International Journal of Science, Environment and Technology, Vol. 7, No 6, 2018, 2033 – 2039

ISSN 2278-3687 (O)
2277-663X (P)

PRODUCTIVITY AND ECONOMICS OF DIRECT SEEDED RICE

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BAU Communication No. 544/2018

Abstract: Puddling doesn't have much influence on rice yields. Many changes and innovations have contributed to the expanding use of resource conserving technologies in the country. One of the most important has been the development, testing and marketing of a low cost seed-cum-fertilizer drill which can establish crops with a minimum of soil disturbance, can take best advantage of residual soil moisture and thereby reduce irrigation requirements, can help improve the timeliness of sowing, can place seed and fertilizer nutrients at suitable soil depths, and can foster the development of innovative inter-cropping systems that are particularly suitable for flood-prone and drought-prone environments. A field study was conducted during Kharif season of 2016-17 and 2017-18, to evaluate direct seeded rice options as compared to drum seeded rice, and manual transplanting of rice with an objective to improve farm productivity and efficiency. Labor saving was recorded from average of 24 in case of manual transplanting to 2 in the case of direct seeded rice (DSR), and only 1 in case of drum seeded rice. Tillage and crop establishment methods had a significant effect on rice yields. Average yield of manual puddled transplanted rice was higher i.e., 40.1 q/ha, in comparison to 38.7 q/ha by DSR method, and 37.1 q/ha by Drum seeding method. DSR planted rice took minimum time for maturing of rice, i.e., 136.5 days, in comparison of 142.5 days by manual transplanting, and 138 days by drum seeder. The B: C ratio was highest in DSR in zero till condition (2.29) as compared to manual puddled transplanted rice (2.06), and by drum seeder (2.18). The study showed that the conventional practice of puddled transplanting could be replaced with zero till DSR to increase BC ratio.

A field study was conducted to evaluate the comparison between direct seeded rice vs transplanted rice vs drum seeded rice with an objective to improve productivity and efficiency during kharif 2016-2018. Maximum number of Weed population/ (m^2) at 15 DA Planting was recorded in direct seeded rice (38.52); (41.70) followed by drum seeded rice (22.35); (19.35) and transplanted rice as (19.94); (15.50) during these two respective years. At the end it was concluded that direct seeded rice is a site specific technology for sowing of rice which save labor and energy. However the farmers are advised to grow their rice crop with the consultation of university/government officials.

Keywords: manual puddled transplanted rice, DSR, drum seeder.

INTRODUCTION

The process of change has begun to transform the paradigm of agricultural research and development. A transformation represented by an ongoing shift from conventional to

*Received Nov 22, 2018 * Published Dec 2, 2018 * www.ijset.net*

conservation agriculture ie., from an earlier set of principles based on massive soil inversion with a plough towards a new set of principles based on minimal soil disturbance, management of crop residues and innovative cropping systems is the best option of farming under rice-wheat cropping system. Current crop cultivation practices in rice-wheat systems degrade the soil and water resources thereby threatening the sustainability of the system [1]. At the same time, rapid urbanization decreases the land available for agriculture. As a result, food security in the country remains a challenge for the future. If the supply of food is to keep pace with the rapidly growing demand, rice-wheat farmers will have to produce more food from fewer resources while sustaining the environmental quality. This will require rapid changes towards technologies that are more productive but less resource-degrading. Many changes and innovations have contributed to the expanding use of resource conserving technologies in the country. In this regard, one of the most important technology has been the developed and tested is low cost seed-cum-fertilizer drill which can establish crops with a minimum of soil disturbance. This seed-cum-fertilizer drill can take best advantage of residual soil moisture and thereby reduce irrigation requirements, can help in improving the timeliness of sowing, can place seed and fertilizer nutrients at suitable soil depths, and can foster the development of innovative inter-cropping systems that are particularly suitable for flood-prone and droughtprone environments.

Increasing yields achieved during green revolution through increase in cultivated areas, high yielding varieties, intensive use of fertilizers, better agronomical practices and expansion of irrigation facilities are showing sign of stagnation across Indo-Gangetic Plains (IGP) and factor productivity is declining [2]. Today's real agricultural challenges are resource fatigue with declining factor productivity, decreasing human resources and their rising costs and socioeconomic changes [5]. The conventional system of rice production (conventional tilled-transplanted rice) in this region is basically water, labour and energy intensive, adversely affecting the environment.

The conventional method of rice growing is not only water-guzzling but also cumbersome and laborious. Delay in transplanting beyond optimum time due to labor scarcity is creating a reduction in rice yield. Further, reduced labor availability is increasing the cost of transplanting and squeezing the farmer's profit as the cost of transplanting is increasing continuously. Paddy transplanting by labor also results in low and non-uniform plant population due to which crop yields are reduced [4].

Paddy is generally transplanted in the first fortnight of July in puddled (wet tillage) soil, which leads destruction of macropores and reduction in permeability. With direct seeding, rice seed is sown and sprouted directly into the field, eliminating the laborious process of planting seedlings by hand and greatly reducing the crop's water requirements [3]. Traditional paddy cultivation requires 200-250 man-hours per hectare, which are about 25 percent of the total labour requirement for the crop production. Resource conservation by adopting direct seeded rice (DSR) with the help of seed-cum-fertilizer drill have the potential to reduce the production costs by consuming less time, labour, fuel, energy and machinery inputs. Puddling breaks capillary pores, reduces void ratio, destroys soil aggregates, disperses fine clay particles, and lowers soil strength in the puddle layer. The destruction of soil aggregates by puddling leads to the formation of surface crusts and cracks on drying thereby delaying preparation of a seedbed for ensuing crops. Keeping the above facts in view, the present study was done for resource conservation in paddy by introducing DSR at the farmers' fields of Bhagalpur district in Bihar during 2016-18 with an objective to study the impact of direct seeded rice over traditional method of transplanting.

Farmers cultivating transplanted rice in irrigated and rainfed areas are increasingly faced with water shortages due to deficit rainfall, declining groundwater table due to insufficient recharge, late and limited release of irrigation water from canals or poor inflows into tanks. Land preparation for nursery and main field require large volume of water and involve labor for nursery raising of seedlings and subsequent transplanting. Water shortage at the transplanting time leads to delay and use of over aged seedlings with limited tillering capacity.

Drum seeding technique involves direct seeding of pre-germinated paddy seeds in drums made up of fibre material to dispense seeds evenly in lines spaced at 20 cm apart in puddled and levelled fields. About 35 to 40 kg paddy seed/ha is soaked overnight in water and allowed to sprout. Care should be taken not to delay sowing as seeds with long shoot growth are not suitable for drum seeding. The sprouted seed is air-dried in shade briefly (<30 minutes) prior to sowing for easy dispensing through the holes in the drum seeder. Excess water in puddled field is drained out ensuring the soil surface is moist. Drums are filled with sprouted seeds (3/4th full) and pulled across the field maintaining a steady speed for evenly sowing. Number of drums could vary between 4 and 8 with number of lines sown ranging from 8 to 16 in one pass. Irrigation water should not be applied for 2-3 days after sowing to allow rooting and anchoring to soil. However, heavy rainfall immediately after sowing is

likely to wash away the newly sown seeds. As the seedlings grow, water level in the field can rise for better weed control. Intermittent irrigation is given till the panicle initiation stage. Where weed problem is severe, herbicide is applied within 1-2 days after seeding and if necessary, a second application is given 30-35 days later. Line sowing permits operation of modified conoweeder (width between wheels reduced to 15 cm instead of 25 cm) between the rows in the same direction adopted for drum seeding. Drum seeding in one ha area can be completed in 5 to 6 hours time by three persons compared to transplanting operation which requires about 30 to 40 man days. This technique can help in saving seed, water, labour requirement apart from improving productivity because of line sowing (spacing of 20 cm between rows) and early maturity of crop (by 7-10 days). Drum seeding reduces the cost of cultivation as it does away with the requirement for raising paddy nursery and transplanting thereafter. The technique fits into contingency planning as it provides flexibility in timing of sowing in lands prepared using irrigation water or immediately after receipt of monsoon rains with a crop variety of suitable duration to fit into the left over season.

MATERIALS AND METHODS

The experiments were conducted at farmers' field in Bhagalpur district of Bihar state in India during Kharif season of 2016-17 and 2017-18. Soil of Bhagalpur district is Greyish red in colour; medium to heavy in texture, slightly to moderately alkaline in reaction, cracks during summer (1cm to more than 5 cm wide and more than 50 cm deep) becomes shallow with onset of monsoon, with clay content nearly 40 per cent to 50 per cent throughout the profile. The rainfall under this zone is mainly influenced by the south-west monsoon, Sometimes cyclonic rain also occurs.

The paddy establishment method, which has been evaluated in this paper are Farmer Practice using Manual transplanting (T-0), Sowing of rice by direct seeded rice machine/ Planter (T-1), and Sowing of sprouted seed by drum seeder (T-2). The experiments were conducted for two consecutive Kharif years of 2016-17 and 2017-18 in the same fields, and Rajendra Shweta veriety of paddy was used for these experiments. A total of 11 trials were conducted each year for the evaluation of various yield components like No. of effective tillers/m^2, Field grains/panicle, Test wt. (1000 grain wt.), Weed population/ (m^2) at 15 DAP, Yield (q/ha), and Cost component and BC ratio.

RESULT

Yield components of the results for the trial Year of 2016-17 and 2017-18 are shown in tabular form in Table 1. Cost component and B:C ratio are shown in Table 2 for the two

consecutive years of experiments i.e., 2016-17 and 2017-18. While numbers of trials were kept constant as 11 in each case. Maturity days have been found as 142 and 143 days respectively for two years of experiment using farmers practice of annual transplanting. While in case of Sowing of rice by direct seeded rice machine (Planter) it was 136 and 137 days for the year 2016-17 and 2017-18 respectively. In case of Sowing of sprouted seed by drum seeder it was found that the maturity days was same as 138 days for both the years.

Similarly, labours required for planting/transplanting work was 25 and 23 laobours for 2016-17 and 2017-18 respectively, in case of farmers practice using manual transplanting. While in the case of Sowing of rice by direct seeded rice machine (Planter) it was found fixed as 02 number of labours for both the years of experiment. In case of Sowing of sprouted seed by drum seeder, it was found that a single labour is sufficient to do the work in both the years of experiments.

Table 1: Yield components of the results for the trial Year of 2016-17 and 2017-18

Technology option	**Year of trail**	**Yield component**			**Weed population/ (m^2) at 15 DAP**	**Yield (q/ha)**
		No. of effective tillers/m^2	**Field grains/ panicle**	**Test wt. (1000 grain wt.)**		
Farmer Practice (Manual transplanting)	2016-17	301	196	23.5	19.94	39.5
	2017-18	303	195	23.7	15.50	40.7
	Ave.	302	195.5	23.6	17.72	40.1
Tech. option-1 (Sowing of rice by direct seeded rice machine (Planter)	2016-17	289	188	23.3	38.52	37.9
	2017-18	299	190	23.6	41.70	39.5
	Ave.	294	189	23.45	40.11	38.7
Tech. option-2 (Sowing of sprouted seed by drum seeder	2016-17	276	187	23.2	22.35	37.2
	2017-18	281	185	23.5	19.35	37.0
	Ave.	278.5	186	23.35	20.85	37.1
SEm	2016-17	10.94	6.47	0.48	2.91	1.05
	2017-18	10.24	6.51	0.37	3.21	0.99
	Ave.	10.59	6.49	0.425	3.06	1.02
CD	2016-17	22.99	NS	NS	6.11	2.20
	2017-18	21.51	NS	NS	6.74	2.08
	Ave.	22.25	NS	NS	6.425	2.14

Table 2: Cost component and BC ratio results for the trial Year of 2016-17 and 2017-18

Technology option	Year of trail	Cost of cultivation (Rs./ha)	Gross return (Rs/ha)	Net return (Rs./ha)	BC ratio
Farmer Practice (Manual transplanting)	2016-17	28000	58060	30060	2.07
	2017-18	31900	65342	33442	2.05
	Ave.	29950.0	61701.0	31751.0	2.06
Tech. option-1 (Sowing of rice by direct seeded rice machine (Planter)	2016-17	25500	55500	30000	2.18
	2017-18	26400	63464	37064	2.40
	Ave.	25950.0	59482.0	33532.0	2.29
Tech. option- 2 (Sowing of sprouted seed by drum seeder)	2016-17	25300	54500	27800	2.15
	2017-18	27150	59931	32781	2.21
	Ave.	26225.0	57215.5	30290.5	2.18

The maximum No. of effective tillers/m^2 was observed with 'T-0' (302) followed by 'T-1' (294), and by 'T-2' (278.5). The maximum No. of Field grains/panicle was observed with 'T-0' (195.5) followed by 'T-1' (189), and by 'T-2' (186). Test weight (1000 grain weight) also shown similar pattern, as of No. of effective tillers/m^2, and Field grains/panicle, wand was observed as with 'T-0' (23.6) followed by 'T-1' (23.45), and by 'T-2' (23.35).

The result (Table 2) shows that the T-1 i.e. sowing of rice by DSR gave maximum BC ratio i.e. 2.29 for timely showing of rice with proper weed management. The second best option recorded for sowing of rice is T-2 i.e. sowing of sprouted rice seed by drum seeder because they gave BC ratio of 2.18 both option also save the time of sowing of wheat crop up to six (6) days because of maturity days of crop in Farmers practice 142.5 days, T-1 136.5 days & T-2 138 days.

Conclusion

During 2016-18, efforts have been made for resource conservation in paddy by introducing DSR at the farmers' fields of Bhagalpur district in Bihar. The results of Rajendra Shweta variety in paddy revealed that in DSR farmers fetched an average yield of 38.7 q/ha with B-C ratio of 2.29, in comparison to 37.1 q/ha by drum seeding method with BC ratio as 2.18, and lowest BC ratio was recorded in the case of manual transplanting as 2.06 with average yield of 40.1 q/ha.

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