded rice with zero tillage machine may be owing to better performance of yield attributing characters through optimum utilization of resources which had direct bearing on the production of higher grain yield.

These results are in close conformity with finding of Singh *et al.,* (2005); Sharma *et al.,* (2006); Bohra *et al.,* (2006).

Table.1 Effect of paddy establishment method on yield attributes, man power, yield and Economics

Treatment	No. of Effective tillers/m^2	No. of grains/ panicle	Test weight (g)	man power required/ha	Yield (q/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C
Farmer Practice	215	152	18.18	40	41.6	66,624	31,384	1.89
Drum Seeding	237	163	18.38	10	44.4	70,973	37,493	2.12
Direct seeding with Zero tillage machine	261	178	18.8	5	50.0	79,974	45,908	2.43
LSD=0.05	19.91	17.39	NS	1.74	5.77	9,233	10,106	0.44

*Polled data of two years *kharif* 2014 and 2015

Man Power

Significantly lowest man power was recorded with DSR with zero tillage machine over paddy drum seeder and transplanting. Lowest number five labour required for direct seeded rice with zero tillage machine over drum seeder and transplanting at sowing time. This is due to mechanization reduce the labour consumption over transplanting. Transplanting is labour intensive technology.

Economics

The cost of cultivation, gross return, net return and benefit cost ratio were worked out and the data are presented in (Table 1). Among different crop establishment methods lowest cost of cultivation (Rs. 28200) over drum seeding and manual transplanting. However, highest gross return (Rs.79974), net return (45908) and (2.43) were obtained with direct seeding with zero tillage machine which were at par with drum seeding they were significantly higher over transplanting. These results are in close conformity with the finding Singh *et al.,* (2005); Sharma *et al.,* (2006); Bohra *et al.,* (2006).

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